ADASS XIX, Large systems - 2

Flexible operations planning repository for space science missions

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OUTLINE

- The (variable) ground segment.
- The modular approach in science operations.
- The P-REP Science Planning Repository.

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The ground segment

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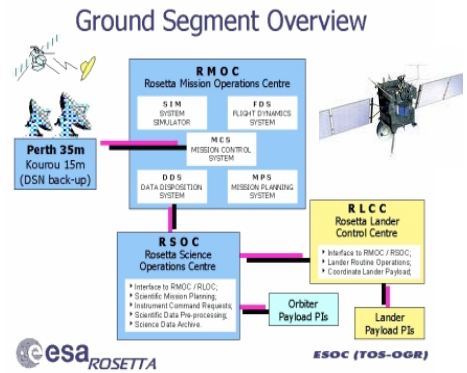
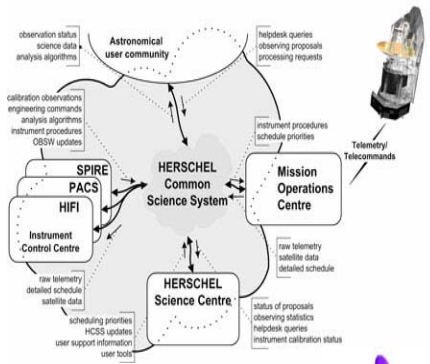
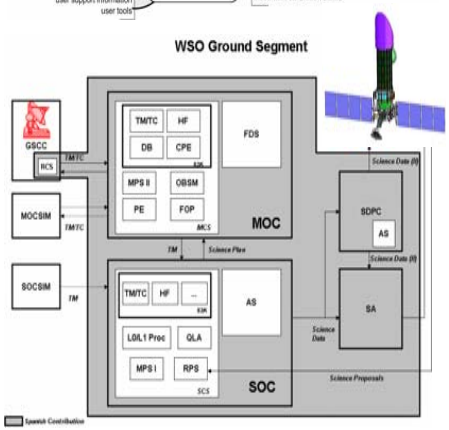
THE (VARIABLE) GROUND SEGMENT

- Ground facilities, the link between the spacecraft and its user.
- GS requirements vary across missions (obviously).
- GS requirements vary within the mission lifetime (if long enough).
  - Scientific missions (or their data) survive meanwhile in good condition, they are cheap to operate and keep a high rate of published papers.
  - So requirements may change because ageing, costs reduction or search for an increase on the scientific return.
- Wishful thinking: to have a unique GS able to cope with such a variability.







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YESTERDAY

- A one-fit-for all system is impossible.
  - A bottom-up approach was traditionally used to develop one mission from another.
  - Coordination/reuse was not a priority.

- However, MOC/SOC were developed sometimes in a combined way. It was noted,
  - A reduction of management overheads, risks, and increase of coordination in common areas.

- But unavailability of multi - purpose / multi - mission / time - evolving systems.
  - It may be easiest for platform operations, not so easy for data operations, difficult for science operations.

TODAY

- Between yesterday and today the problem is different,
  - An increasing number of missions and a shrinking budget.
- Between yesterday and today the problem is the same,
  - A one-fit-for all system is impossible!
- Today's approach to the above problems,
  - Coordination/reuse is a priority.
  - Some solutions are,
    - To have common reusable infrastructures, such as ESA EGOS, or GSCF GMSEC, providing standard middlewares.
    - To have common GS elements, such as ESAC Multimission archives, ESAC MIG activities, Commercial "generic" products, ...

TOMORROW

- A top-down approach is the only approach which will allow the efficient development of such systems.
- The development of P-REP is positioned in a global effort for building generic science operation center frameworks.
- P-REP is one building block corresponding to a planning repository within a **modular SOC**.

