XMM

XMM Data Files Handbook

XMM-SAX-VILSPA/2000-0109/Dc

Issue 2.3

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February, 2002

Revision history

Revision number	Date	Revision author	Comments
Draft 1.0	March, 1999	M. Santos-Lleó	First draft
Draft 2.0	November, 1999	M. Guainazzi	Second draft
Draft 3.0	January, 2000	M. Guainazzi	Third draft
Issue 1.0	July, 2000	M. Guainazzi	First issue (with SAS 4.1)
Issue 2.0	January, 2001	M. Guainazzi	Second issue (with SAS 5.0)
Issue 2.1	February, 2001	M. Guainazzi	Update for the new content of data CD-ROMs
Issue 2.2	June, 2001	M. Guainazzi	Typo in the ODF file name convention corrected
Issue 2.3	February, 2002	M. Guainazzi	Third issue (with SAS 5.3)

Contents

1 Introduction **1**

1.1 Purpose . . . 1

1.2 A summary of the data flow . . . 1

1.3 Document structure . . . 2

2 An overview of the XMM data file subsystems **3**

2.1 A first look to my CD-ROM . . . 4

3 File formats **6**

3.1 FITS format . . . 6

3.2 SAS and LHEASOFT . . . 7

3.3 Portable Data Format (PDF) . . . 7

3.4 Portable Network Graphics (PNG) . . . 7

3.5 HTML . . . 7

3.6 ASCII . . . 8

3.7 Compression . . . 8

4 Uncalibrated science data, housekeeping and spacecraft files: ODF/SDF **9**

4.1 EPIC MOS science files . . . 10

4.1.1 EPIC MOS Imaging Mode Event List File . . . 11

4.1.2 EPIC MOS Timing Mode Event List File . . . 11

4.1.3 EPIC MOS Auxiliary File . . . 11

4.2 EPIC MOS housekeeping files . . . 12

4.3 EPIC p-n science files . . . 12

4.3.1 EPIC p-n Imaging Mode Event List File . . . 13

4.3.2 EPIC p-n Timing/Burst Mode Event List File . . . 13

4.3.3 EPIC p-n Auxiliary File . . . 14

4.4 EPIC p-n housekeeping files . . . 15

4.5 RGS science files . . . 15

4.5.1 RGS Spectroscopy Mode Event List File . . . 16

4.5.2 RGS High Time Resolution Mode Event List File . . . 16

4.5.3 RGS Auxiliary File . . . 16

4.5.4 RGS Diagnostic Mode Image File . . . 17

4.6 RGS housekeeping files . . . 18

4.7 OM science files . . . 18

4.7.1 OM common keywords . . . 18

4.7.2 OM Imaging Mode Data Image File 19
4.7.3 OM Fast Mode Event List File 20
4.7.4 OM Tracking History Data Auxiliary File 20
4.7.5 OM Reference Frame Data Auxiliary File 21
4.7.6 "Priority files" 21
4.8 OM housekeeping files 22
4.9 Spacecraft files 23
4.9.1 Spacecraft Time Correlation File 23
4.9.2 Spacecraft Attitude History File 25
4.9.3 Spacecraft Reconstructed Orbit File 25
4.9.4 Spacecraft Periodic Housekeeping File 25
4.10 Observation/slew summary file 26
4.11 How to recognize my ODF files 27

5 Calibration data: CCF **29**

5.1 The Calibration Index File 29
5.2 File naming convention 30
5.3 File description 30
5.3.1 Scope: xmm 31
5.3.2 Scope: om 31
5.3.3 Scope: xrt 34
5.3.4 Scope: emos 35
5.3.5 Scope: epn 36
5.3.6 Scope: rgs 38

6 Calibrated event lists **40**

6.1 Event list structure in the MOS Imaging Mode 40
6.2 Event list structure in the MOS Timing Mode 41
6.3 Event list structure in the p-n Imaging Mode 41
6.4 Event list structure in the p-n Timing Mode 41
6.5 Event list structure in the RGS Spectroscopy Mode 41
6.6 Event list structure in the RGS High Resolution Timing Mode 42
6.7 Additional scientific files created by `rgsproc` 44

7 Pipeline data products: PPS **47**

8 The standard XMM CD-ROM set **51**

8.1 CD-ROM contents 51

8.1.1 top-level CD-ROM files 51
8.1.2 File types and CD-ROM directories 51
8.2 Naming conventions 51
8.2.1 CD-ROM set file-names and labels 52
8.2.2 Observation/Slew data file names 53
8.2.3 Pipeline product file names 56
8.2.4 XID product file names 59

9 Acronym list **61**

10 Glossary of binary table column description **63**

11 Acknowledgments **64**

12 Reference documents **65**

List of Figures

List of Tables

1 *Values of the* DATATYPE *keywords for the MOS/p-n science data file types* . 11
2 *EPIC MOS Imaging Mode Event List file binary table columns* 11
3 *EPIC MOS Timing Mode Event List File binary table columns* 12
4 *EPIC MOS Auxiliary File Binary table Columns* 12
5 *EPIC p-n Imaging Mode Event List File binary table columns* 14
6 *EPIC p-n Timing/Burst Mode Event List File binary table columns* 14
7 *EPIC p-n Auxiliary File binary table columns for the extension* PNAUX1 . . . 14
8 *EPIC p-n Auxiliary File binary table columns for the extension* PNAUX2 . . . 15
9 *Values of the* DATATYPE *keywords for the RGS science data file types* 16
10 *RGS Spectroscopy Mode Event List File binary table columns* 16
11 *RGS High Time Resolution Mode Event List File binary table columns* . . . 16
12 *EPIC RGS Auxiliary File first binary table columns* 17
13 *EPIC RGS Auxiliary File second binary table columns* 17
14 *Values of the* DATATYPE *keywords for the OM science data file types* 19
15 *Common keywords for the OM Science Files* 19
16 *Mandatory/additional keyword in the header of the OM Imaging Mode Event Image File* 20
17 *OM Fast Mode Event List File binary table columns* 20
18 *OM Tracking History Data Auxiliary File binary table columns* 21
19 *OM Reference Frame Auxiliary File binary table columns* 22
20 *OM Priority Field Acquisition Auxiliary File binary table columns* 23
21 *OM Priority Field Window Data Auxiliary File binary table columns* 24
22 *OM Priority Fast Auxiliary File binary table columns* 25
23 *Spacecraft Time Correlation File binary table columns* 25
24 *Spacecraft Attitude History File binary table columns* 26
25 *Binary table extension name(s) for the ODF/SDF files* 27
26 *CIF binary extension columns* 30
27 *Allowed scope identifiers* 31
28 *Allowed calibration data types by scope* 32
29 *MOS Imaging Mode event list column* 42
30 *p-n Imaging Mode event list column* 43
31 *RGS Spectroscopy Mode event list columns* 44
32 *Attitude file columns* 44
33 *Columns of the* SOURCES *extension in the RGS source file* 45
34 *Pipeline product files* 47
35 *File types* 52

36 *CD-ROM directory names* 53
37 *CD-ROM labels and file-name conventions* 53
38 *ODF/SDF component filenames* 53
39 *Pipeline product filenames* 56
40 *Description of the constituent strings of XID product file names* 60

1 Introduction

1.1 Purpose

The purpose of this document is to provide a detailed description of the data that is distributed from the XMM Science Control System (SCS) archive.

The handbook deals with the format and structure used to distribute data from the archive and with the details of individual file contents. It does not demonstrate how to search the XMM archives and retrieve data or how to analyze the data with the Science Analysis Subsystem (SAS). Users are referred to section 12 below for a list of useful links and documents that provide all the necessary information.

In the following, the reading of [22] is assumed.

1.2 A summary of the data flow

The XMM payload operations are run by the Science Operations Center (SOC), located in the VILSPA ESA ground station, at Villafranca del Castillo, Spain. Except for the pipeline data processing which is performed by the Survey Science Center (SSC) in Leicester, UK, the SOC team is responsible for all the services to the community associated with an observatory type science mission. In particular, the SOC dispatches the re-formatted telemetry (Observation Data Files, or ODF, and Slew Data Files, SDF) to the SSC and receive back the processed data, archive and catalogue them and, finally, distribute the data to the Guest Observers (GOs) on CD-ROM's. In addition, the SOC is responsible for the calibration of the instruments and, together with the SSC, for the maintenance and optimization of the SAS, part of whose tasks are invoked by the pipeline processing software at SSC. The Mission Operation Center (MOC), located at ESOC, Darmstadt, Germany, has the overall responsibility for the XMM spacecraft operations. The raw telemetry is received and archived by the MOC and sent in real time to the SOC via a dedicated and redundant 128 kbps line. Similarly, there is a dedicated line between the SOC and SSC for the exchange of ODF, processed data and ancillary files (e.g. calibration, pipeline scientific products and summary files).

All data resulting from or pertinent to a given observation get archived, cataloged and linked in the XMM Science Archive, which is the **sole** repository of **all** XMM data. All relevant files, from the initial proposal up to the processed data and distribution logs are automatically stored, linked via pointers and cataloged such they can easily be retrieved. The archive also encapsulates the software and data-bases necessary to run XMM payload operations. Therefore it plays a crucial role in the de-centralized XMM ground segment and ensures that all files, data-bases and software systems shared by the three centers are identical and under strict configuration control. In this role, the archive acts as the main interface to the scientific community. Only the Principle Investigator (PI) of a given proposal can access his/her own data during the proprietary period (after the data have been correctly processed and calibrated). After one year, they are released for access by the scientific community. PIs get automatically notified by e-mail as soon as their data have been processed and archived and they receive their data on CD-ROMs, without the need for the investigator to submit a request.

1.3 Document structure

This handbook is organized as eleven chapters or *Sections* (Sect.). The first section is this introduction. The second chapter provides an overview to the different data subsystems, like the Observation Data Subsystem (ODS), the Pipeline Processing Subsystem (PPS), which uses some specific SAS tasks and the Archive Management Subsystem (AMS), used to access the XMM Science Archive. It also outlines the procedure followed to make the data available to the PI of a particular proposal. Sect. 3 deals with the specification of the file formats. Sect. 4, 5 and 7 provide a detailed description of the science reduced data (or PPS data products), the calibration files and the uncalibrated science data and spacecraft files, respectively. Sect. 8 is dedicated to describe the actual content of the CD-ROMs, with which the XMM data are delivered to the PIs, and the naming conventions for thereby included files. The last three sections contain an acronym list, due acknowledgments and a list of reference documents, respectively.

2 An overview of the XMM data file subsystems

The nomenclature used for XMM pointings is as follows: every proposal consists of one or more **observations**. Within each observations there are several measurements with different instruments, called **exposures**. An observation is taken to be a continuous pointing at a fixed position, with at least one (and usually all) of the EPIC, RGS or OM taking data, and following the operational sequence created from a single proposal. The time interval between the start and the end time of an observation is called the **duration** of the observation. In turn, an observation consists of a sequence of exposures for each instrument. For an individual instrument, exposures form a non-overlapping sequence. During an exposure the commanded state of the individual instrument is unchanged, no important hardware or data acquisition mode changes occur, and the data thus have a fixed format. An exposure is necessarily a concept, which refers to a single individual instrument.

A **slew** is the period of time elapsed during a single maneuver from one observation to another.

The XMM ODS[1] generates a set of files per observation period (*i.e.* the period of time from the start of configuring the spacecraft and instruments for an observation until the end of the observation itself) or per slew period. An Observation Data File (ODF) or Slew Data File (SDF) consists of all the data files generated for a specific observation or slew. An ODF or SDF contains data from all operative instruments. Basically, their component files contain raw, uncalibrated science data from each active instrument mode and spacecraft information data.

All scientific data produced in the ODF/SDF are systematically and automatically analyzed by the PPS at the SSC. PPS products are generated for each instrument mode, using some specific SAS tasks.

The collection of data sets (calibration files and algorithms) necessary to reduce and analyze the data collected with the scientific payload of XMM is called Current Calibration File (CCF). A CCF contains all the calibration files that are valid for a particular time. The files or constituents of the CCF are generated by personnel at the SOC. Once the constituents are scientifically validated, they are transferred to the XMM archive for permanent storage. At that moment they become available to the SSC for the pipeline processing of the ODF/SDF.

The PPS treats every ODF and SDF in isolation, with the single exception of the OM slew data. During slews the OM detector is lit by an internal lamp, and this data is used to accumulate flat field images. These have to be combined in the OM pipeline in order to provide sufficient signal to noise in the calibration of the observation data set. EPIC and RGS slew data are not analyzed.

For most purposes the PPS treats individual exposures separately, most PPS products are derived from data taken during a single exposure. However, there are some significant exceptions: all EPIC exposures are input to a joint source detection process; OM source information from different exposures is combined to provide color information; potential OM counterparts to EPIC sources are identified; the RGS gets the zero order position from the EPIC source location; the attitude may be derived from OM tracking star data rather than the star tracker; and observation-level summaries are produced for the whole

[1]For a description of ODS, see [6], Sect. 2.1.4.5 and Sect. 7

observations.

EPIC Radiation Monitor System (ERMS) data are not processed by the PPS for its scientific content and there are no PPS products. The data from the ERMS may however be made use of in the PPS in the same way as the housekeeping data (HK), to define good time intervals for the other instruments. In this case a plot of the ERMS data may be included in the HK summary products.

Pipeline products are made available to the SSC within 30 working days of SSC receipt of the ODF/SDF in normal circumstances. The data products are stored in the XMM science archive located at the SOC.

Access to the data products in XMM science archive are via the AMS for both XMM PIs and, after the proprietary period has elapsed, archival researchers from the whole scientific community. For delivery to the PI, once the pipeline products for a particular observation have been received at the SOC and the observation marked as complete, a set of CDs is produced containing the ODF, CCF and PPS products. Researchers from the whole scientific community are able to access the XMM data products after proprietary period has elapsed. The AMS catalogue contents can be accessed using a web browser, allowing files to be down-loaded via the internet or delivered on CD-ROM. When the required CD-ROMs are written they are distributed via the regular postal service to the requester.

Standard CD-ROMs of 650 Mbyte are used as the media to distribute a particular data set. The data set is spread across several CD-ROMs if needed.

