Data Processing and User Software

presentation
and
demonstration

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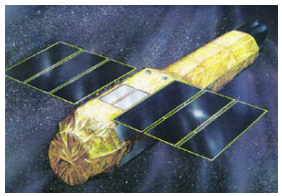
Astro-E2 Software Policy

- Astro-E2 data analysis will be easy
  - *New* instrument (XRS), but standard and established software scheme (ftools, xspec etc)
  - Hardly new *data analysis technique* required
- Astro-E2 users do not have to worry about technicality
  - GOF takes care of interface between instrument/satellite team and users
  - Prompt release of the *best* software and calibartion
- Users can concentrate on *SCIENCE*
  - Some specific analysis may *not* be supported (e.g., spatial-spectral analysis of clusters of galaxies)

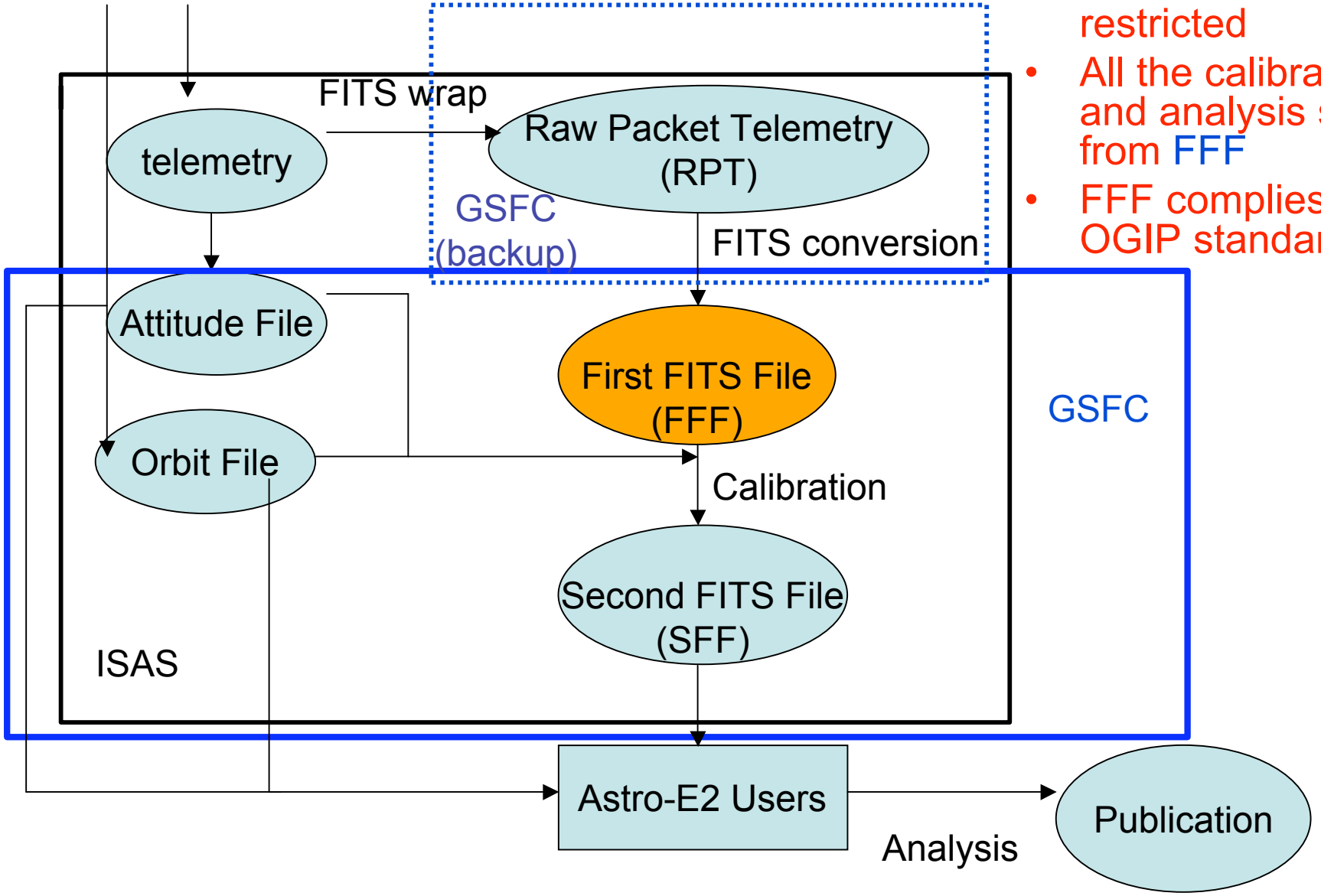
Astro-E2 Software Characteristics

- Astro-E2 is Japan-US mission
- There are three instruments (XRS, XIS, HXD)
- Several institutes in two countries involved
- *Goals:*
  - Same software used in US and Japan
  - Same software is used by different instrument teams and Guest Observers
- We have established a software development scheme to achieve these goals



Data Processing Outline

- Access to RPT is restricted
- All the calibration and analysis start from FFF
- FFF complies OGIP standard



Data Processing: Stage 0 (only at ISAS)

- ISAS receive telemetry from the satellite
  - FITS wrapped "Raw Packet Telemetry (RPT)" is created from satellite database
  - One RPT for one pointing observation
  - Time assignment is made on RPT
  - RPT is not distributed. Access to RPT restricted
- Attitude is calculated from RPT
- Orbit is determined

Data Processing: Stage 1
(at ISAS; if necessary at GFSC)

- RPT is converted to a set of First FITS Files (FFF)
  - *mk1stfits* is run routinely at ISAS
  - mk1stfits is available *only* at ISAS and GSFC
  - In case of urgent needs, GSFC is able to run mk1stfits to create FFF (back-up purpose)
- From one RPT, ~50 FFFs are created
  - Separate for instruments and observational modes
  - Separate for scientific data and HK data
  - FFF comply OGIP standard
- All the analysis and calibration should start from FFF
  - This is the only data access route
  - No other data access path exist

Data Processing: Stage 2
(ISAS and GSFC; if necessary by GOs)

- Calibration is applied to FFF
  - Carried out both at ISAS and GSFC
  - Using Astro-E2 ftools (e.g., all the tools distributed)
