Elements for a discussion concerning the SAX CDS software components

Prepared by: L.Chiappetti - IFCTR, M.Morini - IFCAI

Draft 1.3 - March 31th, 1988

The SAX Coordination Group approved in its meeting, held in Rome on January 28th, 1988, the document "A Proposal for the Organization of the Activities concerning the SAX Data Analysis, Calibration, Distribution and Archive (the "Centro Dati Scientifici")", prepared by the SAX Data Analysis Working Group and dated December 15th, 1987. The SAX Coordination Group designated L.Chiappetti as coordinator of the activities described in that document, and M.Morini as its deputy. It was also indicated that a team consisting of L.Chiappetti, M.Morini, a representative for each payload experiment, and one for Telespazio, should start an action for defining the SAX CDS software components also pointing out which components are suitable for development within an industrial contract.

This document is intended for discussion within the above group. L.Chiappetti wrote a first version (draft 1.1 and 1.2, dated February 25th and 27th, 1988), which was discussed with M.Morini on February 29th, March 1st, 1988. The present version embodies all the comments by M.Morini. It reflects the (sometimes different) points of view of the authors, which mean to bring them explicitly to the discussion.

1. Context

We will not summarize here what the SAX mission is, or what are the current plans for the SAX ground operations, as we assume that the potential readers of this document (within the SAX Consortium, the PSN or the industrial parties involved in the project) are already familiar with such topics. The following references are made to clearly delimit the scope of the present document.

The idea of a Centro Dati Scientifici (CDS), brought forward within the Consortium since the earlier times, has been outlined in a report by G.C.Perola to the PSN Scientific Council.<date ref TBV?> The **functions and activities** of the CDS, as well as its **needs for manpower** (and a **timeline** for its deployment), are described in detail in the Proposal prepared by the Data Analysis Working Group (DAWG), dated December 15, 1987.

The **hardware components** of the CDS, in terms of requirements, are described in the "Computer System Requirements for SAX Scientific Data Analysis" (SAX/SCS/REQ, Issue 0.0, dated September 8, 1987). This description pertains to a SAX Computer System (SCS), which includes the Local Centres at the Institutes and the CDS proper. The activities for the procurement of the hardware of the Local Centres are in progress within a dedicated Technical Committee nominated by the PSN. **Note** that, for what concerns the software to be developed, the CDS is to be intended as comprehensive of the Local Centres.

The CDS proper is located, in the "logical" data flow, upstream with respect to the Local Centres, and downstream to (hence **different from**) the **Operations Control Centre (OCC)**, which is the terminal component of the **Ground Segment (GS)**.

The activities concerning the Ground Segment are in progress under an industrial contract between PSN and Telespazio. The requirements for the scientific software at the OCC, contained in the "SAX Scientific Data Processing Software User Requirements", Rev. 0.0, dated May 5, 1987, are being incorporated by Telespazio in the "Ground Segment Procurement Specifications", which cover all aspects of the hardware

Document for which no computer readable source exists any longer

Partial scan of original hardcopy of 46 pag. (available on request) supplied

and software for the GS, and will be finalized at the forthcoming Final Design Review. In particular document GSPS-401 concerns the OCC Software Requirements.

There are however, as noted also in the DAWG document, a number of **indeterminations**, mainly in the area of logistics, which affect the current level of definition of the CDS, and namely:

The **physical location** of the CDS (and of the OCC) has not been defined (this is regarded as a minor problem for our concerns here)

The **position of the CDS with respect to PSN** and/or the Consortium (in terms of responsibilities, authority, etc.; for instance the document by Perola refers to a CNR "Centre"). This is a very important point.

The **involvement of industry** (Telespazio or others) in the development and operation of the CDS. This is partially covered in this document.

The **difficulties of staffing**. Even if we assume that an industrial contract will ease the hiring of technical staff, and that a favourable situation arises concerning financial and relocation aspects for scientific staff, we are left with the need of finding some 15 young scientists. This is, in our view, a very serious concern.