2.1 A first look to my CD-ROM

This chapter provides only a quick overview of the content of the XMM data CD-ROM. The following sections deal with a detailed description of the file properties (see Sect. 3) and content (see Sect. 4 to Sect. 7). More information about the standard XMM CD-ROM set, including the file naming conventions, is reported in Sect. 8.

Each XMM data CD-ROM contains two directories:

> `ODF`

> `PIPEPROD`

If the capacity of a CD-ROM is exceeded, the currently written directory is split, and a new CD-ROM is created, starting from the first not-written file in the same directory. Each CD-ROM can therefore have 2 or 1 of the above directories.

In addition to the above directory, any XMM data CD-ROM contains also three files, which describe the content of the CD-ROM:

- a Disk Contents File
- a Disk Set Contents File
- a VOLDESC file

The above three files are described in detail in Sect. 8

The directory `ODF` contains FITS file with processed telemetry for both scientific (*i.e.*: event lists or images), auxiliary or housekeeping data. They are described in Sect. 4.

The directory `PIPEPROD` contains PPS products, generated at the SSC with standard reduction pipelines. They are described in Sect. 7.

3 File formats

Almost all the science data are stored in "Flexible Image Transport System" (FITS) format, with a few exceptions that are either ASCII or HTML files or in common display formats (e.g PDF).

3.1 FITS format

All of the ODF/SDF component files, with the exception of the summary files, are FITS files and conform to the FITS standard. A description of the FITS format can be found in [9], which is accessible also at the URL `http://www.gsfc.nasa.gov/astro/fits/fits_home.html`. The calibration files and the bulk of the PPS products also conform to the FITS standard. Wherever possible and desirable the calibration files and the PPS products follow the conventions of the OGIP (Office of Guest Investigator Programs) FITS working group (the HEASARC FITS Working Group activities are described at the following URL: `http://heasarc.gsfc.nasa.gov/docs/heasarc/ofwg/ofwg_intro.html`). For FITS files where OGIP FITS standards are not applicable or available, new standards closely following the OGIP approach are used. Extensions to the OGIP FITS standards adopted by other projects have been carefully considered.

The FITS format is primarily designed to store scientific data sets consisting of multidimensional arrays (1-D spectra, 2-D images or 3-D data cubes) and 2-dimensional tables containing rows and columns of data. A FITS data file is composed of a sequence of Header + Data Units (HDUs).

The general structure of a FITS file is as follows:

- a primary header;
- a primary data array of zero length;
- zero or more extensions

Each extension consists of an extension header and a data section. Extensions are named and can appear in any order. Only the following FITS extensions are used:

- ASCII table: `XTENSION=TABLE`
- binary table: `XTENSION=BINTABLE`
- image: `XTENSION=IMAGE`

The header consists of `keyword=value` statements, which describe the organization of the data in the HDU and the format of the contents. It may provide also additional information, for example, about instrument status or the history of the data. The data follow, structured as the header specifies. The data section of the HDU may contain a digital image, a table or a multidimensional matrix that is not an image. An HDU need not contain data.

In the following, familiarity with the FITS format is assumed.

3.2 SAS and LHEASOFT

The SAS provides all the tools needed to manipulate, reduce and analyze XMM data. However, the fact that all the XMM FITS files are OGIP complaint ensures the possibility to apply the already existing FTOOLS package to the XMM data reduction/analysis. Moreover, the scientific products created by the PPS and the SAS can be analyzed with XANADU (i.e. XIMAGE, XRONOS, XSPEC). A detailed documentation about these packages can be found at the following URL: `http://heasarc.gsfc.nasa.gov/docs/software/lheasoft`.

3.3 Portable Data Format (PDF)

Intrinsically compressed PDF files are used for the display of line graphics. In some cases, these graphics files are derived, at least in part, from product files in FITS format. In these cases the PDF file is significantly smaller than the FITS file and/or contains annotations providing a user-friendly summary of the FITS file.

3.4 Portable Network Graphics (PNG)

Portable Network Graphics (PNG) format (see the PNG home page at the following URL `http://www.cdrom.com/pub/png/`) is used for the display of pixel images in the PPS products. PNG is an extensible file format for the lossless, portable, well-compressed storage of images. PNG provides a patent-free replacement for GIF as the graphics file format of choice and can also replace many common uses of TIFF. Indexed-color, grayscale, and true-color images are supported, plus an optional alpha channel for transparency. Sample depths range from 1 to 16 bits. PNG has been accepted as an image standard by the WWW Consortium and is slowly being integrated into the major web browsers including Netscape and Internet Explorer.

As with PDF graphics, in some cases, PNG graphics files are derived, at least in part, from PPS product files in FITS format. In these cases the PNG files are significantly smaller than their FITS files and/or contain annotations providing a user-friendly summary of the FITS file.

3.5 HTML

HTML is the standard format for files which provide overview or summary-type text information for PPS products. Important PPS results are not presented only in HTML files, and thus some information may be found in more than one type of file.

HTML files offer the possibility to provide structure to the collected PPS products of an observation through the use of hyperlinks. Web browsers can then provide a nice interface to the products. Links within the PPS products point to both external and internal services (or uniform resource locators, i.e. URLs)

- External URLs: URLs to external sites are limited to links to the SIMBAD family of servers only [for which the Centre de Dennees astronomiques de Strasbourg (CDS) ensures support throughout the life of the SSC]. These links provide reference data only, they do not provide access to bulk data.

- Internal URLs: internal links are those pointing to SSC products within the XMM archive. Its use provides a quick and user-friendly mechanism for navigating around a product set (i.e. those belonging to a single ODF or SDF).

Within a PPS product set HTML internal links are self-contained, i.e., apart from the external URLs described, there are no link destinations outside of the product set.

3.6 ASCII

ASCII files are used to present script and some tabular information. In particular, each ODF/SDF contains a single summary file, with a summary of the information relating to the observation or slew (see Sect. 4).

3.7 Compression

With few exceptions, all PPS products are supplied in compressed form, that is, each product is individually compressed using the UNIX command `gzip -1`. Unix WWW software can uncompress files transparently, and decompression is a fast process. The exceptions are:

- All PNG product files. PNG is an intrinsically compressed form.
- PDF product files. These are created intrinsically compressed.
- PPS run message product files, that are ASCII files.
- All HTML files. Browsers do not understand gzipped HTML files.

4 Uncalibrated science data, housekeeping and spacecraft files: ODF/SDF

This section details all possible ODF/SDF component files. There are 5 categories of ODF/SDF component files as listed below:

- Instrument science files: no calibration of the science telemetry is performed before it is stored in the instrument science files. The science parameters are extracted from the telemetry packets and stored in their raw form with, in general, no further processing being performed. Where any additional processing is required in order to generate an instrument science file then it is described in the relevant section for that file.
- Instrument housekeeping files:
  - Instrument periodic housekeeping files: contain the calibrated instrument periodic housekeeping parameters and instrument related derived parameters. The periodic housekeeping parameters are extracted from the telemetry packets and the derived parameters calculated. The parameters are then calibrated using the applicable calibration curves (as defined in the XMM telemetry data base) and stored, with the corresponding time key, in the relevant instrument periodic housekeeping file.
  - Instrument non-periodic housekeeping files
- EPIC radiation monitor (ERM) observation/slew period files. These are ERM science files which correspond to observation and slew periods. The ERM data is partitioned to correspond to observation and slew periods[2].
- Spacecraft files
- Summary files, which contain a summary of the information relating to the observation or slew

All the above files, except the Summary files, are in FITS format. They can occur in two flavors: binary table files or image files. A binary table file consists of a primary header unit, a primary data unit of zero length and one or two binary table extensions. These binary table files are further classified in this document as being either an event list, an auxiliary file or an housekeeping file. An **event list** contains singularly all the events detected in a specific CCD (EPIC, RGS) or defined window (OM). One file per exposure is defined. An **auxiliary file** contains frame/cycle information, plus other general information, generated by the CCD active during an exposure/observation, or bookkeeping information generated by the on-board software. An **housekeeping** file contains the calibrated instrument housekeeping parameters and instrument related derived parameters.

[2] The ODS creates actually two sets of ERM science files. Apart from the EPIC radiation monitor observation/slew period files, it produces also the ERM fixed configuration period files. These are ERM science files created for each ERM fixed configuration period. The ERM performs independently of the other XMM instruments and has fixed configuration periods which do not correspond to the observation/slew period concept. These files are a separate data type within the archive and *do not constitute part of an ODF/SDF*. The two sets of files have the same format and structure. The only difference between the two sets of files is the time periods covered.

An ODF/SDF **image file** consists of a primary header unit, a primary data unit of zero length and one image extension HDU.

All the ODF/SDF files share a common primary header. The header of the binary or image extensions of the other ODF/SDF files differ each other, although sharing a set of common keywords (see [10]).

The ODF/SDF constituent files are described in the following sections from 4.1 to 4.10. In them, all the science file binary table columns will be shortly described. Most of these descriptions are self-explanatory. A short description of a few of them is given in Sect. 10.

4.1 EPIC MOS science files

The following EPIC MOS Science Files are defined:

1. Imaging Mode Event List File
2. Timing Mode Event List File
3. Auxiliary file
4. Counting Cycle Report Auxiliary File
5. Offset/variance Mode Event List File
6. Diagnostic Mode Image File

A GO is expected to encounter on its CD-ROM only files of the type 1–5, according to the instrument mode(s) defined in her/his accepted proposal. However, only type 1–3 are likely to be useful for the purpose of scientific analysis. Their content will be described in the following subsections from 4.1.1 to 4.1.3. These are all binary table files. A short description of types 4–5 follows. Offset files are downlinked confirmation that the CCD Zero Bias signal level were applied. If not present, onboard fixed tables were applied. Counting Cycle reports will be included if the MOS telemetry is exceeded during the observation. The cycle reports should already correspond with Bad Time Intervals, but the data contained indicate the fraction of events detected but lost in the on-board processing. Therefore, the information included in these files may be useful for detailed timing analysis. Type 6 are engineering files, which are not available for general users. The reader may refer to [10] for a detailed description of their structure and content.

The reader must be aware that the above files do **not** map one-to-one with the instrument modes defined in [22]. In particular:

- the "Full Window" and "Partial Window" instrumental modes produce Imaging Mode Event List Files only. If the latter is used, the sensitive area of the central chip (CCD0) is reduced. The other CCDs still produce Imaging Mode Event Lists Files for the full 600×600 pixels area.
- the "Timing" instrumental mode produces *both* Image Mode Event List (in CCDs 2–7) *and* Timing Mode Event List files (from central CCD0)
- Auxiliary files are produced for every instrumental mode

The above files can be recognized by the value of the keyword DATATYPE in their binary table header, as indicated in Tab. 1.

Data mode	value of DATATYPE
Imaging Mode	IMAGE.EL
Timing mode	TIME.EL
Burst mode (p-n only)	BURST.EL
Auxiliary file	AUX.EL

Table 1: *Values of the* DATATYPE *keywords for the MOS/p-n science data file types*

4.1.1 EPIC MOS Imaging Mode Event List File

An EPIC MOS file of this kind is created for each CCD node which is producing imaging mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 2[3].

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
RAWX	1I	PIXEL	Event raw X position
RAWY	1I	PIXEL	Event Y position
ENERGYE1	1I	CHANNEL	Event energy (E1)
ENERGYE2	1I	CHANNEL	Event energy (E2)
ENERGYE3	1I	CHANNEL	Event energy (E3)
ENERGYE4	1I	CHANNEL	Event energy (E4)
PATTERN	1B		Pattern number
PERIPIX	1B		Peripherical pixels above Threshold Counter

Table 2: *EPIC MOS Imaging Mode Event List file binary table columns*

4.1.2 EPIC MOS Timing Mode Event List File

An EPIC MOS file of this kind is created for each CCD node which is producing timing mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 3.

4.1.3 EPIC MOS Auxiliary File

An EPIC MOS file of this kind is created for each exposure in which at least one CCD node is producing either timing or imaging mode data. Each file consists of a single binary table. A single file per observation is created, where each row is labeled according to the relevant frame and CCD. The binary table will consist of the columns listed in Tab. 4.

[3] In this table, as in similar following ones, the following convention is used for the column "Type": 1J = INTEGER*4; 1I = INTEGER*2; 1B = BYTE, XXA = CHARACTER*XX

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
RAWX	1I	PIXEL	Event raw X position
RAWY	1I	PIXEL	Event Y position
ENERGYE12	1I	CHANNEL	Event energy (E1+E2)
PATTERN	1B		Pattern number
PERIPIX	1B		Peripherical pixels above Threshold Counter

Table 3: *EPIC MOS Timing Mode Event List File binary table columns*

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
CCDID	1B		CCD identifier
CCDNODE	1B		CCD node identifier
FTCOARSE	1I	SECOND	Coarse frame time
FTFINE	1I		Fine time frame
NPIXEL	1J	PIXEL	Pixel count
NVALID	1I	COUNTS	No. of valid events
NBELOW	1I	COUNTS	No. of events rejected by lower thresholding
NABOVE	1I	COUNTS	No. of events rejected by upper thresholding
GATTIFLG	1B		Gatti flag
FIFOOVF	1B		FIFO Overflow Flag

Table 4: *EPIC MOS Auxiliary File Binary table Columns*

4.2 EPIC MOS housekeeping files

The following EPIC MOS housekeeping parameter files are defined:

1. Periodic Housekeeping File
2. Non-periodic Housekeeping File

One file will be created for each camera per observation period. The file consists of a single binary table. The EPIC MOS housekeeping parameters are described in [10] and [2].

4.3 EPIC p-n science files

The following EPIC p-n Science Files are defined:

1. Imaging Mode Event List File
2. Timing Mode Event List File
3. Burst Mode Event List File

4. Auxiliary File
5. Offset Data Image File
6. Noise Data Image File
7. Discarded Lines Image File
8. Counting Cycle Report Auxiliary File

A GO is expected to encounter on its CD-ROM files of the type 1–6, according to the instrument mode(s) defined in her/his accepted proposal. Their content of type 1–4 will be described in the following subsections from 4.3.1 to 4.3.3. These are all constituted by a single binary table. Type 5 and 6 are analogous to the MOS Offset data. Type 7 files occur whenever cosmic ray hits in the p-n CCDs result in the blanking of a column containing the hit. This information is needed during the reduction procedure for a proper exposure correction. Type 8 files provides a summary record of the data which were lost when the telemetry rate is exceeded by the data rate produced by the p-n cameras.

