XMM-Newton Science Analysis Software: Development and Maintenance... but thinking of the future

Aitor IBARRA – Richard SAXTON - Eduardo OJERO - Carlos GABRIEL
XMM-Newton SOC, European Space Astronomy Centre (ESAC) / ESA, Madrid, Spain.

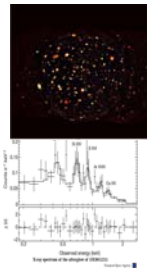
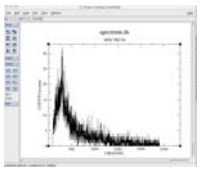
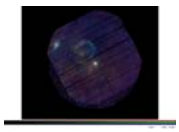
ABSTRACT:
The XMM-Newton Science Analysis Software (SAS) is a robust software designed to analyse X-ray data. It is coded mainly in C++, F95 and perl. It is distributed in binary format for several architectures (Intel, SPARC and PowerPC) and Operating systems: Linux (Red Hat, SuSE), Mac OS X (Tiger, Leopard) and Solaris. SAS is developed and distributed based on the free software paradigm. Except for the usage of the commercial NAG Fortran 95 compiler, SAS is built on GNU tools, including gcc C/C++, autoconf and make. Although it is almost fifteen years old, the tool is evolving continuously to be inline with new compilers (gcc-4.X, NAG 5.2), architectures (64-bit) and technologies (Web based interfaces).

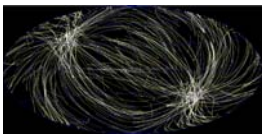
Our goal now is to move beyond the paradigm of simply delivering products to providing a complete solution for the non-expert astronomer, SAS is offering a complete suite of programs to reduce and analyze XMM-Newton data . The advent of new computer paradigms focusing on low-cost computer resources and maintenance, such as, virtualization and cloud computing, force SAS to move towards a completely new field where data reduction demands will not decrease.

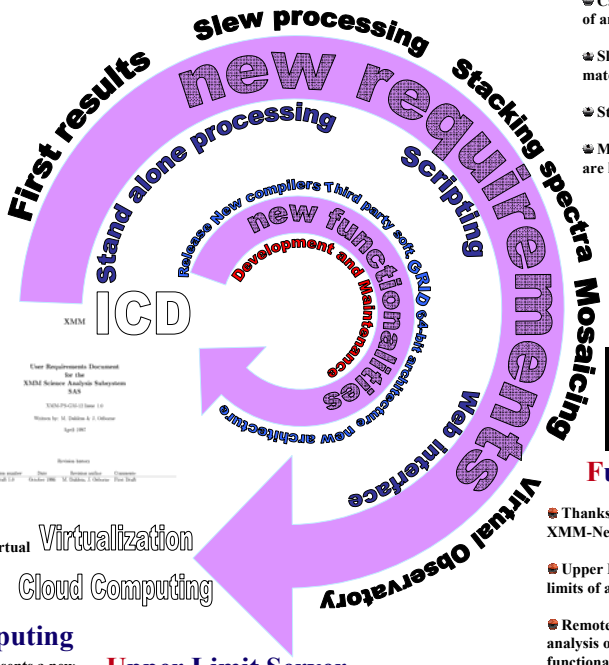
We discuss the origin, present and future of the XMM-Newton scientific data reduction software, with the aim of keeping the analysis capability throughout the next 10-15 years.

Initially: Standalone application

- **Beginning with the Interface Control Document, SAS was developed in C++ and F95, using gcc-2.X and NAG 4.X on 32-bit platforms.**
- **Software compatible with SPARC and Intel processors.**
- **Strong constraints to run SAS in ≥ 512 Mb RAM machines.**
- **Imaging, spectroscopy and timing analyses were the first requirements.**

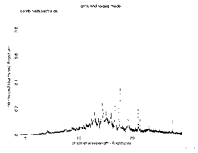
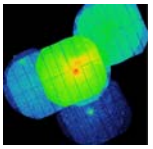
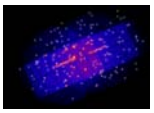








