ANNEX 21

OBSMS – SGS ICD

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INTEGRAL OBSMS-SGS ICD

OGS-SGS ICD Chapter 3.13

OBSMS – SGS ICD

INT-MOC-ICD-0003

Issue 1

Revision 5

14 January 2002

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{ TE "CHANGE RECORD SHEET" }{ TE }CHANGE RECORD SHEET

Date	Issue/ Rev	Page/Para affected	Description	Associated CR No	Approval Authority
26/Nov/98	Draft 1	All			
16/Dec/98	Draft 2	All	Image naming convention and image header updated in accordance with the IMCS-OBSMS-ICD document.		
12/Mar/99	Issue 1.0	All	Changes to update the ICD with the INTEGRAL needs (de-scope from XMM). IFTS deleted as transfer mechanism. File header contents updated. Appendix A added to cover the transfer of IBIS Context Tables		
15/Sept/99	Issue 1.1	All	Changes to reflect agreement MOC-ISOC on the ICD.		
17/Dec/99	Issue 1.2	Sect 1 and 5	Changes to reflect telecom on 15/12/99 MOC-ISOC on the ICD.		
02/Feb/00	Issue 1.3	Sect 2 and 5	Changes to reflect FAX DSO/ED/DI/SI-2000-SPI-10 from SPI and agreements on it.		
22/Oct/01	Issue 1.4	Sect 5	Update of OBSW Image Header Record Table		
14/Jan/02	Issue 1.5	Sect 5.1.1	Word Length changed to Data Word Length.		

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{ TE "STATUS SHEET" }STATUS SHEET

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TE
{ TE "ABSTRACT" }**ABSTRACT**

The document defines the data interface between the MOC and ISOC concerning the transfer of Instrument OBS Images and Tables.
The data is provided to the On Board S/W Maintenance System (OBSMS) that performs configuration control of it.

The document defines mainly the data interface. The operational aspects are dealt with in the corresponding concept documents.

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{ TE "GLOSSARY OF TERMS" }**GLOSSARY OF TERMS**

ACC	Attitude Control Computer
APID	Application Identifier
CDMU	On-Board Central Data Management Unit
CRP	Contingency Recovery Procedure
DEVLAN	Development LAN
ESA	European Space Agency
ESOC	European Space Operations Centre
FCP	Flight Control Procedure
FOP	Flight Operations Plan
FTP	File Transfer Protocol
IFTS	Integral File Transfer System
IASW	Instrument Application Software
ICD	Interface Control Document
IFOP	Instrument Flight Operations Plan
IMCS	INTEGRAL Main Control System .
INT, INTEGRAL	INTernational Gamma Ray Astrophysics Laboratory
IOBS	Instrument On Board Software
KW	Kilo Word (1 KW = 1024 x 16 bits)
LAN	Local Area Network
MB	Mega Byte
MID	Memory Identifier
MOC	Mission Operations Centre
MOCSIM	MOC Simulator
MSSW	CDMU Mission Specific Software
OBDH	On Board Data Handling System
OBSM	On-Board Software Maintenance (as belonging to MOC)

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OBSMS	On-Board Software Maintenance System (as belonging to Platform OBS Maintenance)
OBSW	On Board Software
OPSLAN	Operational LAN
PI	Principal Investigator
RAM	Random Access Memory
ROM	Read Only Memory
SASW	CDMU Standard Application Software
SDE	Software Development Environment
SME	Software Maintenance Environment (of OBSMS)
SPR	Software Problem Report
STR	Star Tracker Subsystem
SVF	Software Validation Facility (of OBSMS)
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
TC	Tele-Command
TID	Task Identifier
TLD	TLD Ada Development System
TM	TeleMetry

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1 INTRODUCTION

TETE Background

The instrument OBSW images are maintained by the Instrument teams at PI site. They provide validated OBSW images to ISOC, that acts as the I/F between MOC and Instrument Teams. The images are provided unmodified to MOC.
The OBSMS at MOC is used to perform an operational validation of the DPE images before up-link. The operational validation consists in the load of the DPE images in the OBSMS and the provision of the appropriate environment to verify that the images do not include a bug that causes an immediate crash.
All of the images are then provided to the IMCS that generates the relevant Memory Load Commands and is used to uplink those Commands and to verify the current OBS though dump data.

Since the on-board tables can be handled in a similar way the tables will be converted into image files by the instrument teams. The process of tables is similar to the OBS images.