The reader must be aware that the above modes do **not** map one-to-one with the instrument modes defined in [22]. In particular:

- the "Full Window" and "Partial Window" instrumental modes produce Imaging Mode Event List Files. If the latter is used, only a subset of the CCD array is actually sensitive
- the "Timing"/"Burst" instrumental mode produces *only* Timing/Burst Mode Event List data (from one chip)
- Auxiliary files are produced for every instrumental mode

As for the other XMM-Newton instruments, the p-n ODF files do not explicitly contain a column `TIME`. p-n imaging, timing and burst modes contain a "Frame Counter", that increments monotonically in steps of 1 for the full detector, each time a time information is encountered in the telemetry. Therefore: each event in a p-n imaging mode event list is labeled with the frame, when it occurred. The first table of the EPIC p-n auxiliary file has at most 3 records for every identified frame: one for each CCD on the relevant quadrant.

The above files can be recognized by the value of the keyword `DATATYPE` in their binary table header, as indicated in Tab. 1.

4.3.1 EPIC p-n Imaging Mode Event List File

An EPIC p-n file of this kind is created for each CCD node which is producing imaging mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 5.

4.3.2 EPIC p-n Timing/Burst Mode Event List File

EPIC p-n files of this kind are created for each CCD node which is producing timing/burst mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 6.

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
RAWX	1I	PIXEL	Event raw X position
RAWY	1I	PIXEL	Event Y position
ENERGY	1I	CHANNEL	Event energy
F1291	1I		Frame time description[a]

[a]this parameter is used to discriminate between "Full Frame" (0) and "Extended Full Frame" (3) Modes

Table 5: *EPIC p-n Imaging Mode Event List File binary table columns*

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
RAWX	1I	PIXEL	Event raw X position
RAWY	1I	PIXEL	Event Y position
ENERGY	1I	CHANNEL	Event energy

Table 6: *EPIC p-n Timing/Burst Mode Event List File binary table columns*

4.3.3 EPIC p-n Auxiliary File

An EPIC p-n file of this kind is created for each exposure in which at least one CCD node is producing either timing or imaging mode data. Each file consists of two binary tables:

1. the first extension contains the frame information for all the active CCDs (see Appendix A.2 of [10] for a description of the relevant algorithm)
2. the second extension contains the statistical information which is produced by each quadrant after a certain number of cycles (see Appendix A.2 of [10] for a description of the relevant algorithm)

A single file per exposure is created, where each row is labeled according to the relevant frame and CCD identifier (in the first extension). The binary tables consist of the columns listed in Tab. 7 and Tab. 8, respectively.

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
CYCLE	1J	COUNTER	Cycle Identifier
FTCOARSE	1I	SECOND	Coarse frame time
FTFINE	1I		Fine time frame
CCDID	1B		CCD identifier
QUADRANT	1B		Quadrant identifier

Table 7: *EPIC p-n Auxiliary File binary table columns for the extension* PNAUX1

Name	Type	Units	Description
CYCLE	1J	COUNTER	Cycle Identifier
QUADRANT	1B		Quadrant identifier
NABOVE	1I	COUNTS	ATHR Counter
NDEFA	1I		DEFA Counter
NEPDH	1I		EPDH Counter
NDISCLIN	1I		Discarded Line Counters
MCOMMODE	I1		Mean Common Mode

Table 8: *EPIC p-n Auxiliary File binary table columns for the extension* PNAUX2

4.4 EPIC p-n housekeeping files

The following EPIC p-n housekeeping parameter files are defined:

1. Periodic Housekeeping File
2. Non-periodic Housekeeping File

These files contain the calibrated (non-)periodic housekeeping parameters and the calibrated derived parameters produced during the observation. Two periodic housekeeping files will be created for each observation. Details on these files can be found in [4]. The files consist of a single binary table. The EPIC PN housekeeping parameters are described in [10] and [4].

4.5 RGS science files

The following RGS Science Files are defined:

1. Spectroscopy Mode Event List File
2. High Time Resolution Mode Event List File
3. Auxiliary File
4. Diagnostic Mode Image File

A GO is expected to encounter on its CD-ROM only files of the type 1–3, according to the instrument mode(s) defined in her/his accepted proposal. Their content will be described in the following subsections from 4.5.1 to 4.5.4.

These modes map one-to-one the corresponding instrumental modes, as specified in [22]: the Spectroscopy (BSM) and High Time Resolution (HTRM) modes, respectively.

The above files can be recognized by the value of the keyword DATATYPE in their binary table header, as indicated in Tab. 9.

Data mode	value of `DATATYPE`
Spectroscopy Mode	`SPECT.EL`
High Time Resolution Mode	`HTR.EL`
Auxiliary file	`AUX.EL`

Table 9: *Values of the* `DATATYPE` *keywords for the RGS science data file types*

4.5.1 RGS Spectroscopy Mode Event List File

A RGS file of this kind is created for each CCD node, which is producing spectroscopy mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 10.

Name	Type	Units	Description
`FRAME`	1J	`COUNTER`	Frame number
`RAWX`	1I	`PIXEL`	Event raw X position
`RAWY`	1I	`PIXEL`	Event Y position
`ENERGY`	1I	`CHANNEL`	Event energy
`CCDNODE`	1B		CCD node
`SER`	1B		Split Event Reconstruction

Table 10: *RGS Spectroscopy Mode Event List File binary table columns*

4.5.2 RGS High Time Resolution Mode Event List File

A RGS file of this kind is created for each CCD node, which is producing high time resolution mode data. Each file consists of a single binary table. The binary table consists of the columns listed in Tab. 11.

Name	Type	Units	Description
`FRAME`	1J	`COUNTER`	Frame number
`RAWY`	1I	`PIXEL`	Δt
`ENERGY`	1I	`CHANNEL`	Event energy
`CCDNODE`	1B		CCD node

Table 11: *RGS High Time Resolution Mode Event List File binary table columns*

4.5.3 RGS Auxiliary File

A RGS file of this kind is created for each exposure in which at least one CCD node is producing either spectroscopy or high time resolution data. A single file per exposure is created, where each row is labeled according to the relevant frame and CCD. Each file consists of two binary tables:

- the first binary table contains the frame/cycle details and statistics for all the active CCDs
- the second binary table contains the CCD read-out sequence description

The binary tables consist of the columns listed in Tab. 12 and Tab. 13, respectively.

Name	Type	Units	Description
FRAME	1J	COUNTER	Frame number
CCDID	1B		CCD identifier
NLOSTEVT	1I	COUNTS	Lost event counter LEF in HTR marker
ABORTFLG	1I		Abort flag
DELTA_T	1I	2^{-16} s	Time resolution

Table 12: *EPIC RGS Auxiliary File first binary table columns*

Name	Type	Units	Description
SEQINDEX	1I	CONTER	Sequence index
CCDID	1B		CCD identifier
CCDNODES	1B		CCD Read-out node(s)
CCDOCB	1B		CCD OCB
RTHRESHC	1I		CCD rejection threshold (side C)
ATHRESHC	1I		CCD acceptance threshold (side C)
UTHRESHC	1I		CCD upper threshold (side C)
RTHRESHD	1I		CCD rejection threshold (side D)
ATHRESHD	1I		CCD acceptance threshold (side D)
UTHRESHD	1I		CCD upper threshold (side D)
WINDOWX0	1I	PIXEL	CCD X-start
WINDOWY0	I1	PIXEL	CCD Y-start
WINDOWDX	1H	PIXEL	CCD X-length
WINDOWDY	1H	PIXEL	CCD Y-length

Table 13: *EPIC RGS Auxiliary File second binary table columns*

4.5.4 RGS Diagnostic Mode Image File

An RGS file of this kind will be created for each CCD, which is producing diagnostic mode data. It consist of a single image table extension. Diagnostic data are identical to the "Q dumps" (the only difference being the naming convention; see 8.2.2). As it is possible to have separate, distinct Q dump files associated with a SPECTROSCOPY+Q exposure, separate, distinct exposure numbers are allocated to these files. However, the exposure identifier (keyword EXP_ID) in the header of each file will be associated with the SPECTROSCOPY+Q exposure.

4.6 RGS housekeeping files

The following RGS housekeeping parameters files are defined:

1. Periodic Housekeeping File
2. Non-periodic Housekeeping File

These file contains both the calibrated housekeeping parameters produced during an observation period and the calibrated derived parameters. Three instances are created for each RGS detector (details can be found in [12]). There is one periodic and two non-periodic housekeeping files. Each file consists of a single binary table. The RGS housekeeping parameters and calibration curves are described in [10] and [12].

4.7 OM science files

The following OM Science Files are defined:

1. Imaging Mode Data Image File
2. Fast Mode Event List File
3. Tracking History Data Auxiliary File
4. Reference Frame Data Auxiliary File
5. Priority Field Acquisition Auxiliary File
6. Priority Window Data Auxiliary File
7. Priority Fast Auxiliary File
8. Engineering Mode Image File

The content of the above files will be described in the following subsections from 4.7.2 to 4.7.6. These are all binary table files, except the imaging data, which are written in a single `IMAGE` extension. Type 8 are engineering type data, which are not available for general users. The reader may refer to [10] for a detailed description of its structure and content.

The first two modes above map one-to-one the corresponding instrumental modes, as specified in [22]: the Imaging and the Fast mode, respectively.

The above files can be recognized by the value of the keyword `DATATYPE` in their binary/image table header, as indicated in Tab. 14.

4.7.1 OM common keywords

A set of common keyword is defined to be present in the header of each OM Science File. They are listed in Tab. 15, with a short explanatory description.

Data mode	value of DATATYPE
Imaging Mode	IMG.EL
Full-frame low resolution	IMG.EM
Full-frame high-resolution	ENG.IM
Fast Mode	FST.EL
Reference frame Auxiliary file	REF.EL
Tracking history Auxiliary File	TRH.EL

Table 14: *Values of the* DATATYPE *keywords for the OM science data file types*

Name	Value	Description
TELESCOP	"XMM"	
INSTRUME	"OM"	
CHAIN	1/2	OM detector chain in use (redundant/prime)
DATATYPE	see Tab. 14	
OBS_ID		Observation identifier
EXP_ID		Exposure identifier (as from the XMM Archive)
TMEXP_ID		Exposure identifier (as from the telemetry; see [20])
SCIWIN		Science window identifier (see [20])
PARAM		Additional information related to the data type (see [20])
FRMTIME		Frame time
WINDOWX0		Window details as from the OM priority window data file (see Sect. 4.7.6)
WINDOWY0		See description for WINDOWX0
WINDOWDX		See description for WINDOWX0
WINDOWDY		See description for WINDOWX0
DATE-OBS		The start time as from the housekeeping telemetry
DATE-END		The end time as from the housekeeping telemetry

Table 15: *Common keywords for the OM Science Files*

4.7.2 OM Imaging Mode Data Image File

An OM file of this kind is produced for each imaging mode science window. It is an image file, with a single image extension containing a single image. The set of mandatory/additional keyword present in the extension header are listed in Tab. 16, together with their value (when applicable). The keyword BLANK indicates the value assigned to missing pixels.

Starting from the AO2, two former engineering modes can be used for scientific purposes. They provide full frame binned ("Low-resolution", formerly known as "Engineering-2") and unbinned ("High resolution", formerly known as "Engineering-4") imaging. These modes share the same common keywords with the standard OM Imaging Mode Data Image files, as detailed in Tab. 16. Additionally, binning information is provided by the keywords BINAX1 and BINAX2. In "High-resolution" Full Frame Mode: WINDOWX0=0, WINDOWY0=0, WINDOWDX=2048, WINDOWDY=2048.

Name	Value
BITPIX	32
NAXIS	2
NAXIS1	
NAXIS2	
BUNIT	COUNTS
BLANK	
BINAX1[a]	
BINAX2[a]	
BINPE[b]	T(rue)/F(alse)
FILTER	
EXPOSURE	SECONDS

[a]Pixel binning factor
[b]T/F = Low/High resolution

Table 16: *Mandatory/additional keyword in the header of the OM Imaging Mode Event Image File*

4.7.3 OM Fast Mode Event List File

OM files of this kind are created for each fast mode science window. Each file contains data from one exposure only and is constituted by one binary table. The binary table consists of the columns listed in Tab. 17. A more detailed description can be found in [20].

Name	Type	Units	Description
FRAME	1J	COUNTER	Timeslice number
FTCOARSE	1J	SECOND	Coarse Time Stamp
FTFINE	1I		Fine Time Stamp (in units of 1/1000th seconds)
RAWX	1I	PIXEL	Event X position
RAWY	1I	PIXEL	Event Y position

Table 17: *OM Fast Mode Event List File binary table columns*

4.7.4 OM Tracking History Data Auxiliary File

An OM file of this kind is created for each exposure of an observation, if tracking occurred (lack of suitable tracking stars can in principle prevent this from happening). Each file will consist of a single binary table, with each row representing one frame. It contains the coordinates, in detector pixels, of the guide stars found in the FOV as well as the offsets found in different tracking frames due to small jitters in the spacecraft pointing. These offset are corrected by the shift-and-add algorithm on board. The binary table consists of the columns listed in Tab. 18. A more detailed description can be found in [20].

Name	Type	Units	Description
FRAME	1J	COUNTER	Tracking number
NGGS	1J	COUNTS	No. of good guide stars found
DX	1J		Drift in x direction (in units of 1/1000th centroided pixels)
DY	1J		Drift in y direction (in units of 1/1000th centroided pixels)
ROLL	1J		Roll drift (in units $10^6 \sin(\theta)$)
QUALITY	1J		Quadratic sum of the x and y residuals
GSX	10J	PIXEL	Guide Star x coordinate
GSY	10J	PIXEL	Guide Star y coordinate
GSCTS	10J	COUNTS	Guide Star counts integrated over PSF

Table 18: *OM Tracking History Data Auxiliary File binary table columns*

4.7.5 OM Reference Frame Data Auxiliary File

An OM file of this kind, will be created for each exposure of an observation. Each file consists of a single binary table, with each row representing one frame. The binary table consists of the columns listed in Tab. 19. A more detailed description can be found in [20].