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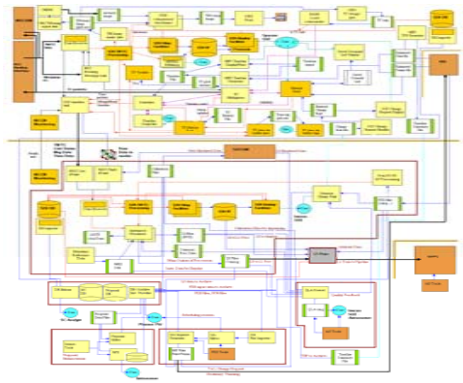
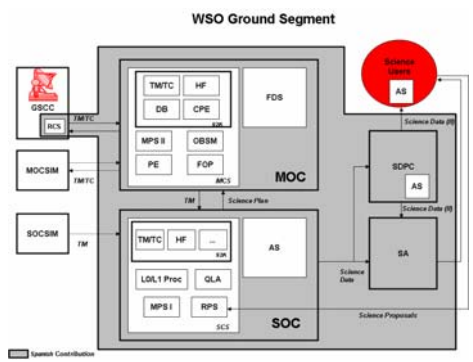
MODULAR SOCs

- Driver; We cannot have a one-fit-for all system;
- The functional architecture of the SOCs must be modular to cope with the variations of the requirements.
- So … design all systems (maybe even its infrastructure itself) as flexible as possible, to be used **across different missions**.
- Subsystems replacement or reengineering, incorporation of new elements within the SOC, or changes of the functional architecture, should be affordable **even during operational phase**.





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MODULAR SOCs (II)

- MOCs are “well” standardized. SOCs are still built from scratch.

- Some trends point to locating its functional development in non-centralized scientific entities.
  - Modularity still essential.

- Building pluggable blocks approach,
  - Allows future enhancements and major changes.
  - Allows future paradigms which at the moment are not mature enough.
  - Clean/Clear interfaces are a key issue

- A period of one decade in s/w and h/w is an era.
  - Any system, any module should cope with this.

The P-REP planning repository

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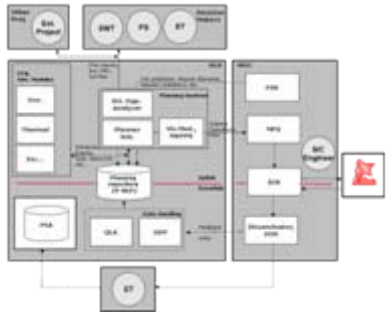
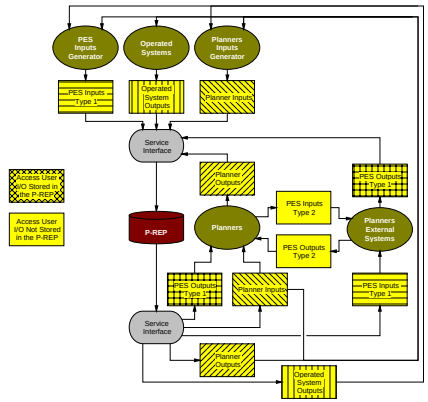
P-REP PLANNING REPOSITORY



- P-REP was born as a call from ESA for developing a planning repository, (planetary) mission-independent.



- It was decided to carry out this project within the modular SOCs context, taking advantage of our previous activities there.

- It is being carried out by a consortium made of Grupo Mecanica de Vuelo (GMV) and of the Rutherford Appleton Laboratory (STFC/RAL).

- Main goal: to specify, design and develop a prototype for a centralized information repository to store any relevant operation planning data **for any past, current or future mission**.

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BASED ON LESSONS LEARNED

- Combined developments reduce management overheads, risks, production times.

- A mission with modular design can cope with in-flight major changes (keep i/f)...and still be cheap to operate.

- S/W is notorious for (unexpected?) growth of costs
  - Still an art, not an engineering task (?).
  - Considered to be a buffer area for the problems (!). Always expect last minute modifications and requirements.
  - S/W replacement and re-engineering of complete systems is possible in long-life operations.

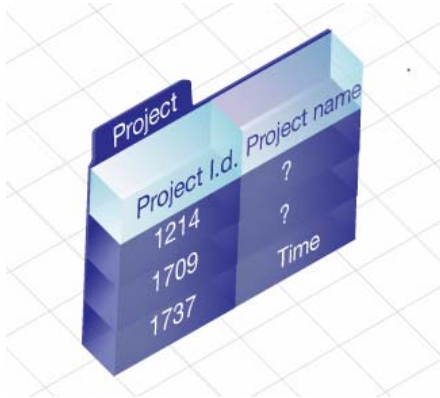
- Complex monolithic leading-edge systems can cope with today mission requirements, but may be cumbersome to re-engineer tomorrow, for other mission or even for the mission itself.