The main subject of this document is the **definition of the software component** of the CDS, which in a sense corresponds to the activity indicated as "A0" in the DAWG document. However, pending the solution of the indeterminations listed above, in our view this **cannot fulfil the activities of the CDS Coordinator(s)** but identifies itself as a preliminary activity.

This document will attempt to **outline the design** of the CDS software, in its various **sub-components**, often entering also in **technical details** (intended as "samples" of possible problems). Moreover, **the possible involvement of an industrial party**, in the frame of a "division of work", is considered alongside with the description of the sub-components. This document will address most of the activities in the list (A-J) of the DAWG document, however only from the software development point of view: this is **no Operation Plan**.

The elements here outlined may also be helpful in the further specification of some future hardware choices.

2. Introduction

The SAX software system will be characterized below in detail in terms of programs, data structures and user interfaces. Before passing to some general definitions, it is felt useful to point out some issues of global nature.

It is implied by the current (VAX) hardware choice that the SAX software system will be integrated **under the DEC VMS operating system**. These choices will be given for granted, and the reasons for it will not be discussed or described again. An adoption of a set of "minimum portability constraints" (see below) could however be helpful in view also of future development inside the Consortium (e.g. availability of new hardware and/or operating system, e.g. single user computing facilities). The DEC VMS choice obviously gives a number of **constraints** on items like the overall environment, organization of data on disk, modalities of graphical and pictorial data display, etc., which could be partially relaxed by the "minimum portability constraints".

One further, but preliminary, issue, which is affected by the above choices, is of a more "political" relevance, although with technical implications. This concerns the **policy for distribution of the software to the general community**.

It is in our opinion highly desirable that we take, from the very beginning, a **definite commitment that all the relevant software will be open to public distribution** to any requestor in the astronomical community.

By "relevant" software, we mean all software components of general use and interest (typically the analysis software). Most of the calibration software, for instance, will not fall under this category. It is also implied that **the totality of the software will be available to the institutes of the Consortium**, even if:

Some components will run only at the CDS proper (may be also because the relevant hardware is available only there, e.g. optical disk archive).

The Dutch part of the Consortium has not yet taken a decision in the sense of hardware homogeneization with the Italian part (notwithstanding that, we believe that the software developed on both parts should be reciprocally available).

The kind of commitment towards the general community should however include the usual **"no-warranty implied"** and **"no support"** clause: the software will be distributed freely, but no guarantee whatsoever will be given concerning the accuracy and completeness of it, specially if one considers that the software may need extensive re-fitting at the requestor's site. Some kind of registration (see "distribution list and list server" in 6.10 below) could be foreseen, only in order to make the external users informed of any bug and availability of new versions of the software components. The CDS will not offer any support to the installation of the software, both on VMS and non-VMS systems, nor to the conversion to non-VMS systems or to the support of other devices (the only support given will be the distribution of the relevant Users' and Programmers' documentation). The above comment may need to be expressed, also in legal terms, as a formal disclaimer.

The choice of **minimum portability** will impose some constraint on the way the software is written. By "minimum portability" (opposite to "universal portability") we could e.g. mean that the software, integrated under the VMS operating system, should hopefully run also within an UNIX environment. Although a large part of the astronomical community is now on VAX systems (and therefore could have access to the software with very limited effort), I believe we should not a priori confine to such environment, even if we intend to exploit the full capabilities of it, and not to aim for "universal" portability.

At the level of programming languages, such constraints will be similar, but hopefully less cumbersome, than those prospected at the time a "non-hardware-compatible" (e.g., VAX/VMS, IBM/VM-SP, and HP/RTE) solution was being sought within the SAX Consortium (see "SAX Fortran" by M.Morini, June 1986; "A study about Fortran compatibility" by L.Chiappetti, August 1986; and "Rules and recommendations for Fortran programs" by L.Chiappetti, September 1986). As one may remember, such investigation lead, on one side, to the abandonment of the "non-hardware-compatible" idea and to the SCS, on the other side to the adoption, for short term activities, of a preliminary set of rules (Letter by M.Morini, September 18, 1986). Some useful extensions of Fortran 77 (e.g. DO - END DO, etc.) could be bring back to it through the use of pre-compilers. Problems related to i/o can be solved in the VOS approach (see below).