4.7.6 "Priority files"

Three kinds of OM "Priority" data exist:

- Priority Field Acquisition Auxiliary File (the so called "DP_FAQ" data)
- Priority Window Data Auxiliary File (the so called "DP_WDW" data)
- Priority Fast Auxiliary File (the so called "DP_BFAST" data)

They are called "priority", because they are issued with a higher priority by the DPU than the regular data. These file are issued before the start of the actual science exposure.

DP_FAQ data contain information on the OM field acquisition made at the beginning of the observation. The coordinates of a set of uplinked Guide Star (GS) position are compared to the actual measured positions in the field acquisition frame. From this comparison, the OM readout window is offset to maintain a correct centering of the target. Each instance of this file consists of a single binary table, whose columns are described in Tab. 20.

DP_WDW data contain the position of the science window (up to 5) during an exposure and the associated memory window and detector windows, together with the position of the autonomously selected guide star windows (up to 16). The dataset also lists the tracking window positions and the finally calculated memory and detector window configurations. Each instance of this file consists of a single binary table, whose columns are described in Tab. 21.

The DP_BFAST data contain information on the fast mode data. A single file is produced for each exposure of the observation (excluding the Field Acquisition Exposure) if there are windows configured in fast mode. Conversely, this file is not present during exposures,

Name	Type	Units	Description
XROLL	1J	PIXEL	Roll center x coordinate
YROLL	1J	PIXEL	Roll center y coordinate
GOODSTAR	1J	COUNTER	No. of good guide stars
BADSTAR	1J	COUNTER	No. of bad guide stars
GGSX	16J	PIXEL	Good guide star x coordinate
GGSY	16J	PIXEL	Good guide star y coordinate
GGSCNTS	16J	COUNTS	Good guide star counts
GGSPKCO	16J	PIXEL	Good guide star peak coordinates
GGSPKCNT	16J	COUNTS	Good guide star peak counts
GGSQUAL	16J		Good guide star quality
GGSXMIN	16J	PIXEL	Good guide star box minimum X
GGSXMAX	16J	PIXEL	Good guide star box maximum X
GGSYMIN	16J	PIXEL	Good guide star box minimum Y
GGSYMAX	16J	PIXEL	Good guide star box maximum Y
GGSX2MNT	16J	PIXEL	Good guide star X 2nd momentum
GGSY2MNT	16J	PIXEL	Good guide star Y 2nd momentum
GGSXYMNT	16J	PIXEL	Good guide star XY 2nd momentum
BGSX	16J	PIXEL	Bad guide star x coordinate
BGSY	16J	PIXEL	Bad guide star y coordinate
BGSCNTS	16J	COUNTS	Bad guide star counts
BGSPKCO	16J	PIXEL	Bad guide star peak coordinates
BGSPKCNT	16J	COUNTS	Bad guide star peak counts
BGSQUAL	16J		Bad guide star quality
BGSXMIN	16J	PIXEL	Bad guide star box minimum X
BGSXMAX	16J	PIXEL	Bad guide star box maximum X
BGSYMIN	16J	PIXEL	Bad guide star box minimum Y
BGSYMAX	16J	PIXEL	Bad guide star box maximum Y
BGSX2MNT	16J	PIXEL	Bad guide star X 2nd momentum
BGSY2MNT	16J	PIXEL	Bad guide star Y 2nd momentum
BGSXYMNT	16J	PIXEL	Bad guide star XY 2nd momentum

Table 19: *OM Reference Frame Auxiliary File binary table columns*

where no fast windows are active. The file consists of a single binary table, whose columns are described in Tab. 22. There is one record per fast mode window.

4.8 OM housekeeping files

The following OM housekeeping parameters files are defined:

1. Periodic Housekeeping File
2. Non-periodic Housekeeping File

Both types of file are delivered to the GOs. Two types of periodic housekeeping files can be created, ("diagnostic" and "standard"). They can be recognized from the different

Name	Type	Units	Description
ITERATN	1J	COUNTER	No. of iterations to solution
XCOMMAND	1J	PIXEL	Commanded X coordinate
YCOMMAND	1J	PIXEL	Commanded Y coordinate
DX	1J	PIXEL	Pointing error in x (in units of 1/1000th pixels)
DY	1J	PIXEL	Pointing error in y (in units of 1/1000th pixels)
SINTHETA	1J		Absolute roll error [1/1000th $\sin(\theta)$]
NGSUP	1J	COUNTER	No. of uplinked guide stars
NGSFOUND	1J		No. of guide stars found
GSX	16J	PIXEL	X coordinates of the guide stars
GSY	16J	PIXEL	Y coordinates of the guide stars
RSX	16J	PIXEL	X coordinates of the reference stars
RSY	16J	PIXEL	X coordinates of the reference stars

Table 20: *OM Priority Field Acquisition Auxiliary File binary table columns*

increment steps of the `TIME` column (1 and 10 seconds, respectively). These files contain both the calibrated periodic housekeeping parameters produced during an observation period and the calibrated derived parameters. Only one of these two types is included in a specific ODF.

The OM housekeeping parameters and calibration curves are described in [10] and [21].

4.9 Spacecraft files

The following spacecraft files are defined:

1. Time Correlation file
2. Attitude History file
3. Reconstructed Orbit file
4. Periodic Housekeeping file
5. Dummy Attitude file
6. Predicted Orbit file

A GO is expected to encounter on its CD-ROM only files of the type 1–4. Files 5 and 6 are intermediate files, which are replaced by the spacecraft attitude history file and the spacecraft reconstructed orbit file when they become available. The content of the files distributed in the ODF will be described in the following subsections from 4.9.1 to 4.9.4.

4.9.1 Spacecraft Time Correlation File

This file contains the OBDH time and the corresponding UTC. The epoch for UTC time reference is: 1958, January 1. More details about the definition of the time packets is

Name	Type	Units	Description
DETWINS	1J		No. of detector windows
SCIWIND	1J		No. of science windows
MEMWIND	1J		No. of memory windows
DWX0	16J	PIXEL	Bottom left X coordinate of detector window
DWY0	16J	PIXEL	Bottom left Y coordinate of detector window
DWXSIZE	16J	PIXEL	X dimension of detector window
DWYSIZE	16J	PIXEL	Y dimension of detector window
DWMMWID	16J		Identificator of corresponding memory window
DWKOMPX	16J		MIC data decoder parameter
DWBB	16J		MIC data decoder parameter
DWAA	16J		MIC data decoder parameter
DWKOMPY	16J		MIC data decoder parameter
SWX0	16J	PIXEL	Bottom left X coordinate of science window
SWY0	16J	PIXEL	Bottom left Y coordinate of science window
SWXSIZE	16J	PIXEL	X dimension of memory window
SWYSIZE	16J	PIXEL	Y dimension of memory window
SWMODE	16J		Science window operating mode (0 = Imaging; 1 = Fast)
SWP1	16J		Science window mode dependent parameter[a]
SWP2	16J		Science window mode dependent parameter[b]
SWP3	16J		Science window mode dependent parameter[c]
SWP4	16J		Science window mode dependent parameter[d]
SWBASE	16J		Science window data storage address
SWMMWID	16J		Science window identificator of the corresponding memory window
MWX0	16J	PIXEL	Bottom left X coordinate of memory window
MWY0	16J	PIXEL	Bottom left Y coordinate of memory window
MWXSIZE	16J	PIXEL	X dimension of memory window
MWYSIZE	16J	PIXEL	Y dimension of memory window
MWBASE	16J		Memory window retrieval address

[a]Pixel binning factor in X ($2^{\texttt{SWPI}}$; Image Mode) or sampling time (Timing Mode)
[b]Pixel binning factor in Y ($2^{\texttt{SWPI}}$; Image Mode)
[c]Not used
[d]Starting address in DPU global memory to which the accumulated image is written

Table 21: *OM Priority Field Window Data Auxiliary File binary table columns*

given by [18]. One file is created for each observation and for each slew period. Each file is constituted by a single binary table, whose columns are listed in Tab. 23

The UTC is calculated as follows:

$$\mathrm{UTC} = \mathrm{CORRPARA} \times \mathrm{OBT} + \mathrm{CORRPARB}$$

The UTC is expressed in units of 100 nanoseconds from the epoch 1858-11-17T00:00:00:00.000. The number is then split in its day, ms, and μs units, as indicated in Tab. 23.

Name	Type	Units	Description
BFASTID	1J		Blue DSP 1 or 2
SAMPTIME	1J		Sample time
NFASTPIX	1J		No. of pixels for fast time slice
FASTDEST	1J		Memory address of fast mode data stream
FASTEND	1J		Termination address of fast mode data
NFASTEVT	1J		Total no. of events in mode data
FASTADDR	503J		Fast addresses

Table 22: *OM Priority Fast Auxiliary File binary table columns*

Name	Type	Units	Description
FRAME	1J	COUNTER	
OBTCOARS	1J	SECOND	Coarse COBT
OBTFINE	1J		Fine COBT
UTCDAY	1I		UTC day corresponding to COBT
UTCMILLI	1J		UTC ms of day corresponding to COBT
UTCMICRO	1I		UTC μs of day corresponding to COBT
CORRPARA	A39		Slope of least squares fit
CORRPARB	A39		Abscissa of least square fit
UTCFLAG	1I		UTC quality flag
ERTIME	27A		Corrected Earth received time
ERTIMERAW	27A		Raw Earth received time
GSID	5A		Ground station identifier

Table 23: *Spacecraft Time Correlation File binary table columns*

4.9.2 Spacecraft Attitude History File

This file contains the attitude data extracted from the flight dynamics. A single file is created for the whole revolution, when the observation/slew period occurred. All information is expressed with respect to the mean geocentric equatorial reference system of Equinox J2000.0. Each file consists of a single binary table, whose columns are described in Tab. 24

4.9.3 Spacecraft Reconstructed Orbit File

This files contains the reconstructed orbit of the spacecraft. A single file is created for the whole revolution, when observation/slew period occurred. Details of the orbit files are provided in [16]

4.9.4 Spacecraft Periodic Housekeeping File

This files contains periodic housekeeping telemetry packets concerning:

- Experiment housekeeping

Name	Type	Units	Description
VALTIME	19A	yyyy-mm-ddTh:mm:ss	Time from which data in this record are valid
VALDUR	1E	SECOND	Duration for which data in this record are valid
OTFTHRES	1E	ARCSEC	On target flag threshold
VIEWRA	11A	HH:MM:SS.S	R.A. of viewing direction
VIEWDECL	11A	±DD:MM:SS.S	Declination of viewing direction
ASTPOS	1E	DEGREE	Astronomical position angle
ROLLANG	1E	DEGREE	Roll angle
GSREFNO	12A		Guide Star reference number in catalogue
GSRA	11A	HH:MM:SS.S	Guide Star right ascension
GSDEC	11A	±DD:MM:SS.S	Guide Star declination
ASPANGLE	1E	DEGREE	Solar aspect angle
ACFLAG	1B		Attitude contingency flag
APDAMP	5A	ARCSEC	Observable SPD amplitude
DIFFVRA	11A	DEGREE	Difference between reconstructed and commanded viewing direction right ascension
DIFFVDEC	11A	DEGREE	Difference between reconstructed and commanded viewing direction declination
DIFFPOS	11A	DEGREE	Difference between reconstructed and commanded viewing direction position angle
PREQID	14A		Pointing request identifier
TYPEID	1A		Type identifier
SOURCEID	1A		Source identifier
ATTSEQNO	3A		Attitude sequence number
SLEWTIME	19A	yyyy-mm-ddThh:mm:ss	Start time of slew to the pointing request
PTTIME	19A	yyyy-mm-ddThh:mm:ss	Start time of stable pointing period

Table 24: *Spacecraft Attitude History File binary table columns*

- Spacecraft temperature
- Attitude

Details of the contents of these files and format are given by: [17], [7], [8], [14] and [21].

4.10 Observation/slew summary file

Each ODF and SDF contains a summary file in ASCII format. Each line is a record, containing the following information:

- Observation/slew information
- File details
- Proposal summary
- Data quality

A detailed description of the summary file can be found in [10].

File type	BINTABLE ...
MOS Imaging Mode Event List File	M[12]IME1
MOS Timing Mode Event List File	M[12]TIE1
MOS Auxiliary File	M[12]AUX1
MOS Periodic Housekeeping File	PERIODIC_HK
p-n Imaging Mode Event List File	PNIME1
p-n Timing Mode Event List File	PNTIE1
p-n Burst Mode	PNBUE1
p-n Auxiliary File (first extension)	PNAUX1
p-n Auxiliary File (second extension)	PNAUX2
p-n Housekeeping (first file)	PERIODIC_HK
p-n Housekeeping (second file)	MAIN_PERIODIC
RGS Spectroscopy Mode Event List File	R[12]SPE1
RGS High Time Resolution Event List File	R[12]HTE1
RGS Auxiliary File (first extension)	R[12]AUX1
RGS Auxiliary File (second extension)	R[12]AUX2
RGS Periodic Housekeeping Files	PERIODIC_HK
OM Imaging Mode Image File	OMIMI1
OM Fast Mode Event List File	OMFAE1
OM Tracking History Data Auxiliary file	OMTHX1
OM Reference Frame Auxiliary File	OMRFX1
OM Periodic Housekeeping File	OMPEH1
OM Non-Periodic Housekeeping File	OMNPH1
Spacecraft Attitude History File	SCATS1
Spacecraft Time Correlation File	SCTSC1

Table 25: *Binary table extension name(s) for the ODF/SDF files*

4.11 How to recognize my ODF files

A typical ODF/SDF is expected to have several tens of files. It may therefore be useful to have easy rules to quickly pinpoint a certain file in the storming sea of all the others. Two main distinguishing features can be used:

- the XMM ODF/SDF naming convention (see Sect. 8.2) allows the GO to pinpoint the nature of the file. Each character/string in the name represents a code, which identifies uniquely: the instrument, the type of observation (scheduled or unscheduled), the exposure number, the CCD/OM window identifier, the file type and the format
- the *science* ODF/SDF FITS files are uniquely characterized by the value of their binary table(s) extension. This coding is described in Tab 25 [in this table the Unix convention to indicate multiple files is used; e.g.: `M[12]IME1` means `M1IME1` (MOS1) and `M2IME1` (MOS2)].