New Requirements: Massive data reduction

- **Increasing quantities of data have been collected by XMM-Newton, and more and more users need to analyze large samples of data.**
- **Calibration, always under development, needs reprocessing of an increasingly large data volume.**
- **Slew processing is available as a SAS task. Useful to cross-match sources in different catalogues.**
- **Stacking spectra to improve signal to noise ratio.**
- **Mosaicing and source detection using several observations are highly demanded by users and CPU intensive**

Future technologies

SAS is evolving thinking of …

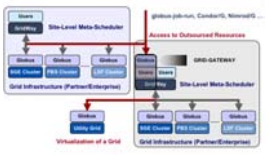
- **How virtualization and software deployment work in virtual machines environment.**
- **Ways to take advantage of cloud computing.**

Future-proofing: Web interface

- **Thanks to the non-stop SAS evolution, new tools have emerged to make XMM-Newton data reduction evolve with new technologies.**
- **Upper Limit Server: It is a web application that allows users to get flux limits of any point in the sky, using XMM-Newton slew and pointing data.**
- **Remote Interface for Science Analysis: A web service system allowing the analysis of XMM-Newton data making use of all the existing SAS functionalities. This tool takes advantage of GRID architecture to run SAS, achieving high performance in resource management.**
- **All these new developments are following the VO standards.**

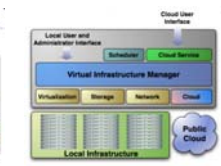
Virtualization

Thanks to virtualizations, we have the ability to dynamically shape a hardware infrastructure. Giving us new management techniques, such us, server consolidation and isolation, custom execution environment provisioning



Cloud Computing

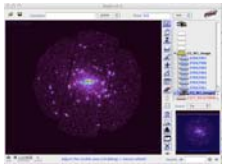
Cloud computing represents a new tipping point for the value of network computing. It delivers higher efficiency, massive scalability, and faster, easier software development.



Upper Limit Server

Remote Interface to Science Analysis

VO compliant



Developer's point of view

- **Migration to 64-bit platforms.**
- **New compiler (gcc and NAG) versions.**
- **New Operating System/flavours distributions.**
- **Virtualization concept to be able to run SAS in frozen systems.**
- **Cloud Computing paradigm to be able to decouple SAS data reduction from new hardware.**
- **Web based SAS tools.**
- **...**

User's point of view

- **Astronomy User Group advice.**
- **Requirements from users.**
- **Calibration improvements.**
- **Hardware scalability to cope with a high number of users.**
- **VO interoperability.**
- **Higher-level products and processing, To easily cross-match results with catalogues in different energy ranges.**
- **Provide solutions and products for non X-ray experts.**

References

- **B. Sotomayor, R. S. Montero, I. M. Llorente and I. Foster; in press, "Virtual Infrastructure Management in Private and Hybrid Clouds", IEEE Internet Computing.**
- **A. Vazquez, I. de la Calle, J. L. Contreras, A. Ibarra and D. Tapiador. 2009; "Migration of Monte Carlo Simulation of High Energy Atmospheric Showers to GRID Infrastructure". 17th International Conference on Computing in High Energy and Nuclear Physics.**
- **C. Gabriel, et al. 2003; "The XMM-Newton SAS – Distributed Development and Maintenance of a Large Science Analysis System: A Critical Analysis". Astronomical Data Analysis Software and Systems XIII, vol. 314.**
- **C. Gabriel, et al. 2007; "RISA: Remote Interface for Science Analysis". Astronomical Data Analysis Software and Systems XVII, vol. 394.**
- **R. Saxton et al., 2008: "The first X-MM Newton slew survey catalogue: XMMLS1". Astronomy and Astrophysics. 480, 611**


ADASS XIX, October 4-8 2009.
Sapporo, Japan
Aitor.Ibarra@sciops.esa.int
Richard.Saxton@sciops.esa.int
Eduardo.Ojero@sciops.esa.int
Carlos.Gabriel@sciops.esa.int