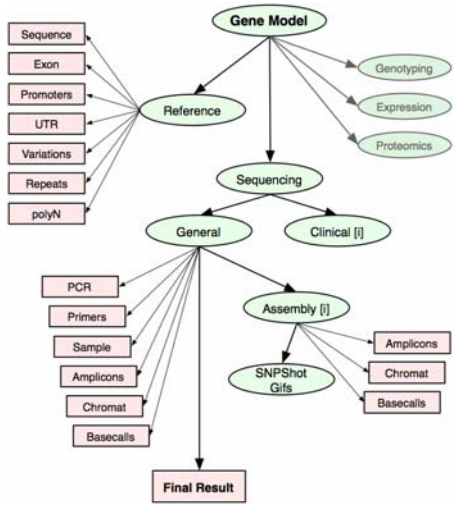
P-REP BASICS

- The P-REP is more than just a database.

- It provides a user environment that facilitates, in a secure and role-driven system,
  - The access to the database contents.
  - The adaptability of its external interfaces to per-mission requirements.
  - The adaptability to the user defined, mission specific data storage modeling.

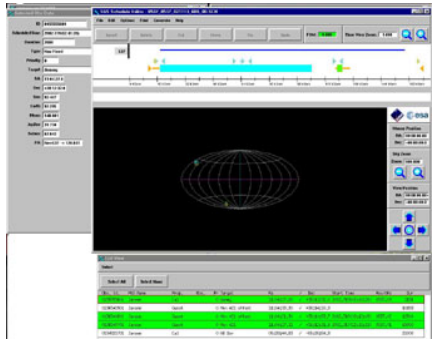
- The data to be handled by the P-REP can be files, file content or any type of relevant planning information. That is,
  - Format specific information.
  - Planning system specific information.



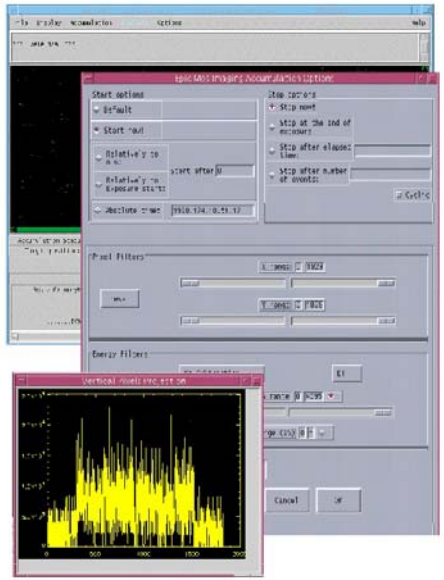


PLANNING DATA STORAGE

- Typical planning information that can be stored includes,
  - Predicted or measured events.
  - Constraints and/or rules
  - Plans.



- But also any information that can help users to generate the latter.
  - Results of the processing of downlinked data, as QLA results.
  - Feedback of the science results from the PI teams.
  - Etc…



- These data are variable per mission basis, both in terms of the data itself and its definition.