  - Guest Observers may repeat calibration, if necessary
  - Second FITS Files (SFF) created
  - Event files may be split depending on minor modes (e.g., XIS window option)
- "Filter file" is created from HK, attitude and orbit
  - "makefilter" ftool used
  - Later used for data screening

Data Processing: Stage 3
(ISAS, GSFC, GOs)

- Data screening (using filter file)
  - We shall learn proper data selection criteria after launch
  - Earth elevation, orbital condition, particle monitor condition etc.
  - "Screened event files" are created
- Make images, spectra, light curves
  - Standard products will be in the archives
- Extract "trend products"
  - Earth data for background monitor, calibraiton source peak spectra etc.
  - Used for calibration and monitoring the satellite health condition

Astro-E2 ftools: development

- US-Japan collaborative development
- “Critical” ftools for calibration are mostly written in Japan
- Same codes for on-line monitoring system at ISAS and ftools for general users
  - XRS, XIS and HXD team adopts the standardized coding style (“ANL” system)
  - ANL modules are converted to FITS
- GSFC takes care of packaging, testing, distribution, maintenance

Astro-E2 ftools: distribution

- Astro-E2 ftools are distributed as a component of the "HEAdas" package
- HEAdas:
  - A new component of HEASoft
  - Simpler, leaner, more portable, stable, extensible than ftools
  - Clear separation of the mission dependent part and independent part
- Swift ftools is in the HEAdas package

Pipe-line processing

- Original script written for ASCA (in shell language) at GSFC
- Improved and rewritten in Perl for Astro-E1
- Adopted for Swift with some modification
- Identical script will be running at GSFC and ISAS
- Data distribution package for users made
- Same data will be also put in archives

Ground data processing

- Function test data (full satellite) are taken at ISAS in 2004/12/15,16
- FFFs created successfully
- Testing further processing
  - SFF (calibration), filter file, data products

XRS specific development

- How to make XRS ARFs?
  - When select particular XRS pixels
  - Extended sources?
  - Planning many ray-tracing simulations
- How to combine XRS RMFs
  - XRS RMFs are different for different chips
  - Need to combine different RMFs
- How to handle different resolution events
  - High and Med-p combined?
  - How to adjust normalization?