SAS status and development - medium and long term strategy

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On behalf of SOC SAS & SAS WG teams

21st XMM-Newton Users Group Meeting

Overview and timeframe

- **SAS 19.0 – released in October 2020**

- **SAS 19.1 – released in March 2021**

- **SAS 20 - ongoing**

    - Science validation over summer, early Autumn
    - Expected release after AO 21, October/November

- **What is on the horizon**

SAS 19 and 19.1 contents

- **Increased flexibility for product extraction**
    - Extraction region centre defined in celestial coords - CIRCLE(RA,DEC,radius)
    - Extraction region defined by an image
- **Support combined spectra from different cameras and from different observations**
    - epicspeccombine, multiespecget, multixmmselect: improved documentation, threads
- **Produce quiescent particle background products from FWC scaled by the discarded line rate in units of Counts (qpbselect, evqpb)**
- **PN energy scale -** new algorithm for Burst mode, rate-dependent correction
- **Small enhancements/fixes (epevents, emtaglenoise, emosaic,emsaplib, emask…)**
- **Build and infrastructure – move to GCC 9 – implications for C++ / F90 interface**
- **Ommosaic**
- Change in access to shared libraries to avoid clashes with SIP (Mac) & Linux security
- **Python changes**

SAS 19 and 19.1 - Python

- *pysas*: New SAS Python infrastructure included in v.19.

- New packages *pkgmaker*, *sasver* and *startsas*. Adapted existing *xmmextractorGUI*.

- In v.19.1 *pysas* included enhanced and improved nested mandatory parameter support, logging and testing support via *pytest*.

- Python interface to SAS presented in 3 new example Python Threads and SAS v19.1 User's Guide.

Upper Limits - RapidXMM database
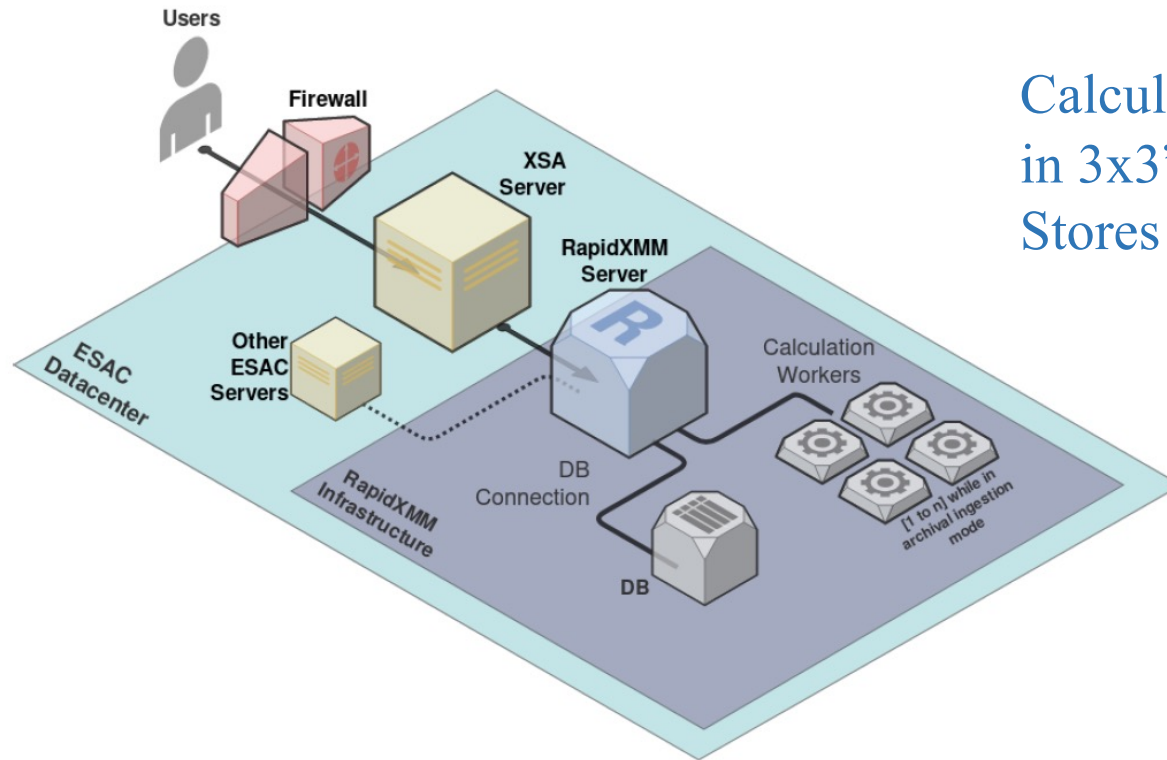
Calculates an upper limit
in 3x3" box (pointed) and 6x6" (slew).
Stores results in a very large database.

Contract finished in Sep 2020 to pre-calculate upper limits from XMM pointed and slew data, avoiding area close to sources. Can return ~20 positions per second. Integrated into XSA for both ingestion and serving results.