We observe that a further indication on the nature of the file is provided by the value of the keyword `DATATYPE` in the binary table header, although in this case only the file type can be unambiguously determined, whereas a degeneracy in the instrument remains.

As mentioned above, the housekeeping files cannot always be uniquely determined through the name of their binary table extension. However, they can be still recognized through their filenames.

5 Calibration data: CCF

The Current Calibration File, CCF, is the collection of data sets that are distributed with observation data files to allow science analysis, i.e. to reduce and analyze the data collected with the scientific payload of XMM. A dedicated software (Calibration Access Layer, CAL), included in the SAS distribution, is available to access and visualize CCF files. The reader may refer to [15] for a detailed description of the CAL structure and functions.

The nomenclature used here is as follows:

- calibration data type: a kind of data related to a particular aspect of the calibration or analysis.
- calibration file or constituent: one instance of a particular calibration data type.

  A calibration file has an issue number and a start-of-validity data, by which it can uniquely be identified

  Several calibration files can refer to the same calibration data type. The may refer to different instruments (or scope), or to different issues of the same data. Each triplet {scope, calibration type, issue} is unique.
- Current Calibration File (CCF): the collection of all the calibration files that are valid at a particular time.

  This is different from the collection of all the calibration files stored in the archive.

  The current calibration file does not have a version number, and it should be seen as a view of what calibration files are valid for a time and for a specific observation date.

The decision of what calibration files are relevant to a given observation is solely based on the time when the observation was made. A repository of all the CCF constituents can be found at `ftp://xmm.vilspa.esa.es/pub/ccf/constituents`.

A more detailed description of the calibration file content can be found in [3].

5.1 The Calibration Index File

Several SAS tasks make use of calibration files. Hence, they need to know which calibration files are suitable for the data analysis, and where they are located.

This information is provided by the *Calibration Index File* (CIF), which indicates to the CAL where to find the CCF constituents it needs. A CIF is provided as part of the pipeline products. Moreover, it can be rebuilt during any SAS session through the `cifbuild` SAS task, specifying the observation date, the analysis date and the directory where the CCF are located (cf. [15]).

The CIF is constituted by a single binary table. Its columns are specified in Tab. 26.

A CIF can be generated also based on the content of the *Master Index File* (MIF). The MIF contains a list of all CCF constituents released from the start of the mission until

Name	Type	Description
TELESCOP	4A	XMM
SCOPE	6A	see Tab. 27
TYPEID	32A	Calibration file type
ISSUE	1I	Sequential number
VALDATE	19A	Validity date (start)
FNAME	256A	File name
DATE	19A	Creation date
FSIZE	1J	File size (in bytes)
SUBDATE	19A	Submission date
EXTSEQU	32A	Extension sequence
EXTSEQID	256A	Extension sequence identifier
MD5	32A	MD5 digital signature
CREATOR	64A	File creator

Table 26: *CIF binary extension columns*

the date specified in the `SUBDATE` column. A continuously updated version of the MIF is available at `http://xmm.vilspa.esa.es/ccf`.

5.2 File naming convention

The constituents of the current calibration file are named as follows:

scope_calname_issue.ccf

where:

scope indicates the scope of the calibration file (at most 5 characters long). The list of scope identifiers is given in Tab. 27.

calname is the calibration data type identifier (at most 17 characters long). The list of data type identifiers is given in Tab. 28.

issue is the file issue number (integer ≥ 0 and ≤ 9999, zero padded).

File names are case sensitive. However, in this document they are type set with upper and lower case letters for readability.

5.3 File description

In this Section, a short description of all constituent of a CCF is given. In all the following subsection **calibration type** indicate both the calibration data type identifiers, as listed in Tab. 28, and the value of the keyword `TYPEID` in each file.

xmm	general files or files shared by more than one instrument
om	Optical Monitor files
xrt1, xrt2, xrt3	X-ray Telescope files
emos1, emos2	European Photon Imaging Camera MOS files
epn	European Photon Imaging Camera PN files
rgs1, rgs2	Reflection Grating Spectrometer files

Table 27: *Allowed scope identifiers*

5.3.1 Scope: xmm

There will be one instance of each of these files.

Calibration type: *AbsCoefs*
Description: Elemental absorption coefficients

Calibration type: *BoreSight*
Description: Alignment of individual instruments with respect to XMM-Newton's reference frame in terms of Euler angles

Calibration type: *CalIndex*
Description: Master index file for all possible current calibration file constituents

Calibration type: *HKParmInt*
Description: Housekeeping parameter ranges used to generated GTIs

Calibration type: *MiscData*
Description: Miscellaneous data

5.3.2 Scope: om

There will be one instance of each of these files.

Calibration type: *AstroMet*
Description: Contains the definition of the linear detector grid and the deviations of pixel positions from ideal (i.e. flat grid) locations.

Calibration type: *BadPix*
Description: Table of bad pixels, listing the position, the type of defect and the severity level.

Calibration type: *ColorTrans*
Description: Contains the coefficients for the color transformation

Calibration type: *DarkFrame*

	xmm	xrt	om	emos	epn	rgs
AbsCoef	+			+		+
ADUConv				+	+	+
AstroMet			+			
Background				+	+	+
BadPix			+	+	+	+
BoreSight	+					
CCDrmf						+
CTI				+	+	+
CalIndex	+					
CalSourceData			+	+	+	+
ClockPatterns						+
ColorTrans			+			
Contam				+	+	+
CrossPSF						+
DarkCurrent				+	+	+
DarkFrame			+	+	+	+
DiffuseGala			+			
EventSizeDist				+	+	+
EXAFS				+	+	+
FilterTransV				+	+	+
FilterTransX				+	+	
HKParmInt	+		+	+	+	+
LightLeak			+			
LinCoord			+	+	+	+
LineSpreadFunc						+
LargeScaleSens			+			
MiscData	+					
ModeParam			+	+	+	+
PatternLib				+		+
PhotToNat			+			
PhotVsLam			+			
PixToLam			+			
PixToPixSens			+			
PSF1DRB			+			
PSFPileUp				+	+	+
QuantumEf				+	+	+
QuickMag			+			
Redist				+	+	+
RedistPileUp				+	+	+
StrayLight			+			
TimeCorr			+	+	+	
VAreaEf		+				
VPSF		+				
VSLAreaEf		+				
VSLDist		+				
XAreaEf		+				
XEncirEn		+				
XPSF		+				
XSLAreaEf		+				
XSLDist		+				
Wavelength scale						+
Zodiacal			+			

Table 28: *Allowed calibration data types by scope*

Description: Contains the dark current map. It comprises one image extension holding a map at full resolution.

Calibration type: *DiffuseGala*
Description: Contains information (image and spectrum) on diffuse galactic emissions.

Calibration type: *HKParmInt*
Description: House keeping parameter ranges used to generate good time intervals.

Calibration type: *LightLeak*
Description: Currently not used.

Calibration type: *LinCoord*
Description: Data required to transform from pixel to physical coordinates on the CCD

Calibration type: *LargeScaleSens*
Description: Contains the non-uniformity correction maps describing the large-scale sensitivity variations of the combination filter plus detector

Calibration type: *ModeParam*
Description: Currently not used.

Calibration type: *PhotToNat*
Description: Contains the conversion curve coefficients to correct the count rates for detector effects

Calibration type: *PhotVsLam*
Description: Grism conversion from counts per pixel to photon rates.

Calibration type: *PixToLam*
Description: Contains the conversion from off-set pixel to wavelength for the two grisms at the centre of the field of view.

Calibration type: *PixToPixSens*
Description: Contains map describing the non-uniformity of the detector flatfield response.

Calibration type: *PSF1DRB*
Description: Describes the radial point spread function for each filter at 10 different ratios of count-rate/framerate.

Calibration type: *QuickMag*
Description: Lookup table for a rough count to magnitude conversion for different spectral types.

Calibration type: *StrayLight*
Description: Currently not used.

Calibration type: *TimeCorr*
Description: Currently not used.

Calibration type: *Zodiacal*
Description: Contains the intensity map and average spectrum of the zodiacal light.

5.3.3 Scope: xrt

There will be three instances of each of these files, one for each optical unit.

Calibration type: *VAreaEf*
Description: Optical collecting area of a single module mirror as a function of field angle and wavelength

Calibration type: *VPSF*
Description: Optical point spread function of a single module mirror as a function of field angle and wavelength

Calibration type: *VSLAreaEf*
Description: Optical collecting area within EPIC detector associated with a source located outside the EPIC field of view as a function of wavelength and off-axis position

Calibration type: *VSLDist*
Description: Optical surface brightness distribution associated with a source located outside the EPIC field of view as a function of wavelength and off-axis position

Calibration type: *XAreaEf*
Description: X-ray effective area of a single mirror modules versus energy, field angle and azimuth.

Calibration type: *XEncircEn*
Description: X-ray encircled energy function of a single mirror modules versus energy, field angle and azimuth.

Calibration type: *XPSF*
Description: X-ray point spread function of a single mirror module vs energy, field angle and field azimuth.
Description: X-ray effective area over the EPIC detector, associated with a monochromatic point source located outside of the EPIC field of view as a function of the point source position and wavelength.

Calibration type: *XSLDist*
Description: X-ray surface brightness distribution over the EPIC detector, associated with a monochromatic point source located outside of the EPIC field of view as a function of the point source position and wavelength.

5.3.4 Scope: emos

There will be two instances of each of these files, one for each MOS camera.

Calibration type: *ADUConv*
Description: Conversion factors of the digitalized signal to pulse invariant, and further to observed energy units (keV), not accounting for charge transfer efficiency, GATTI and redistribution.

Calibration type: *Background*
Description: calibrated event list of low background data.

Calibration type: *BadPix*
Description: Table of dead/hot/flickering pixel.

Calibration type: *CalSourceData*
Description: Spectrum and intensity maps of the on-board calibration sources (not yet available).

Calibration type: *Contam*
Description: Set of coefficients used to model the effect of contaminants.

Calibration type: *CTI*
Description: Average charge transfer inefficiency values for the relevant clock shifts, needed to calculate the charge loss as a function of event coordinates and observing mode.

Calibration type: *DarkCurrent*
Description: Parameterized dark current.

Calibration type: *DarkFrame*
Description: Average dark image and raw/column offset vectors.

Calibration type: *Efficiency*
Description: EPIC MOS to RGS effective area ratio.

Calibration type: *EventSizeDist*
Description: Reference event pattern distribution as a function of energy.

Calibration type: *EXAFS*
Description: CCD and filter EXAFS.

Calibration type: *FilterTransV*
Description: Optical transmission curves.

Calibration type: *FilterTransX*
Description: Filter (X-ray) transmission curves. Includes coefficients to characterize spatial distribution as a function of stepper motor position.

Calibration type: *HKParmInt*
Description: Housekeeping parameter ranges used to generate good time intervals.

Calibration type: *LinCoord*
Description: Contains the transformation matrix to convert CCD pixel coordinates into angular and linear offsets from the boresight.

Calibration type: *ModeParam*
Description: Provides the most important fixed parameters for the observation modes.

Calibration type: *PatternLib*
Description: EPIC MOS pattern library.

Calibration type: *QuantumEf*
Description: Spatially varying CCD quantum efficiency.

Calibration type: *Redist*
Description: Analytical model for the CCD energy redistribution.

Calibration type: *RedistPileUp*
Description: Coefficient to calculate the effect of pileup on the redistribution matrix as a function of countrate.

Calibration type: *TimeCorr*
Description: Time offset correction to convert spacecraft time stamps to mean photon absorption time.

5.3.5 Scope: epn

There will be one instance of each of these files.

Calibration type: *ADUConv*
Description: Conversion factors from digital signal to pulse invariant and observed photon energy (keV).

Calibration type: *Background*
Description: Spectrum and scalar modifiers for correlation with the EPIC radiation monitor.

Calibration type: *BadPix*
Description: Table of dead/hot/flickering pixels.

Calibration type: *CTI*
Description: Average Charge Transfer Inefficiency.

Calibration type: *CalSourceData*
Description: Spectrum and intensity maps of the onboard calibration sources.

Calibration type: *Contam*
Description: Set of coefficients to model the effect of contaminants.

Calibration type: *DarkCurrent*
Description: Dark current.

Calibration type: *DarkFrame*
Description: Average dark frame.

Calibration type: *Efficiency*
Description: EPIC p-n to RGS effective area ratio.

Calibration type: *EventSizeDist*
Description: Reference event pattern distribution function as a function of energy.

Calibration type: *EXAFS*
Description: CCD and filter EXAFS.

Calibration type: *FilterTransV*
Description: Filter (optical) transmission curves.

Calibration type: *FilterTransX*
Description: Filter (X-ray) transmission curves.

Calibration type: *HKParmInt*
Description: House keeping parameter ranges used to generate good time intervals.

Calibration type: *LinCoord*
Description: Contains the transformation matrix to convert CCD pixel coordinates into angular and linear offsets from the boresight.

Calibration type: *ModeParam*
Description: Observation mode fixed parameters.

Calibration type: *PSFPileUp*
Description: Coefficient to calculate the effect of pileup on the point spread function as a function of countrate.

Calibration type: *QuantumEf*
Description: Spatially varying CCD quantum efficiency.

Calibration type: *Redist*
Description: Analytical model for the CCD energy redistribution.

Calibration type: *RedistPileUp*

Description: Coefficient to calculate the effect of pileup on the redistribution matrix as a function of countrate.

Calibration type: *TimeCorr*
Description: Frame time per CCD per mode.

5.3.6 Scope: rgs

There will be two instances of each of these files, one for each RGS camera.

Calibration type: *ADUConv*
Description: Coefficients tables and model to convert PHA to energy.

Calibration type: *Background*
Description: Background model and spectra (left empty for the time being).

Calibration type: *BadPix*
Description: Table of bad (hot/dead/flickering/pin hole) CCD pixels.

Calibration type: *CalSourceData*
Description: Data relative to the on board calibration sources: energies, reference pulse heights intensity maps, CCD images

Calibration type: *CCDrmf*
Description: Large version of CCD energy redistribution (not used for the time being).