Concerning portability at the level of operating system and specialized device, minimum portability may be achieved by means of appropriate subroutine library inter-

gorithms and of any programming "funnies", instructions for linking, documentation of changes).

It would be appreciated if any software module would be known, in line of principle, not only to its writer.

7.3 Library organization

It is suggested to adopt the following scheme:

All software modules including main programs, subroutines and functions (with the only exception of the eventual addition in the same main program source file of any subprogram called exclusively by such main), will be kept in individual (Fortran) files.

Use of INCLUDE files is recommended to handle common parts of codes.

All subroutine source files will be homogeneously grouped into subdirectories.

All subroutine modules will be compiled into one or more object libraries.

Linking information shall be kept in command files common to families of programs, or in individual command files for special programs.

Handling of the above collection of programs, libraries, link files and related documentation is not easy. A strict configuration control shall be adopted. Any modification shall be officially recorded, and if possible increment a release/modification number.

The adequacy of the existing DCL commands to handle such libraries and the need of some special tool (acquisition, either DEC supplied, e.g. Code Management System or Module Management System, or otherwise available, or development) to handle such libraries, which could take care of system integrity, automatic module interfacing, updating of documentation, etc., shall be assessed.

A policy concerning normal software distribution (within and outside the Consortium) shall be adopted (source, relocatable or executable format). The source shall always be available on request.

8 Involvement of industry, discussion

8.1 Involvement for "technical" support of CDS

The following activities listed in the DAWG document have not been fully described above, as they are not software development activities: AO related activities (H), Observer assistance (I) and in part Newsletters (J). With reference to the manpower listed in the DAWG document, we note, that with the exception of the 2+4+3 scientist (+8 Duty Scientists), all the remaining personnel could be supplied under an industrial contract.

This will possibly also simplify CNR internal problems (specially in view of personnel relocation).

8.2 Summary for software development

The following is a summary of the software development activities which have been indicated above as "suitable" for development within an industrial contract.

RRD archive management (excluding data layout definition)
Filing software
Accumulation software (excluding data layout definition)
Possibly contributions to data display and reduction
Auxiliary routines
Graphics
Mail interface et sim.
Text processing and documentation

As a final point on the subject, we note that a constant worry is that "one may spend more time explaining somebody else what to do, that doing it himself". The way the possible collaboration with industry is arranged should be considered (in particular how close the contact with the institutes should be). In any case a clear specification of each software module and subcomponent must be established, not only for those part of the system which could be contracted to industry, but also for internal use.

Specifications need to communicate the expected software behaviour to the implementor of each module and of the modules which interface to it. Specifications can be therefore considered as the basis for a contract between the user and the implementors (an informal contract if the implementor is not an external industry, or is the user itself). Specifications can be part of the software documentations: they are more readable than programs themselves, and do not change if the specific implementation of a module is changed. The use of formal specification techniques should in our case be avoided because of the difficulties in understanding them by general users and because no single technique has emerged as a standard. We note that some informal specification rules have been adopted in the case of software systems like our one (see e.g. the case of ROSAT and COMPASS, the analysis system for the GRO-COMPTEL experiment, which use Nassi-Shneiderman control flow diagrams, etc.).

In any case we remark that, in particular because of the scientific nature of the software system which we are referring to, during the implementation cycle and also at the operational time as a maintenance activity, must be possible to modify the specifications and the related implementation: as a matter of fact the development of a system like this is a multi-step process in which the programs are subsequently refined , both to account for the hardware physical limitation, and to correct statement errors in the previously defined specifications.