SAS 20 : contents – priority 1

- Extended Source Analysis System (esas) updates – modular tasks, XMM-style CCFs
- Python updates
- Omsource – fix for C++ / F90 interface issue + other problems
- Combine MOS,PN pipeline-spectra up to >=15 keV
- Other OM tasks – C++/F90 interface (dope) fix
- Preparation for spatial CTI calibration (Sanders / Dennerl technique)
- radmonfix - remove from epproc (epchain) and make SOC-only
- Creation of sensitivity maps in units of flux

SAS 20 : contents – priority 2

- Give temporary files unique names to avoid clashes with multi-thread processing

- Allow evqpb / qpbselect to work without an ODF

- OM task updates and enhancements needed for catalogue production (may have additional help from Vladimir)
    - Comments and Keywords consistency
    - Consistent treatment of Jupiter Flag throughout OM tasks
    - Overhaul of flagging for distinct scenarios
    - Identifying readout streaks where no bright star appears in windows
    - Mapping the expected positions of smoke rings from global OM source positions

SAS 20 – Python

- Improvement of Python infrastructure (***pysas***).
- *eslewchain (Perl script)* migrated to Python.
- First set of PGPLOT based packages migrated to Python (+ utility library packages):
- ***ombackground***
- ***omdrifthist***
- ***rgsimplot*** • ***rgsspecplot***
- ***pyutils*** • ***pysasplot_utils***

- Improved testing and documentation.

Frames from the past problem
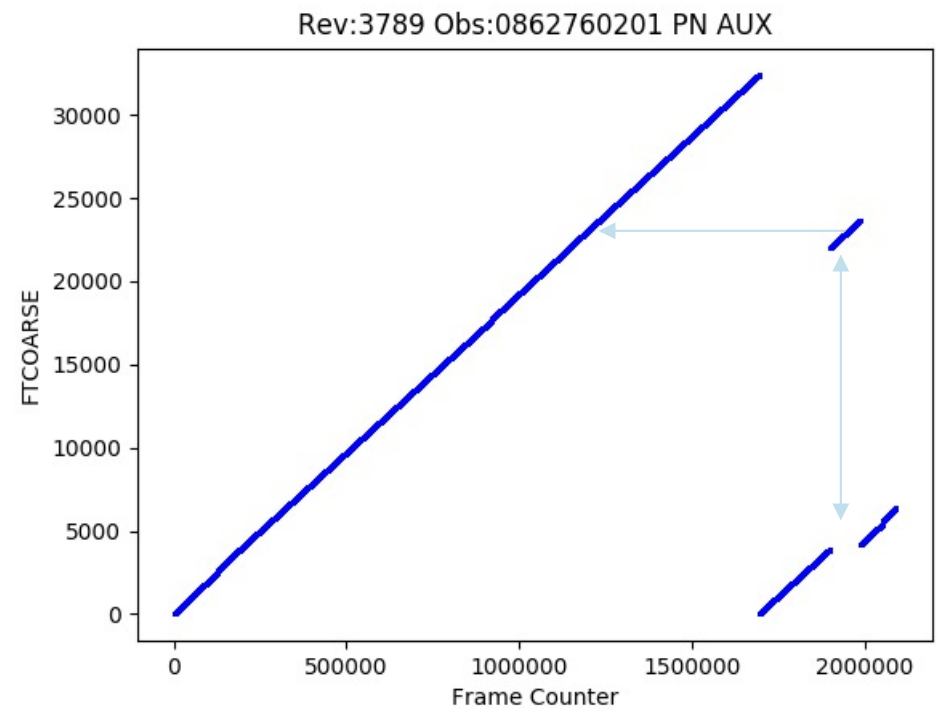
Frames (and events) from the past

Two observations in revolutions **3789** and **3792** contained *duplicated* events but with "valid" FRAME counter.

MOS AUX FILE

	FRAME	CCDID	CCDNODE	FTCOARSE	FTFINE	NPIXEL	NVALID	NBELOW	
Select	1J	1B	1B	1I	1I	1J	1I	1I	
All	COUNTER			SECOND		PIXEL	COUNTS	COUNTS	
Invert	Modify	Modify	Modify	Modify	Modify	Modify	Modify	Modify	
56462	8611	2	0	23562	18112	2594	8	0	
56463	8611	5	0	23562	18112	2165	7	0	
56464	13907	5	0	23562	18112	2165	7	0	
56465	8610	4	0	23562	18341	2379	50	0	

FRAME 13907 = FRAME 8611
13907 -> MOD(16) = 3
8611 -> MOD(16) = 3

Rev:3789 Obs:0862760201 PN AUX

Frames from the past problem

Seems to be related to ground station issues in revs 3789 and 3792

MOS processing did not produce correct event files for ODF in rev 3789

PN processing produced event file but throwing the following warning messages:

UnknownDeltaFrameTime, UnidentifiedTimeGaps

RGS processing produced event files with incorrect GTI and EXPOSURE size (RGS Frames jumps)

Checks show that the number of affected observations is low.

SAS task to delete duplicated frames and events for RGS and MOS in testing phase. To be released with SAS 20 as SOC-only.

Post -SAS 20 – ideas and intentions

- RGS background smoothing task
- EPIC-pn filter identification when temperature is low
- xmmextractor python refractoring
- Solve EPIC-pn exposure time problem with huge count rates

Source code release: on-hold. Numerical Recipes code to be replaced because of copyright issues. Then code to be used for building SAS to aid long-term preservation.

Continue migration of PERL chains and tasks using PGPLOT/Grace and FTOOLS to Python.

Continue enhancement of Python infrastructure and support for Jupyter notebooks and processing threads.

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Future Goals – medium term

- Implement EPIC-pn phenomenological response matrices

- Introduction of spatially-dependent CTI correction.

- Initial exploration of putting RISA into dockers and running on AWS ongoing.

- Future enhanced integration of GUI-based SAS with XSA

- Add multi-threading to improve performance (C++)

Summary

- SAS v19 & 19.1 released

- RapidXMM upper limit database released and integrated into XSA

- SAS v20.0 – release towards end of year

- *esas* further integration into SAS

- Enhanced support for Python scripting, Jupyter Notebooks

- Future evolution of RISA and integration with XSA