Preservation of Operational Science Processing in XMM-Newton

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XMM-Newton Data Processing facilities are facing a major migration exercise. This aims to preserve their processing functionality up to the end of the mission. Highly constrained by the limited resources and uncertain time scales, it will use the modular SOC approach. Once the processing data flow functional entities are identified, some of the building blocks will be frozen and virtualized under newer platforms, meanwhile others will be replaced by enhanced modules, with no interruption of the processing operations.

THE XMM-NEWTON OBSERVATORY

XMM-Newton is an ESA X-ray observatory mission, operating continuously with great success since early 2000. With solid perspectives for having the satellite still in good condition during this decade, some efforts are being done aiming to keep its high scientific production rate during the years to come. We focus here in the XMM-Newton Science Control Systems (XSCS), in charge of the L0/L1 processing. These are the systems responsible for the conversion from the raw telemetry data as received at the ground station into FITS formatted scientifically meaningful files, not yet fully calibrated but already sorted by instrument data types and modes. The activities done in other parts of the data processing and ground segment, such as the Pipeline, Science Analysis Systems (SAS) and the Science Archive (XSA) are not described here.

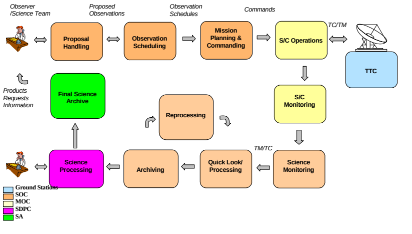

Fig1: XMM-Newton operational uplink and downlink data flow concept

XMM SCIENCE CONTROL SYSTEM (XSCS)

XMM-Newton was designed as a real time operations based observatory. This means continuous TM and TC contact with ground stations [1]. So the kernel of the XSCS processing is built upon a set of continuously running data processors. Specifically, the L0/L1 XSCS processing is formed by the SCOS2000 (S2K) Payload Monitoring and the Observation Data Systems, a Quick Look Analysis facility and one Archive Management System.

The XSCS architecture design was driven by three main constraints: MOC, SOC and Pipeline at geographically distant locations, a combined MOC-SOC development, and a highly centralized SOC archive, in the form of one single, persistent, repository, to be used both for the operations and external scientific usage (but the external XSA took later this role).

This client-server architecture of the end of 90's is currently running into 05's hardware platforms, which are reaching the end of their suppliers support. The migration aims to get rid of these old platforms. In addition, the migration also aims to provide flexibility to the monitoring and control of the processing. One constraint here is the XSCS residing in a mission operational network with highly restricted access. But the main constraint is that after one decade, the available manpower and resources are reduced to the minimum. This means that major refactorings or migrations, with additional extra costs are neither possible nor desirable.

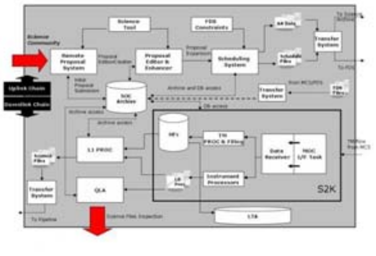

Fig2: XMM-Newton Science Control Systems data flows

CONCLUSIONS

After more than a decade running, the SOC L0/L1 data processing side is facing a major migration. Highly constrained by available time and resources, both refactoring and virtualisation are being considered. The virtualization allows the replacement of ad hoc systems by more modern approaches that fulfill or even increase the same functionalities without major efforts. At completion, the launch-era architecture should have been converted into a modern and flexible modular one.

MODULAR SCIENCE CONTROL SYSTEMS

A modular ground segment approach is being taken for facing the migration of the XSCS [2]. First step of this approach is to identify every functional entity of the processing chain. Second, every individual module will be detached from the rest of building blocks and migrated separately. With this abstraction every module can be migrated using different techniques, different base technologies and different calendar schedules. Fulfilling the condition of keeping the interfaces the same at every instant, the in-operations replacement of the whole set of subsystems is permitted, with no interruption in the data processing flow.

ENHANCEMENT AND VIRTUALISATION

Migration of some systems consist in the reuse of existing server side infrastructure, embedding them into a new three-tier layer architecture for enhancing the external access capabilities. The external user layer is common for all facilities, internal or external. The middle tier offers the smart capabilities for accessing differently the data when residing outside or inside the protected areas. The data layer is kept the same. Thanks to the usage of modern language paradigms (or better to say, modern when compared with the current 90's), the external interfaces in the services layers are kept common meanwhile the internal functionality of the logic can be modified.

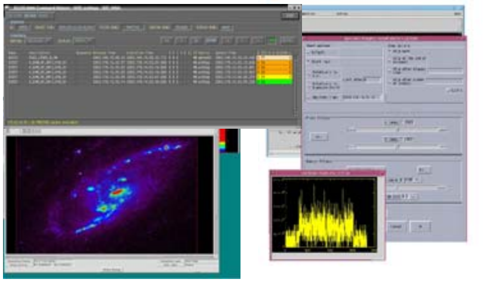

Fig3: S2K display and Quick Look facilities of the XMM-Newton downlink data processing

Another approach is to freeze some systems. This involves the usage of virtualisation techniques. Virtualising systems allows the quick removal of old h/w platform dependencies (but only at mid term, as the containers may evolve as the time goes). So virtualisation can be considered a time buffer, a resting area for potential true migrations. Anyhow, an immediate advantage of virtualisation of old systems is a quick gain in performance, because they are embedded in newer platforms. Another advantage is the reduction of physical boxes, so costs are reduced as well. Finally, this approach increase the redundancy, as some hot stand by copies of the most critical systems can be created on the fly. So thanks to the virtualisation, new enhanced and more flexible data processing operations schemes can be implemented.

SYNERGIES

These activities are being carried out sharing synergies with other projects. This project benefited from GMV modular-SOC studies conclusions. It also shared knowledge from Spectrum-UV (WSO) mission. Finally, GMV is also carrying out several activities regarding data preservation on Earth Observation missions, which are sharing similar goals.

REFERENCES

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