Some specific aspects relevant to the handling of IBIS tables are addressed in Appendix A.

It has to be noted that no IOBS Patches will be exchanged. Only full images will be generated and exchanged with external parties. The reason for this is to be able to keep a tight configuration control on the different SW releases, and be always able to go back to a previous On Board state of the SW in case of a reset.
Full Images are understood as those self standing, i.e. containing all the code, constants and relevant data areas for a determined memory On Board.
The Tables will be complete, containing all the data in the address range defined for every Table.

1.2 TE Scope

This ICD defines the data interface between the MOC and ISOC concerning the transfer of Intrument OBSW images and tables. It is applicable to all mission phases when data are provided to MOC.

This ICD is in line with the I/F between OBSMS and IMCS [RD-4] to allow a straightforward transfer of data to the IMCS that will convert the images into uplinkable telecommands.

1.3 TE Overview

Chapter 1, Introduction.
Chapter 2, Interface Characteristics.
Chapter 3, Data Access, defines the general interface method.
Chapter 4, Data Description, defines the type of files transferred across the interface.
Chapter 5, Data Definitions, defines the contents and the format of the files.

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1.4 Reference and Applicable documents TE

1.4.1 Applicable DocumentsTE

AD-1 Deleted.

AD-2 Deleted.

AD-3 Deleted.

1.4.2 Reference DocumentsTE

RD-1 INTEGRAL File Transfer System (IFTS) ICD, OGS-SGS-ICD Appendix A, Issue A6, 05 June-2001

RD-2 INTEGRAL Packet Structure Definition, INT-RP-AI-0030, Issue 5, July 1997.

RD-3 CLUSTER Command Request ICD (CRID), CL-ESC-ID-0003, Issue 2.2, July 95.

RD-4 INTEGRAL OBSMS - MOC ICD, INT-MOC-ICD-0010-OF, Issue 1.1, 13-August-2001.

RD-5 Definition of OBDH TM & TC Packets, XM-IC-DOR-0003, Issue 2.1, September 1996.

RD-6 Deleted

RD-7 Deleted

RD-8 INT MOC OBSM Concept Document, INT-SYS-MIS-TN-0003-TOS/OGI Issue 1.2 November 98

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TE Overall assumptions and constraints

1.5.1 ResponsibilitiesTE

- MOC-IMCS is responsible of generating the needed TC sequences for uploading the OBSW. The IMCS is as well responsible to obtain the related TM from the Dump Packets and maintain a dump image.
- MOC-IMCS is responsible of generating the needed OBSW patches for up-link (via TC) as result from Image comparison.
- PI is responsible of updating the IOBS and verifying its correctness before generating an instrument image to be transferred to ISOC and from there to MOC. It has to be noted that the procedural information will be extracted from the IFOP or/and provided in the images as comment records. When relevant, PI's are responsible as well of the generation of the Instrument Tables and verify their correctness and completeness.
- ISOC will transfer data between PI's and MOC.

1.5.2 Operational TC/TM TEConsiderations

It has to be taken into account that the DPE SW is loaded via a CDMU command. A TC(6,1) with CDMU APID (129) and an specific MID for the Instrument is used. In this case the CDMU access the DPE directly from the OBDH Bus (DMA). This is handled through the Low Level Protocol of the OBDH. All this applies as well to the IBIS context tables, to be load into the IBIS DPE.

In the case of a dump, there will be dedicated TC(6,2) to request dumps from the DPEs, although the Low Level Protocol persists, to be used in the case of contingency.

The patch and dump of the instrument peripherals or subassemblies, where applicable, will be handled through dedicated commands specific to each instrument.

The TC generation for OBSW Image and Table load is out of the scope of this document. The Instrument Image file data contents do not reflect this operational consideration, although some operational aspects can be address in the header and comments section. The IMCS OBSM will take this aspect into consideration at TC generation time.

1.5.3 AssumptionsTE

- The IMCS will keep under configuration control at least the last three versions of each OBSW images (for each Instrument processor and memory unit).