Calibration type: *ClockPatterns*
Description: CCD read out clock patterns

Calibration type: *Contam*
Description: Description of the loss of quantum efficiency due to contaminants on a CCD basis.

Calibration type: *CrossPSF*
Description: Parameterized point spread function in the cross dispersion direction.

Calibration type: *CTI*
Description: Coefficients to correct for the CCD charge transfer inefficiency.

Calibration type: *DarkCurrent*
Description: Dark current map (left empty for the time being).

Calibration type: *DarkFrame*
Description: CCD Dark frame images on a per node basis.

Calibration type: *EventSizeDist*

Description: Relative probability of event sizes per CCD and per mode

Calibration type: *EXAFS*
Description: Table of relative correction factors for the CCD quantum efficiency.

Calibration type: *FilterTransV*
Description: Optical properties of the CCD filters (left empty for the time being).

Calibration type: *HKParmInt*
Description: Housekeeping parameter ranges used to generate good time intervals.

Calibration type: *LinCoord*
Description: Data required to transform from pixel to physical coordinates on the CCD.

Calibration type: *LineSpreadFunc*
Description: Parameterized line spread function.

Calibration type: *MiscData*
Description: Miscellaneous coefficients

Calibration type: *ModeParam*
Description: Summary of observation mode parameters.

Calibration type: *PatternLib*
Description: RGS pattern library.

Calibration type: *PSFPileUp*
Description: The coefficients needed to calculate the effect of pile-up on the apparent point spread function as a function of countrate (left empty for the time being).

Calibration type: *QuantumEf*
Description: CCD quantum efficiency and grating plates reflection efficiency, RGA intercept and obscuration factors.

Calibration type: *Redist*
Description: Parameters for the CCD redistribution function.

Calibration type: *RedistPileUp*
Description: The coefficients needed to calculate the effect of pile-up on the effective RMF as a function of countrate (left empty for the time being).

Calibration type: *WavelenghtScale*
Description: Coefficients needed to calculate the wavelength scale (currently not used)

6 Calibrated event lists

The XMM Science Analysis System (SAS) for the X-ray instruments can be broadly described as a two-stage process (each of these stages eventually sub-divided in further sub-processes). The first one (called "**reduction**" hereinafter) produces **calibrated concatenated event lists** from the uncalibrated chip-based event lists that are included in the ODF/SDF. To perform this task, the SAS makes use of the information contained in the auxiliary and housekeeping files, as well as the calibration algorithm/files, which constitute the CCF. In this context, *calibrated* means that the raw quantities, which characterize the detection of each photon by the X-ray detectors are converted in physical quantities (or quantities which can be unambiguously mapped into physical quantities); *concatenated* means that a *single* event file is produced, containing photons detected by different chips of the same detector from different exposures, provided that the experimental configurations are mutually consistent. Event lists corresponding to different detectors (*e.g.*: MOS1 and MOS2) are *not* concatenated. The second stage is the extraction of scientific products (images, light curves, spectra, sub-event lists selected according to different scientific and/or instrumental criteria) from the calibrated concatenated event lists.

Given the above structure, the calibrated concatenated event lists (simply "event lists" hereinafter) play a fundamental rôle in the scientific analysis of XMM data, in analogy to most of the recent X-ray missions (ROSAT, ASCA, BeppoSAX). The event lists are the basic "bricks", on which the user will build up the analysis and interpretation of her/his XMM data.

This Section will deal with a short description of the structure of the event files, which are produced by the SAS reduction tasks (aka `*proc` meta-tasks) for EPIC and RGS scientific modes. "Diagnostic" or "engineering" modes produce normally direct images and cannot therefore be encompassed in the above scheme. Calibrated and concatenated event list are delivered also as PPS products. The detailed format of such event lists slightly differ from that of the files produced by the `*proc` meta-tasks. The reader is referred to [11] for a detailed description of the PPS-generated calibrated concatenated event lists.

6.1 Event list structure in the MOS Imaging Mode

The MOS Imaging Mode event lists are constituted by 16 extensions:

- 1 `PRIMARY` extension, which contains no data
- 1 `EVENT` extension, which contains all the events which survived the non-destructive filters of the reduction procedures/algorithms.
- 7 `EXPOSU0n` extensions (one for each chip; n = 1,2,...,7), which contain the exposure fractions (0–1) for each chip as a function of time.
- 7 `BADPIX0n` extensions (one for each chip; n = 1,2,...,7), which contain a map of the bad pixels, with some associated properties.
- 1 `CALINDEX` extension, which contains the CIF employed to reduce the data

- 7 STDGTIn extensions, which contains the Good Time Intervals (GTIs) applied to produce the event list

A short description of the columns in each of the above extensions is given in Tab. 29.

6.2 Event list structure in the MOS Timing Mode

The MOS Timing Mode event lists have the same general structure as the Imagine Mode ones. The main difference is in the nature of the EVENT extension, where a few column are missing (basically due to the lack of 2-D information which characterizes this mode): RAWY, X, Y. Moreover, DETX and DETY are the center of the CCD for computing camera coordinates. The reminders are briefly described in Tab. 29.

6.3 Event list structure in the p-n Imaging Mode

The structure of the p-n Imaging Mode event lists is very similar to that of the corresponding MOS files (see Sect. 6.1 and Tab. 29). The main differences are outlined as follows:

- the number of EXPOSUxy and BADPIXxy extensions is 12 (equal to the number of p-n chips)
- the units for the quantity PI in the EVENTS extension are eV
- the columns PAT_ID and PAT_SEQ are present in the EVENTS extension

A short description of the column in each of the above extension is given in Tab. 30.

6.4 Event list structure in the p-n Timing Mode

The structure of the p-n Timing Mode event lists reflects that of the corresponding MOS files, except the different number of CCD chips (cf Sect. 6.2). The coordinate DETX and DETY correspond to the source position on the CCD.

6.5 Event list structure in the RGS Spectroscopy Mode

The event list for the RGS Spectroscopy Mode is constituted by 2 extensions:

- 1 PRIMARY extension, which contains no data
- 1 EVENTS extension, which contains all the events, which survived the non-destructive filters of the reduction procedures/algorithms

A short description of the column in the EVENTS extension is given in Tab. 31.

Name	Units	Description
BINTABLE EVENT		
TIME	SECONDS	
RAWX	PIXELS	Event X-coordinate as measured by the detector
RAWY	PIXELS	Event Y-coordinate as measured by the detector
DETX	0.05 ARCSECONDS	Linearized X detector coordinate
DETY	0.05 ARCSECONDS	Linearized Y detector coordinate
X	0.05 ARCSECONDS	Sky X detector coordinate
Y	0.05 ARCSECONDS	Sky Y detector coordinate
PHA	CHANNELS	Pulse-Height-Analyzer (uncalibrated spectral channel)
PI	CHANNELS	Pulse-Invariant (calibrated spectral channels)
FLAG		
PATTERN		Event pattern (analogous to the ASCA "grades")
CCDNR		CCD identifier (1–7)
BINTABLE EXPOSU0n		
TIME	SECONDS	Frame central time
TIMEDEL	SECONDS	Frame integration time
FRACEXP	FRACTION	Effective time fraction
BINTABLE BADPIX0n		
RAWX		Bad pixel X-coordinate
RAWY		Bad pixel X-coordinate
TYPE		
YEXTENT		
BADFLAG		
BINTABLE CALINDEX		
TELESCOPE		XMM
SCOPE		EMOS[12], EPN, RGS[12], OM, XRT[12], XMM
TYPEID		CCF constituent type
ISSUE		Issue number
VALDATE		Start of validity date
FNAME		File name
DATE		Production date
FSIZE		File size (bytes)
SUBDATE		Submission date
EXTSEQU		Extension sequence
EXTSEQID		Extension sequence identifiers
MD5		MD5 signature of the constituents
CREATOR		CCF constituent creator
BINTABLE STDGTIn		
START		GTI start time
STOP		GTI stop time

Table 29: *MOS Imaging Mode event list column*

6.6 Event list structure in the RGS High Resolution Timing Mode

The structure of the RGS HTR Mode event lists is analogous to the Spectroscopy Mode ones. However, only the following columns are contained in the EVENTS extension: TIME,

Name	Units	Description
BINTABLE EVENT		
TIME	SECONDS	
RAWX	PIXELS	Event X-coordinate as measured by the detector
RAWY	PIXELS	Event Y-coordinate as measured by the detector
DETX	0.05 ARCSECONDS	Physical camera X detector coordinate
DETY	0.05 ARCSECONDS	Physical camera Y detector coordinate
X	0.05 ARCSECONDS	Sky X detector coordinate
Y	0.05 ARCSECONDS	Sky Y detector coordinate
PHA	CHANNELS	Pulse-Height-Analyzer (uncalibrated spectral channel)
PI	CHANNELS	Pulse-Invariant (calibrated spectral channels)
FLAG		
PAT_ID		
PAT_SEQ	PIXELS	Distance from neighboring event in the same frame and column
PATTERN		Event pattern (analogous to the ASCA "grades")
CCDNR		CCD identifier (1–12)
BINTABLE EXPOSU0n		
TIME	SECONDS	Frame central time
FRACEXP	FRACTION	Fraction of effective time
BINTABLE BADPIX0n		
RAWX		Bad pixel X-coordinate
RAWY		Bad pixel X-coordinate
TYPE		
YEXTENT		
BADFLAG		
BINTABLE CALINDEX		
TELESCOPE		XMM
SCOPE		EMOS[12], EPN, RGS[12], OM, XRT[12], XMM
TYPEID		CCF constituent type
ISSUE		Issue number
VALDATE		Start of validity date
FNAME		File name
DATE		Production date
FSIZE		File size (bytes)
SUBDATE		Submission date
EXTSEQU		Extension sequence
EXTSEQID		Extension sequence identifiers
MD5		MD5 signature of the constituents
CREATOR		CCF constituent creator
BINTABLE STDGTIn		
START		GTI start time
STOP		GTI stop time

Table 30: *p-n Imaging Mode event list column*

CHIPX, BETA, BETA_CORR, BETA_CHANNEL, PHA, PI, FLAG (cf. Sect. 6.5).

Name	Units	Description
TIME		Time stamps of events
CHIPX	PIXEL	Raw column number from telemetry
CHIPY	PIXEL	Raw row number from telemetry
BETA		Not aspect drift corrected β angle
XDSP		Not aspect drift corrected cross-dispersion angle
BETA_CORR	RADIANS	Aspect drift corrected β angle
XDSP_CORR	RADIANS	Aspect drift corrected cross-dispersion angle
BETA_CHANNEL		Channel number of binned BETA_CORR
XDSP_CHANNEL		Channel number of binned XDSP_CORR
PHA		Raw spectral channel
PI		Gain corrected PHA
FLAG		
SHAPE		Number of pixels combined into event on-board
CCD_NR		CCD number
GRADE		Number of pixels combined into event during ground processing

Table 31: *RGS Spectroscopy Mode event list columns*

6.7 Additional scientific files created by `rgsproc`

The SAS reduction pipeline for the RGS data (`rgsproc`) produces - when run with the default values for the input parameters - a number of science files, alongside with the filtered concatenated event lists. This files can be directly used for scientific analysis, and are therefore described in this section:

- SAS internal attitude history file (produced by the SAS task `atthkgen`; file `*_attitude.ds`. It is a FITS file with a single table extension, containing the entire attitude information for the complete observation. Its column are listed in Tab 32. Keywords in the primary header give the mean and median

Name	Units	Description
TIME	SECONDS	Time
AHFRA	DEGREES	AHF RA
AHFDEC	DEGREES	AHF DEC
AHFPA	DEGREES	AHF position angle
OMRA	DEGREES	OM RA
OMDEC	DEGREES	OM DEC
OMPA	DEGREES	OM position angle
DAHFNOM[a]	DEGREES	Difference between AHF and nominal attitude
DOMNOM[a]	DEGREES	Difference between OM and nominal attitude
DAHFNOM[a]	DEGREES	Difference between AHF and OM attitude

[a]Null (INDEF) values are given if the attitude quality is bad

Table 32: *Attitude file columns*

values of the nine tabulated attitude column. They are names as the columns, prefixed by an `A` for "average" and by an `M` for "median"

- list of target sources (created by the SAS task `rgssources` and modified by `rgsregion`; file `*sources.ds`). One file for each exposure is created. This file contains the following extensions:
  - one primary extension
  - one `SOURCES` extension, containing a few properties of the sources, from which a source spectrum is extracted. The columns of this extension are described in Tab. 33

Name	Units	Description
INDEX		Source index number (1,...,n)
LABEL		Source label
RA	DEGREES	
DEC	DEGREES	
RATE		Source count rate
DELTA_DISP	ARCMIN	Source position in the dispersion direction
DELTA_XDSP	ARCMIN	Source position in the cross-dispersion direction
FOV_PHI		ϕ polar coordinate of the source in the FOV
FOV_R		r polar coordinate of the source in the FOV
CONFUSION		Measure of the confusion with respect to the primary source
PROCESS		Source for which spectrum extraction region is calculated
BKG_EXCLUDE		Source to be excluded from the background spectrum extraction region
FIXED_ON_SKY		Flag for sources with fixed attitude
EPIC_FILE		Identifier of the corresponding source in the EPIC source list

Table 33: *Columns of the* `SOURCES` *extension in the RGS source file*

  - one *RGSi_BACKGROU* (i=1,2) extension. It describes the shape the energy versus dispersion angle plane region, from which the background spectrum is extracted
  - n *RGSi_SRCj_SPATIAL* (j =1,...,n) extensions, where n is the number of RGS sources. They describe the shape of the dispersion versus cross-dispersion angles plane region, corresponding to the jth source
  - n *RGSi_SRCj_ORDER1* extensions. They describe the shape of the energy versus dispersion angle plane regions, from which the 1st order source spectrum is extracted
  - n *RGSi_SRCj_ORDER2* extensions. They describe the shape of the energy versus dispersion angle plane regions, from which the 2nd order source spectrum is extracted

- combined exposure map (created by the SAS task `rgsexpcomb`; file `*_expmap.ds`). The file contains the map in the primary array

- Background spectrum for the primary source (created by the SAS task `rgsspectrum`; files `*_bkg${j}o${k}.pha`; k = 1,2). One file is created for each order and each exposure. It is a standard OGIP-compliant spectral file

- Background-subtracted source spectrum (created by the SAS task `rgsspectrum`; files `*_net${j}o${k}.pha`). One file for each source, exposure and order is created. It is a standard OGIP-compliant spectral file

7 Pipeline data products: PPS

A complete description of the PPS products is given in [11]. Their naming convention is reported in Sect. 8.2.3 of the current document. PPS products are currently not generated for exposures, where "non-scientific" modes or filters are employed. They include, *e.g.*, `CAL_CLOSED` and `CLOSED` filters for the EPIC cameras, `BLOCKED` filter and `GO-OFF` mode for the OM. The latter is often substituted during scheduling with a convenient series of engineering exposures for internal calibration purposes.