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- The PI will keep under configuration control all the versions of each IOBS (for each processor and memory unit), including any related documentation, test data, tools and code.
- The OBSMS will keep under configuration control all the images imported from PI for each instrument and memory area.
- Instrument Memory images are understood as:
  - the ones generated by the PI.
- Memory images shall be transferred as **Full Images** (they cannot be split).
- A Full Image is understood as the one containing the data words to be stored in a APID+MID memory, being self standing, i.e. with all the relevant code, data and constants for that Device. It may contain gaps.
- **It may exist gaps in the word addresses between two consecutive records of an Image File.** The number of words per record is variable and the address of the first word from one record is not compulsory equal to the address of the last word in the previous record plus one. The gap can be of any number of words.
- No partial Patch files will be exchanged from PI. In case of patches those are included in a full Image file.
- There may be a previous transfer of CSSW source code from MOC to the ISOC (to be transferred to the PI's) in case of CSSW modification within the DPE. The PI's will recompile the CSSW and IASW together to form the new SW images. This CSSW transfer from MOC to ISOC is not an image transfer, and therefore out of the scope of this document. Further description can be found in [RD-8].
- As file transfer mechanism it will be used the IFTS as defined in RD-1 (providing it is installed free of charge in the OBSMS machine).
- **A special case of this ICD is that of the IBIS Context Tables. They will be considered as Images, and therefore as such will be transferred and handled. It must be noted that all the above applies to them, with the exception that within the Tables no gaps are allowed. Also, the APID+MID approach will be used in the naming convention and file header, as if the Table where the image for a virtual memory within the DPE.**

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2 INTERFACE CHARACTERISTICSTE

2.1 Data Source, Destination and Transfer MechanismTE

The data source will be ISOC.

The data destination will be the OBSMS machine sitting in the MOC.

The connection will be via ESACOM and ISDS crossing the ESOC Bastion Host and on to the OPSLAN to which the OBSMS is connected.

2.2 Interface ProtocolTE

The only product to be transferred are files. The transfer mechanism will be configured to use IFTS protocol for file transfer.

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3 ACCESS TE

3.1 Interface Utility SoftwareTE

In principle, the tool to be used is any covering FTP.

3.2 Failure Protection, Detection and Recovery ProceduresTE

The naming convention reflected below for the files provides version control, to avoid duplicates of the files and to verify a proper number order. Within the file header, a Checksum mechanism will be provided to verify that the contents match with the intended file.

3.3 File Naming ConventionTE

Image files will be named as follows:

FFFF_P_NNN_AAAA_MMMMM_X_D_RRR_SSS_Y.INT

Where:

FFFF is the file type identifier, values can be:

IIMG when containing an **Instrument Image** (for S/C **images** the field will be SIMG)

P it indicates if it refers to a Prime or Redundant unit ("unit" refers to the on-board processor or memory unit), values can be:

P = Prime
R = Redundant
B = Both (in case of loading software in Prime **and** Redundant)

The prime or redundant target is also determined by the MID in the case of DPE Images for SPI, IBIS and JEM-X, so a consistency must be kept among those fields.

NNN is a text string to describe the target Memory Device. The following table gives the relevant values.

ACC	ACC
CDM	CDMU
STR	STR
IBI	IBIS DPE
PIC	IBIS PICSIT

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VET	IBIS VETO
ISG	IBIS ISGRI
HEP	IBIS HEPI (only Context Table)
ECT	IBIS HEPI (only Energy Correction Table)
CLT	IBIS HEPI (only Charge Less Table)
MCE	IBIS ISGRI-MCE
SPI	SPI DPE
SPD	SPI DFEE
ACS	SPI ACS
PSD	SPI PSD
JM1	JEMX-1 DPE
JM2	JEMX-2 DPE
J1D	JEMX-1 DFEE
J2D	JEMX-2 DFEE
OMC	OMC DPE

Note: Some Tables will be determined by the X Full image/contex table field described further below.

AAAA is the Application ID expressed in decimal. The values that identify the Application ID can be found in section 5.1.1.

MMMMM is the Memory ID expressed in decimal. The values that identify the Memory ID as can be found in section 5.1.1.

This is a field to identify the target memory, not always related to the MID concept as expressed in [RD-2].

X is the full image/context table indicator. It is specified as follows:

"F" = Full image
"T"= Context Table

This field is included to allow this ICD to be used also for Table transfer, as is the case of IBIS.

D identifies the development phase on which the image software stands, values are:

X = Development Phase.
A = Alpha Test Phase.
B = Beta Test Phase.
V = Operational Release.

RRR is the Release Level, it is made of three characters representing numbers from 000 to 999 (left padded with 0's).

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SSS is the Sub-release Level, it is made of three characters representing numbers from 000 to 999 (left padded with 0's).

Y is the Internal Release Level, it is made of one character representing numbers from 0 to 9.

INT is the common file extension (always "INT").

NOTES:

- In all alphabetic fields only uppercase characters are used.

- The fields **D_RRR_SSS_Y** are obtained from the configuration management tools used on the PI SDE , and corresponds to the version of the file (TBC) in order to keep a cross check.

- The fields will be separated by underscore characters ("_").
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3.4 Security RequirementsTE

The environment on the operational LANs for ISOC and MOC are protected from external users by Firewalls which prohibit remote login and only allows a limited set of communication protocols.

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4 DATA DESCRIPTION TE

4.1 File StructureTE

All files passed across the interface are standard ASCII text files with a maximum record length of 80 characters, and variable length records.

The record terminator, which may be the 81st character of a record, is the ASCII line feed character (decimal 10).

The file organisation will be SEQUENTIAL.

4.2 Files Passed Across the Interface and their TEDirection

This is the list of entities exchanging OBSW files for INTEGRAL, and the direction of the exchange.

Image Source Description	File Name	Source Node	Destination Nodes
OBSW Image generated from PI SDE.	IIMG	PI	ISOC
OBSW Image received by ISOC.	IIMG	ISOC	OBSMS
OBSW Image received by OBSMS	IIMG	OBSMS	IMCS

4.3 Size and Synchronisation TE

The maximum size for instrument on-board software can in principle be up to 1 Mbytes (case of DPE). However, since the actual images should be much smaller we can consider the file size to be in the order of 1 MB, including the expansion due to file formatting.

As On-Board Software Maintenance related operations will be required at irregular intervals and at non predictable time, the generation method of the interface data is not relevant. The transfer frequency is occasional. Due to that, there is no need for specific synchronisation.

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5 DATA DEFINITION TE

An image file will contain one on-board software image. No patches will be exchanged, in case a patch is to be generated then it will be included in its corresponding full image file.

5.1 OBSW Image FileTE

The OBSW Image files will be exchanged using a file that contains two types of information. The first type is the Header containing general information about the OBSW Image; the second type is the actual OBSW Image data.

5.1.1 OBSW Image Header Record TE

The Header information will be structured as a set of records, being each one of them one entry in the following table. Each record is shown in one line. After each record, there will be an End of Record character. The Header section is of a variable length, depending on the comments included. The first 9 records (i.e. from APID to Checksum) must always be present.

APID: AAAA	4	Application ID of the DPE for the instrument.	the values will follow the assigned APID as described in INT-RP-AI-0030 [RD-2]: **For the transfer of peripherals images:** DPE SPI Nom = 1025 DPE SPI Red = 1153 DPE IBIS Nom = 1281 DPE IBIS Red = 1409 DPE JEM-X 1 = 1537 DPE JEM-X 2 = 1665 DPE OMC = 1793 **For the transfer of DPE images:** CDMU = 0129 Four characters representing decimal 4 digits numbers.

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MID: MMMMM	5	Memory Identifier	the values will follow the MID as described in TM/TC documentation **For the transfer of peripherals images:** **ACC** ACC Checked Mem Wr 04096 ACC Low Level P&D 00001 ACC Unchecked Mem Wr. 02560 **STR** STR P&D 18432 **CDMU** CDMU P&D 00000 **OMC** ODPE Low Level P&D 00008 **SPI** SDPE1 Low Level P&D 00002 SDPE2 Low Level P&D 00003 SVCU1/2 P&D (ACS) 00003 SPSDA/B P&D (PSD) 00004 SDFEE1/2 P&D (DFEE) 00005 **IBIS** IDPE1 Low Level P&D 00004 IDPE2 Low Level P&D 00005 IBIS MCE00A/B Dump (ISGRI) 49951 IBIS MCE01A/B Dump (ISGRI) 49983 IBIS MCE02A/B Dump (ISGRI) 50015 IBIS MCE03A/B Dump (ISGRI) 50047 IBIS MCE04A/B Dump (ISGRI) 50079 IBIS MCE05A/B Dump (ISGRI) 50111 IBIS MCE06A/B Dump (ISGRI) 50143 IBIS MCE07A/B Dump (ISGRI) 50175 IBIS VECU1/2 P&D (VETO) 49856 IBIS PEB1/2 Code P&D (PICSIT) 49527 IBIS PEB1/2 Data P&D (PICSIT) 49520