For easiness of reference, PPS products files are listed in Tab. 34, together with the SSC XID products.

Table 34: *Pipeline product files*

Product	Format	Nr.[a]	Notes
Observation summary product			
Observation summary	HTML	1	
Attitude time series	FITS	1	
OM products			
Science window image	FITS	SE	
Science window sky image	FITS	SE	Rotated and rebinned to North-aligned sky coordinates
Flatfield	FITS	1	
Science window source timeseries	FITS	SWE	Only for `FAST` mode
Science window source timeseries plot	PDF	SWE	Created from the above
Tracking star timeseries	FITS	1	
Tracking star timeseries plot	PDF	1	Created from the above
Science window source list	FITS	WE	
Observation source list	FITS	1	Merging of the above
Tracking history plot	PDF	1	Vector diagram of the spacecraft jitter
Housekeeping summary	PDF	1	
Summary page	HTML	1	
EPIC products			
Raw image	FITS	C	
Annotated raw image	PNG	C	Created from the above, with sky grid, camera, energy band and observation identifiers
Observation image	FITS	1	Exposure-corrected. Data from all cameras operating in `IMAGING` mode
Observation image plot	PNG	1	Created from the above
Exposure map	FITS	CB	
Camera sensitivity map[b]	FITS	C	Map of minimum detectable source flux, in the 0.5–4.5 keV energy band
Sensitivity map	FITS	1	The same as above at the observation level.
Three-colour image	FITS	1	Photon color-code in the 0.1–0.5, 0.5–2.0 and 2.0–10.0 keV energy bands
Variability image	PNG	E	Pixel brightness proportional to the

			variability statistics
Source time-series	FITS	SB	1 per unconfused, bright (>100 counts) source, in the 0.1–2.0, 2.0-10.0, and 0.1–10.0 keV bands
Source time-series plot	PDF	SB	Created from above
Source FFT plot	PDF	SB	Created from each source lightcurve
Global background time-series	FITS	EB	FOV time series, after masking the detected point sources
Source spectrum	FITS	SC	1 per unconfused, bright source
Source background spectrum	FITS	SC	1 for each of the above
Source spectrum plot	PDF	SC	Background-subtracted and exposure-corrected
Global background spectrum	FITS	E	FOV spectrum, after masking the detected point sources
Fluctuation spectrum	FITS	E	FOV fluctuation spectrum, after masking the detected point sources
Exposure box-local source list	FITS	E	Sources detected by running `eboxdetect` ("local" mode) on the individual exposures
Camera box-local source list	FITS	C	Sources detected by running `eboxdetect` ("local" mode) on a camera observation
Observation box-local source list	FITS	1	Sources detected by running `eboxdetect` ("local" mode) on the whole EPIC observation
Exposure box-map source list	FITS	E	Sources detected by running `eboxdetect` ("map" mode) on the individual exposures
Camera box-map source list	FITS	C	Sources detected by running `eboxdetect` ("map" mode) on a camera observation
Observation box-map source list	FITS	1	Sources detected by running `eboxdetect` ("map" mode) on the whole EPIC observation
Exposure ML source list	FITS	E	Sources detected by running `emldetect` on the individual exposures
Camera ML source list	FITS	C	Sources detected by running `emldetect` on a camera observation
Observation ML source list	FITS	1	Sources detected by running `emldetect` on the whole EPIC observation
Summary source list	FITS	1	
Summary source list	HTML	1	
Wavelet map	FITS	1	Wavelet coefficient map to characterize large extended X-ray sources
Wavelet source list	FITS	1	Source parameters detected by the wavelet algorithm
Observation source list	HTML	1	
Intensity histogram	PDF	1	Distribution of image detect cell count rates
MOS `IMAGING` mode event list[b]	FITS	E	
p-n `IMAGING` mode event list[b]	FITS	E	
`TIMING` mode event list[c]	FITS	E	

Housekeeping summary	PDF	1	
Summary page	HTML	1	
RGS products			
Image	FITS	E	Aspect-corrected dispersion versus cross-dispersion angles
Image plot	PNG	E	Created from the above
Energy-dispersion image	FITS	E	Aspect-corrected PI versus dispersion angles
Energy-dispersion image plot	FITS	E	Created from the above
Exposure map	FITS	E	In dispersion versus cross-dispersion coordinates
Source spectrum	FITS	S[d]	Background-subtracted. For the brightest point source. 1st and 2nd dispersion order
Background spectrum	FITS	S[d]	1 for each of the above spectrum
Spectrum plot	PDF	S	Background subtracted, with wavelengths and energy scales
Event list	FITS	E	
Source list	FITS	E	EPIC-detected bright sources in the RGS FOV
Housekeeping summary	PDF	C	
Summary page	HTML	1	
Catalog and archive products[e]			
Main CC page	HTML	1	
Searched catalogues	HTML	1	
Catalogue description	HTML	1	
Source raw position cross-correlation results	FITS	1	
Source cross-correlation summary	FITS	1	
Source cross-correlation results	HTML	1	
Source cross-correlation results	FITS	1	
Find chart	PDF	1	
FOV summary	HTML	1	All SIMBAD and X-ray catalogued objects in the FOV
FOV summary	FITS	1	The same as above
FOV cross-correlation results	HTML	T	
FOV cross-correlation results	FITS	T	The same as above
Catalogue plot	PDF	1	
XMM-Newton/ROSAT image	PDF	1	EPIC source position and flux contours overlaid to a ROSAT image
PPS run products			
Script log	ASCII	1	
Run message	ASCII	1	
Run summary	HTML	1	
Index	HTML	G	

Product index	FITS	1	
Calibration index file	FITS	1	Index file for the CCF
SSC logo 1	PNG	1	Image of the XMM-Newton telescope front end
SSC logo 2	PNG	1	Graphic with the words "XMM-Newton SSC"
CDS logo 1	PNG	1	Graphic with the words "NED"
CDS logo 2	PNG	1	Graphic with the words "Vizier"
CDS logo 3	PNG	1	Graphic with the words "Simbad"
XMM-Newton logo 1	PNG	1	
ESA logo 1	PNG	1	
XID products			
Observation summary	HTML	1	
Reduced image	FITS		Flatfielded, bias- and dark frame-corrected, filtered image
Reduced image plot	PNG		North-aligned image of the field containing the target, with EPIC flux contours and source boxes overlaid
Fluxed spectrum	FITS		
Fluxed spectrum plot	PDF		Created from the above
Finding chart	PNG	S	
Magnitude table	FITS		
Magnitude table	HTML		Created from the above
Index	HTML	G	

[a]If an integer, number of product files per observation. Otherwise: "S" = 1 file per source; "W" = 1 file per OM science window; "E" = 1 file per exposure; "C" = 1 file per camera; "B" = 1 file per energy band; "T" = 1 file per catalogue; "G" = 1 file per product group

[b]for `IMAGING` mode exposures only

[c]for `TIMING` mode exposures only

[d]2 files per brightest source in the RGS FOV

[e]files in this group refer to the EPIC, if not otherwise specified

8 The standard XMM CD-ROM set

Standard CD-ROMs of 650 Mbyte are used as the media to distribute the data. This means that it may be necessary to distribute a particular data across several CR-ROMs in order to have sufficient storage capacity.

There are two mechanisms which can trigger the production of CD-ROMs:

1. Once the pipeline products for a particular observation have been received and the observation processing marked as complete, a set of CDs is produced for the PI containing the ODF, and Pipeline Products.
2. Public data requested by means of the AMS browser result the production of CD(s) containing the requested data

8.1 CD-ROM contents

The CD-ROM shipped to the PI of an XMM observation contains all the files described in Sect. 4 and 7 of this document, organized in specific, separated directories. Moreover, top-level files in the CR-ROM describe its actual content.

8.1.1 top-level CD-ROM files

- disk-set contents file: it is an ASCII file that contains a list of the contents of the complete disk set.
- disk contents file: an ASCII file that contains a list of the contents of a particular disk
- VOLDESC file: it allows the contents of a particular disk to be viewed as a single, logical Standard Formatted Data Unit (SFDU). It uses the SFDU referencing technique to logically include all the other files on the disk. In other words, this file describes the whole volume of data. For further description on the structure and contents of this file (cf. [19])

8.1.2 File types and CD-ROM directories

Each file type (i.e. observation or slew data files, and pipeline products), with the three exceptions listed above (see 8.1.1), has a dedicated directory, in which all files of the same type are written. There is no further directory nesting. The files are then placed into the directories in alphabetical order.

The different file types are listed in Table 35, where the sections of this document are reported, where the files are described. The names allocated to the directories holding each of the file types are listed in section 8.2.

8.2 Naming conventions

In order to find out which file of a given name on a CD ROM contains what kind of information, the user must know which naming convention is used. This is outlined in

Data item type	Described in §(this handbook)
Observation and slew data files	4
Pipeline products	7

Table 35: *File types*

the following.

8.2.1 CD-ROM set file-names and labels

The naming conventions applicable to the labels, directories and file names in the top level directory of the CD-ROM set are described in the following paragraphs. The file naming convention applicable to a particular file type is described in the corresponding section of this chapter (e.g. Sect. 8.2.3 for the pipeline product files). The file naming convention used for all data stored on CD is exactly the same as used to archive the data in the XSCS archive.

- physical disk label

  each CD-ROM is physically labeled. The label is seven lines long and written directly onto the CD-ROM.

  the first two lines are:

  `XMM, yyyy_mm_dd, disk ll of nn`

  `Media Group ID: tttttttttt Obs.Id:  PPPPPPOOLL`

  The meaning of each item here and below is explained in Table 37. In the following lines there is the name of the requester (3rd line) and the address (from line 4 to 7). This information is extracted from that specified when the requester registered (either the proposal submission system or the archive management subsystem). Lines are truncated to 40 characters.

- volume label

  `XMM_yyyymmdd_tttttttttt_ll_nn_VL`

- top-level files:

  - disk-set contents file:
    `X_yyyymmdd_tttttttttt___nn.SET`
  - disk contents file
    `X_yyyymmdd_tttttttttt_ll_nn.DSK`
  - VOLDESC file: named
    `voldesc.sfd`

- directories

The description of the filename fields above is given in Tab. 37)

Data item type	Directory name
Observation and slew data files	ODF
Pipeline products	PIPEPROD

Table 36: *CD-ROM directory names*

Field		Description
XMM		used to designate XMM
yyyymmdd		the date on which the CD-ROM was produced
	yyyy	year
	mm	month
	dd	day of the month
tttttttttt		the XSCS archive transaction ID
PPPPPPOOLL		the observation identifier (cf. Tab. 38)
ll		specifies which number in the total CD-ROM set the current CD is
nn		specifies the total number of CD-ROMs holding the data set
VL		indicates that this is the volume label
DSK		indicates that this file contains a listing of the disk contents
SET		indicates that this file contains a listing of the disk set contents

Table 37: *CD-ROM labels and file-name conventions*

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8.2.2 Observation/Slew data file names

The filenames associated with ODFs and SDFs are up to 27 characters, followed by a '.' (dot), followed by 3 characters. All characters are upper case.

The adopted naming convention is as follows:

RRRR_**obsidentif**_IIUEEECCMMF.ZZZ

The descriptions of the each filename field are listed in Table /refdfhb:tab:namodf

Table 38: *ODF/SDF component filenames*

Field		Description
RRRR		The revolution (orbit) number
obsidentif		The observation identifier, 10 digit: PPPPPPOOLL
	PPPPPP	the identifier of the proposal that contains the obs.
	OOLL	the identifier of the observations within the proposal
	Note:	For slews the first of the ten characters is '9'
II		The instrument, or data source, identifier
	OM	optical monitor

	R1	RGS-1
	R2	RGS-2
	M1	EPIC MOS-1
	M2	EPIC MOS-2
	PN	EPIC pn
	RM	EPIC radiation monitor
	SC	Spacecraft
U		
	S	Indicates that the observation was scheduled
	U	Indicates that the observation was unscheduled
	X	not applicable
EEE		The exposure number within the observation
		'000' means that the file does not correspond to an exposure period
		'9XX' is used for diagnostic Q dumps (RGS spectroscopy+Q)
CC		The CCD identifier/ OM Window identifier (2 digits)
		EPIC MOS CCD number (1-7) & CCD read-out mode (0,1)
		EPIC pn CCD number (01–12)
		RGS CCD number (01–09)
		Note: "00" is used for multi-CCD files
		OM science window identifier
	00	used for those files not having a corresponding CCD or science window
MM		The data contained within the file name
	AT	Spacecraft attitude
	AU	EPIC or RGS auxiliary
	BU	EPIC pn burst
	CC	EPIC counting cycle report (auxiliary file)
	CI	EPIC MOS compressed timing
	DA	Spacecraft dummy attitude
	DI	EPIC or RGS diagnostic
	DL	EPIC pn discarded lines data
	DP	RGS Digital Pre-Processor non periodic housekeeping
	EC	EPIC MOS extraheating configuration non-periodic housekeeping
	EC	EPIC Radiation Monitor (ERC) count rate
	En	OM engineering where n=1-7
	ES	EPIC Radiation Monitor (ERC) spectra
	FA	OM fast
	HB	EPIC high bit rate interface buffer size non-periodic housekeeping
	HC	EPIC high bit rate interface configuration non-periodic housekeeping
	HT	EPIC MOS high bit rate interface threshold values non-periodic housekeeping