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			JEM-X JDPE1 Low Level P&D 00006 JDPE2 Low Level P&D 00007 JDFEE1/2 P&D 00255 Five characters representing decimal digits, left padded with 0's.
Image/Table Identifier: I	1	Image/Table identifier	Values F or T. F = full image. T= Context Table
Full Release Name: RRRRRRRRRRRRRRRRRR	18	Full Release name, including version control (it refers to the name that is used in the PI SDE for having the SW release under configuration control). For instance if it contains a Dump file then it refers to the version number expressed in this same field for the loaded image as it was generated from PI. This will allow the memory load and dump being traced to each other.	This is to trace the version number of the on-board software image as it was generated in the PI and put under configuration control. Maximum length are 18 Characters, less can be used. The purpose of this field is to keep a cross configuration control.
Start Address: AAAAAAAA	8	Start Address (8 digits in Hex, 32 bits)	It is the on-board memory address where to load the image. It is the absolute address. It should be the same always for the same memory area. Hex number padded with leading 0's.
Data Word Length: L	1	Data word length in Bytes	It provides the length of the data words in bytes. Possible values are: 1 = 8 bit word. 2 = 16 bit word.

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Number of words: WWWWWW	6	Total number of ensuing data words in Hex.	Number of words the image data contains (8 or 16 bit). Hexadecimal, padded with leading 0's.
Generation Time: DDDDDDDDDD DDDDDDDDDD	20	Date and time of file creation.	Date and time with format: yyyy-mm-ddThh:mm:ssZ
Checksum: XXXX	4	16 bit Checksum	The CRC of all the Data contained within the Image Data Records, as specified in Annex 3 of [RD-2].
/*CCC...C	0 to 80	Comments	Free text comments, first two characters have to be "/*". More than one line is allowed, containing at most 80 characters (including the heading /* characters).

Notes:

- *Each record ends with a line feed character.*

- *The comments fields are in a separated line from the preceding fields, each line with a maximum length of 80 character, where the first two characters are always "/*".*

- *Hexadecimal fields are character case insensitive.*

- *It must be noted that the IMCS cannot use directly the APID/MID combination to build the relevant TCs, since some of the MIDs here used are fictitious (i.e., not reflected as such in the documentation). This is done to support the concept of the virtual Table memories within the DPE.*

- *The 16 bits CRC is calculated only over the data within the Data Records, i.e., the Memory Address and Number of Data Words as described in section 5.1.2 are not taken into account. It is provided to give a confidence on the data contents, although integrity of the file is guaranteed by the transfer protocol.*

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5.1.2 OBSW Image Data Record StructureTE

The Image data records will be of variable length as a record can have any number of words in a range between 1 and 15. Each word corresponding to a group of hexadecimal digits, the word length is specified in the header.

It has to be taken into account that it may exist gaps in the word addresses between two consecutive records. The number of words per record is variable and the address of the first word from one record is not compulsory equal to the address of the last word in the previous record plus one. The gap can be of any number of words. Words in a record are consecutive (no gaps).

The image data records are sorted by address (from lower to higher).

The Image data information will follow the structure:

aaaaaaaandddddddddddddddddddd.....dddd

aaaaaaaa	8	Memory Address	Address expressed in Hex. It is the address of the first word in the data field.
n	1	Number of data words	Each word is made of a group of ASCII characters representing Hexadecimal digits. The number of words is expressed in Hexadecimal (1-F).
dd or dddd	2/4	Image data word in Hex.	The image data is expressed in Hexadecimal numbers in groups of hexadecimal digits, length of the word is defined by the Word Length field in the header. Each record ends with a line feed character. Maximum number of words per record depends on the word length and on the Number of data words n (up to 15), and will not exceed the 80 character constraint per record. Records are of variable length.

NOTE: This is a generalisation of the TLD LDM format for 1750 processors, obtained by:

- *removing the TLD prefix (/M)*

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- *removing the line checksum*
- *expressing the address on 8 Hex characters, hence for 1750 processors the first 3 characters will always be 0*

This generic format has been introduced to cope with other formats from other processors on-board INTEGRAL (instruments) in a unified way on IMCS, also when those processors are programmed with non-TLD compilers or are 8-bit ones.

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Example of an OBSW Image file with all needed information.