	HT	RGS high time resolution
	IM	EPIC or OM imaging
	NO	EPIC pn noise data
	NP	OM non-periodic housekeeping
	OD	EPIC pn offset data
	OV	EPIC MOS offset / variance
	P1	Spacecraft housekeeping 1 periodic housekeeping
	P2	Spacecraft housekeeping 2 periodic housekeeping
	P3	Spacecraft Attitude 1 periodic housekeeping
	P4	Spacecraft Attitude 2 periodic housekeeping
	P5	Spacecraft SYS_HK_SID0 periodic housekeeping
	P6	Spacecraft SYS_HK_SID1 periodic housekeeping
	P7	Spacecraft SYS_HK_SID4 periodic housekeeping
	P8	Spacecraft SYS_HK_SID5 periodic housekeeping
	P9	Spacecraft SYS_HK_SID6 periodic housekeeping
	PA	EPIC pn additional periodic housekeeping
	PA	OM priority field acquisition (auxiliary file)
	PC	RGS CCD temperature periodic housekeeping
	PF	RGS full periodic housekeeping
	PF	OM priority fast (auxiliary file)
	PM	EPIC pn main periodic housekeeping
	PO	Spacecraft predicted orbit
	PT	EPIC MOS bright pixel table non-periodic housekeeping
	PE	EPIC MOS or OM periodic housekeeping
	RF	OM reference frame (auxiliary file)
	RI	EPIC MOS reduced imaging
	RO	Spacecraft reconstructed orbit
	SP	RGS spectroscopy
	SU	Summary information
	TC	Spacecraft time correlation
	TH	OM tracking history (auxiliary file)
	TI	EPIC timing
	TM	EPIC thermal monitoring limits non-periodic housekeeping
	WD	OM priority window data (auxiliary file)
F		The file type
	E	event list file
	I	image file
	X	auxiliary file
	H	housekeeping
	S	spacecraft
	M	summary

zzz		File format (3 characters)
	ASC	ASCII file
	ASZ	Compressed ASCII file
	FIT	FITS file
	FTZ	Compressed FITS file

8.2.3 Pipeline product file names

Pipeline data product filenames are up to 27 characters, followed by a '.' (dot), followed by 3 characters. All characters are upper case. The filenames take the 27.3 character form:

P**obsidentif**IIUEEETTTTTTSXXX.ZZZ

The descriptions of each of the filename fields are listed in Table 39.

Table 39: *Pipeline product filenames*

Field		Description
P		The character P identifies the files as a PPS product file
obsidentif		The observation identifier, 10 digit: PPPPPPOOLL
	PPPPPP	the identifier of the proposal that contains the obs.
	OOLL	the identifier of the observations within the proposal
	Note:	For slews the first of the ten characters is '9'
II		The instrument, or data source, identifier
	OM	optical monitor
	R1	RGS-1
	R2	RGS-2
	RG	Both RGSs combined
	M1	EPIC MOS-1
	M2	EPIC MOS-2
	PN	EPIC pn
	EP	All EPICs combined
	CA	Catalogue cross-correlation
	OB	Observation
EEE		The exposure number within the observation
		'000' means that the file does not correspond to an exposure period
		'9XX' is used for diagnostic Q dumps (RGS spectroscopy+Q)
U		Exposure flag (1 character)
	S	scheduled
	U	unscheduled

X	not applicable
TTTTTT	The product type (6 digits)
3COLIM	EPIC three-color image
ATTTSR	Attitude time series
BGSPEC	EPIC or RGS source background spectrum
CALIND	Calibration index file
CASNMP	EPIC camera sensitivity map
CATPLT	Catalogue plot
CBLSLI	EPIC camera box-local source list
CBMSLI	EPIC camera box-map source list
CDSLG1	CDS logo 1
CDSLG2	CDS logo 2
CDSLG3	CDS logo 3
CMSRLI	EPIC camera ML source list
CRSCOR	PPS HTML index for cross-correlation group
DXXXXA[1,4]	Catalogue descriptions
EANCIL	PPS HTML index for EPIC ancillary group
EBLSLI	EPIC exposure box-local source list
EBMSLI	EPIC exposure box-map source list
EEVLIS	PPS HTML index for EPIC event list group
EMSRLI	EPIC exposure ML source list
ESALG1	ESA logo 1
ESKYIM	PPS HTML index for EPIC sky images group
ESOURC	PPS HTML index for EPIC source-specific group
ESRLIS	PPS HTML index for EPIC source list group
EVENLI	RGS event list
EXPMAP	EPIC exposure map
EXSNMP	EPIC exposure sensitivity map
FCHART	Finding chart
FLAFLD	OM science window flat field
FLSPEC	EPIC fluctuations spectrum
FOVRES	EPIC field of view cross-correlation results (HTML)
FOVSUM	EPIC field of view cross-correlation summary (HTML or FITS)
FYYYYA[2,4]	EPIC field of view cross-correlation results, FITS
GBKTSR	EPIC global background timeseries
GBSPEC	EPIC global background spectrum
IMAGE_	EPIC, RGS or OM image (either in FITS or PNG format)
INTHIS	EPIC intensity histogram
HKPLOT	EPIC, RGS or OM housekeeping summary
MIEVLI	EPIC MOS `IMAGING` mode event list
OBLSLI	EPIC observation box-local source list
OBMSLI	EPIC observation box-map source list

	OBSMLI	EPIC summary source list (either in FITS or HTML format)
	OBSMLI	OM observation source list
	OBSNMP	EPIC sensitivity map
	OIMAGE	EPIC observation image (either in FITS or PNG format)
	OMIMAG	PPS HTML index for OM images group
	OMSLIS	PPS HTML index for OM source list group
	OMSRLI	EPIC observation ML source list
	ORDIMG	RGS energy-dispersion image (either in FITS or PNG format)
	OMSRTS	PPS HTML index for OM timeseries group
	PIEVLI	EPIC p-n `IMAGING` mode event list
	PINDEX	PPS product index
	PPSDAT	PPS HTML index for PPS data group
	PPSGRA	PPS HTML index for PPS graphics group
	PPSMSG	Pipeline products run message
	PPSSUM	Pipeline products run summary
	REVLIS	PPS HTML index for RGS event lists group
	REXPIM	PPS HTML index for RGS exposure images group
	RIMAGE	PPS HTML index for RGS images group
	RSPECT	PPS HTML index for RGS spectrum group
	ROSIMG	XMM-rosat image
	RzzzzA[3,4]	FITS EPIC source raw position cross-correlation results
	SCRLOG	Pipeline products script log
	SFFTPL	EPIC source FFT plot
	SIMAGE	OM OSW FITS sky image
	SPCPLT	EPIC source spectrum plot
	SRCHD_	Searched catalogues
	SRCLI_	RGS source list
	SRCLOG	PPS script log
	SRCRES	EPIC source cross-correlation results (HTML)
	SRCSUM	EPIC source cross-correlation summary (either FITS or HTML)
	SRSPEC	EPIC or RGS source spectrum
	SRCTSR	EPIC source time series
	SSCLG1	SSC logo 1
	SSCLG2	SSC logo 2
	SxxxxA[1,4]	EPIC source cross-correlation results (FITS)
	STSPLT	EPIC source time series plot
	SUMMAR	EPIC, RGS, OM or Observation HTML summary page
	SWSRLI	OM science window source list
	TIEVLI	EPIC timing mode event list
	TIMESR	OM science window source time series (either FITS or PDF)
	TSHPLT	OM tracking history plot
	TSTRTS	OM tracking star timeseries (either FITS or PDF)
	VARIAB	EPIC variability image

	WVSMAP	EPIC wavelet map
	WVSRLI	EPIC wavelet source list
	XCORRE	Main cross-correlation page
	XMMLG1	XMM logo 1
s		Data subset number (1 character, differentiates energy bands, OM science windows, etc.)
		Taken from the OM science window id for OM products at the OM science window level
		Taken from the OM science window id for OM products at the individual source level
		Taken from the EPIC band for EPIC products at the observations, exposures and individual source level
		Taken from the RGS order for RGS products at the individual source level
xxx		Source number (3 characters, hexadecimal)
zzz		File format (3 characters)
	ASC	ASCII file
	ASZ	Gzipped ASCII file
	FTZ	Gzipped FITS file
	HTM	HTML file
	IND	Index HTML file
	PDF	PDF file
	PNG	Portable Network Graphics file
	TAR	`tar`file

[1]xxxx will take different values according to the names of the (∼100) catalogues searched

[2]YYYY will take different values according to the names of the (∼15) catalogues searched

[3]zzzz will take different values according to the names of the (∼2) catalogues searched

[4]A will take value `T`, if the results are drawn from a table, and `A`, `B`, `C` etc. to represent real catalogue numbers

8.2.4 XID product file names

XID product file names take the following form:

X_TTTTTTT_NNNNNNNNNNNN_V.FFF

The meaning of the string above is explained in Table 40.

String	Description
X	The character `X` identifies the files as XID products
TTTTTTT	Product type
NNNNNNNNNNNNN	Sequence number
V	File version
FFF	File format (*e.g.*: `FTZ`)

Table 40: *Description of the constituent strings of XID product file names*

9 Acronym list

AMS	Archive Management Subsystem
BSM	Basic Spectroscopy Mode
CAL	Calibration Access Layer
CC	Cross-Correlation
CCF	Current Calibration File
CIF	Calibration Index File
CDS	Centre de Donnees Astronomiques de Strasbourg
EPDH	EPIC Data Handling
EPEA	EPIC Event Analyzer
EPIC	European Photon Imaging Camera
ERM	EPIC Radiation Monitor
ESA	European Space Agency
ESOC	European Space Operation Center
FIFO	First-In, First-Out
FITS	Flexible Image Transport System
FOV	Field-of-view
FFT	Fast Fourier Transform
GO	Guest Observer
GS	Guide Star
GT(O)	Guaranteed Time (Observer)
GTI	Good Time Interval
HDU	Header Data Unit
HEASARC	High Energy Astrophysics Science ARchive Research Center
HTML	Hyper-text Mark-up Language
HTRM	High Time Resolution Mode
MCM	Mean Common Mode
MIF	Master Index File
ML	Maximum Likelihood
MOC	Mission Operation Center
No.	Number
OBDH	On-Board Data Handler
OGIP	Office of Guest Investigator Programs
ODF	Observation Data Files
ODS	Observation Data Subsystem
OM	Optical Monitor
OSW	Observation Science Window
PDF	Portable Data Format
PI	Principal Investigator
PNG	Portable Network Graphics
PPS	Processing Pipeline Subsystem
RGS	Reflection Grating Spectrometer
ROSAT	RÖntgenSATellit
SAS	Science Analysis Subsystem
SCS	Science Control System

SDF	Slew Data Files
SFDU	Standard Formatted Data Unit
SIMBAD	Set of Identifications, Measurements, and Bibliography for Astronomical Data
SL	Source list
SOC	Science Operation Center
SSC	Survey Science Center
TS	Time Series
URL	Uniform Resource Locators
UTC	Coordinated Universal Time
VILSPA	VILlafranca del Castillo, SPAin
WWW	World Wide Web
XID	X-ray IDentifier
XMM	X-ray Multi-Mirror Mission, XMM-Newton

10 Glossary of binary table column description

ATHR Counter (p-n): Above Threshold Counter – Number of pixels found by EPEA above the programmed threshold

Coarse frame time (MOS, p-n, RGS, ERM): – End time of a frame integration (expressed in seconds). The granularity may differ from instrument to instrument.

Coarse/Fine readout interrupt latched time (RGS): Time at the start of the readout. *Coarse* is in seconds, whereas *Fine* is equal to an equal division of 1 second in 16 bits (15.258789 μs)

DEFA Counter (p-n): DEFA Read Counter – Number of pixel read by EPEA

Discarded Line Counter (p-n): – Number of discarded pixel lines (frames) when the line (frame) rejection mode is selected

DSP (OM): – Digital Signal Processor

EPHD Counter (p-n): – Number of pixels transmitted by EPEA to EPHD

FIFO overflow flag (MOS): – Flag for a FIFO overflow

Fine frame time (MOS, p-n, RGS, ERM): – End time of a frame integration (expressed in 1/40th of seconds)

Gatti flag (MOS): – Differential non-linearity in the analog-to-digital conversion is minimized with a sliding Gatti scale. The flag is set at the end of each sliding scale cycle

MIC (OM): – Microchannel plate intensified CCD

Number (No.) of events rejected by lower thresholding (MOS): – Number of events whose energy is below the programmed threshold (noise) counted by the EMDH, within a frame or cycle, and therefore not sent to ground

Number (No.) of events rejected by upper thresholding (MOS): – Number of events whose energy is above the programmed threshold (cosmic rays) counted by the EMDH, within a frame or cycle, and therefore not sent to ground

Number (No.) of valid events (MOS): – Number of valid events

Pattern number (MOS): – Pattern type of a recognized event

Peripherical pixel above Threshold Columns (MOS): – Number of pixels, belonging to the peripherical ring of the 5×5 matrix, whose energy is above the EDU threshold

Sequence/CCD-N index (RGS): read-out sequence to be used for the exposure

Split Event Reconstruction (SER) (RGS): see [13]

The exact definition of the count rates in the Low Energy (**L[012C]**) and high energy (**H[012C]**) detectors and the boundaries for the accumulated spectra (**SP_[LH]E[CS]**) of the ERM are given in [5].

11 Acknowledgments

This document is in debt to the contributions of several authors. Contributors include:

Colin R. Haddow – Sect. 1, Sect. 3 and Sect. 8

Christian Erd – Sect. 3 and Sect. 5

Kevin Galloway – Sect. 4

Philippe Gondoin – Sect. 3 and Sect. 5

Uwe Lammers– Sect. 3 and Sect. 5

Mario Merri – Sect. 1, Sect. 3 and Sect. 8

Rudi Much – Sect. 3 and Sect. 5

Julian Osborne – Sect. 7 and 8

Giuseppe Vacanti – Sect. 3 and Sect. 5

Igor Zayer – Sect. 3 and Sect. 5

Moreover, the authors acknowledge inputs and suggestions from M.Dahlem, N.La Palombara, D.Lumb, A.Talavera, and A.Tiengo, and a careful revision of the manuscript by J.Osborne.

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