Name : IIMG_P_JM1_1537_00255_F_V_012_003_1.INT

Data contents:

```
APID: 1537\n
MID: 00255\n
Image/Table Identifier:  F\n
Full Release Name: V0120031 \n
Start Address: 00000000\n
Data Word Length: 2\n
Number of words:  00B54F\n
Generation Time:  1997-10-16T15:37:44Z\n
Checksum: DEAD \n
/*This file contains an IOBS Image generated in the SOC\n
/*-----------------\n
/* Memory allocation for JEMX-1\n
/* The Checksum ( DEAD) included is ficti tious \n
/* comments                \n
/*  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx\n
/*  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx\n
/*  ….\n
/*  ….\n
/*xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx\n
00000000700018010007200750 06E00740069\n
000000077006D0065005F006500720072006F\n
0000000E700720000000D004D0049004C005F\n
00000015700530054004400 5F003100370035\n
0000001C200300041\n
00000020700730074006100740075007300 5F\n
00000027700650072007200 6F007200000000\n
0000002E700640061007400 61005F00650072\n
00000035700720 06F00720000000065006E\n
0000003C70064005F006500720072006F0072\n
00000043700000064006500760069006300 65\n
00000AAA 7005F006500720072006F00720000\n
```

.
.
.

etc.

Note: *the '\n' represents the end of record character*

Also note that the Checksum used is a fictitious one, since this is just an example. See 5.1.1 for further details.

Note that the last shown record reflects a gap within the file (i.e, the address is not 0000004A, as should be for the data to be written in consecutive positions, but instead is 00000AAA).

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APPENDIX A IBIS TABLES HANDLING

The IBIS Context Tables will be considered by MOC as complete Software Memory Images to be received from ISOC.

This way of handling implies:

- The Table Image must be full; i.e. it is not allowed to transfer parts of a table (The reason being the Configuration Control).
- The Table memory position must be fixed along the different versions of the DPE SW image.
- The Table will be considered as a virtual memory within the DPE memory. This means that the image for the DPE must not include the Tables .
- The operational approach for the uplink of the Table will be the same way as for any other memory image. This means that only the differences with the current On Board version will be uplinked, thus saving time in the process. Nevertheless, it is still possible to perform a full uplink if needed.
- The Tables are understood as complete, not having gaps in between.
- The Table Image name will be as follows:

IIMG_*P*_**IBI_0129 _00004_T**_*D_RRR_SSS_Y*_**.INT**

Being the **Bold** fields fixed, and the rest compliant with this ICD. It must be noted that the APID for the Tables will always be "**0129**", since the uplink will be done to the IBIS DPE through the Low Level Protocol. As a convention, the MID for the Tables will start with a "**1**" in the first position. Also, the Full Image/Table Identifier will be set to "**T**".

For the file header, the following applies:

APID: 0129
MID: 00004
Image/Table Identifier: T
...
Start Address: *Always fixed for every Table*
Word Length: 2
Number of words: *Always fixed for every Table*
...

The Comments in the Header may include any special information relevant to the Table or its contents.

An example of Table could be:

Name : IIMG_P_PIC_0129_10064_T_V_010_004_1.INT

Data contents:

```
APID: 0129\n
MID: 10064\n
Image/Table Identifier: T\n
Full Release Name: V0100041 \n
Start Address: 0002B000\n
Data Word Length: 2\n
Number of words: 0000140\n
Generation Time: 2000/10/16T15:37:44Z\n
Checksum: DEAD \n
/*This file contains a Context Table  Image generated by PIs\n
/*-----------------\n
/* Memory allocation for IBIS Prime\n
/* comments                \n
/* The Checksum is fictitious \n
/*  There are  320 words (i.e.  4 characters per word).....\n
/*  There are 22 records (21 records of 15 words each  + 1 record of  5 words)\n
/*  This Table is the PICSIT Context Table in a fictitious example\n
/*  ...\n
/*xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx\n
0002B000 F000000010002000300040005000600070008000900A000B000C000D000E\n
0002B00F F006D0065005F006500720072006F  006D0065005F006500720072006F0056\n
0002B01EF00720000000D004D0049004C005F  00720000000D004D0049004C005F678F\n
...
...
0002B12CFDF6D0065005F006500720072006F006D0065005F006500720072006F0056\n
0002B13B 58675A430FB4599997777\n
```

***Note:** the '\n' represents the end of record character*

***Note** that in the case of a table, it is always true that :*

Start Address + Number of words (as reflected in the header) = last record address + number of data items in last record

Eg.

0002B000 + 140 = 0002B13B + 5 = 0002B140

This can be used as a check of the completeness of the Table

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