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DATA MODELING

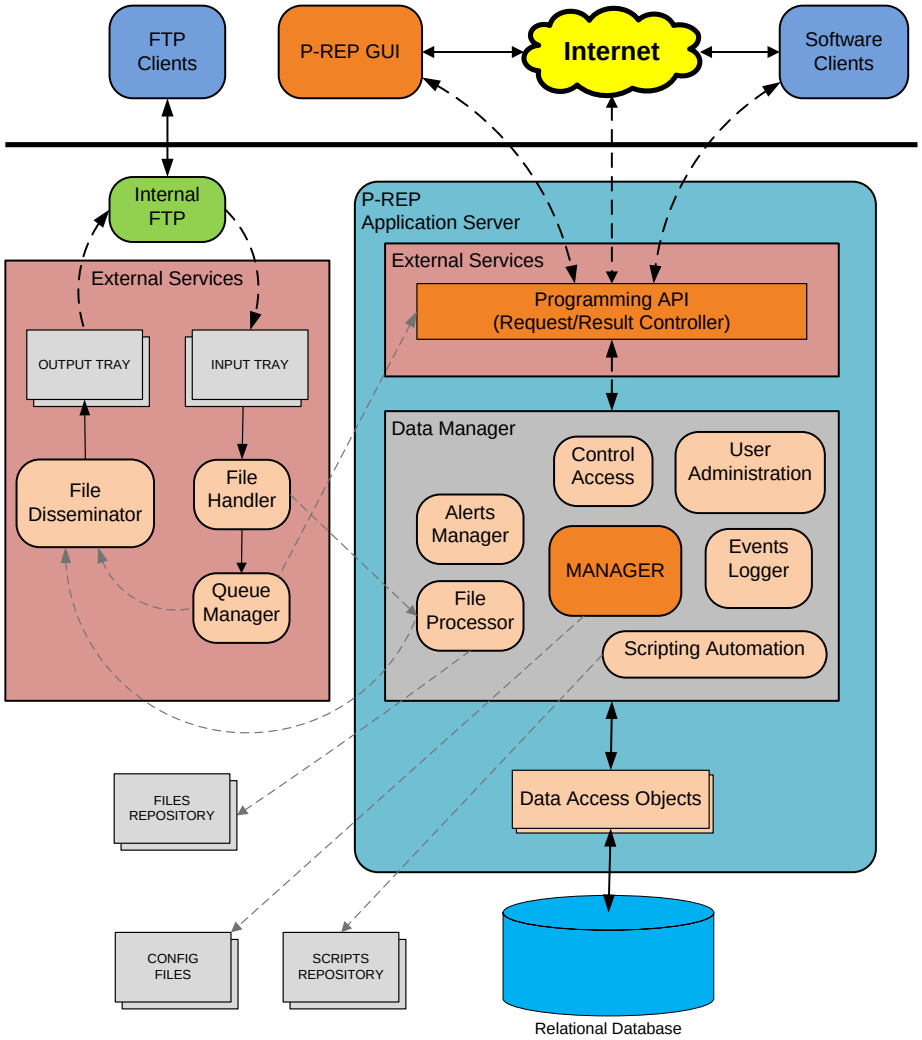
- A key element is the proper data modeling to be embedded in the databases structures.

- P-REP shall allow the modeling of the different and specific mission data types, based on the “Component Philosophy”.

- P-REP manages two type of components,
  - TEMPLATES; model the format of the required structures (data types), i.e. structure types for the variables.
  - ITEMS; they are instantiated templates with specific values (data values), i.e. the variable themselves.

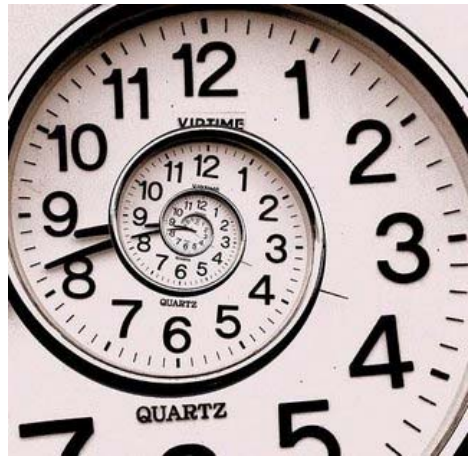
- Components enable the possibility to implement a unique **flexible and combined** way of accessing, structuring and processing the data.

SYSTEM DESIGN



- **External Interfaces:**
  - File based
  - Programming API
- **P-REP interaction**
  - Online (centralised Database)
    - File based
    - Programming API
  - Offline (local Database)
    - Programming API
- **P-REP Server**
  - It's the core of the P-REP software.
- **Security P-REP Access**
  - Security P-REP access
  - Security P-REP data access
    - Based on privileges

STATUS



- Building block approach fully working with other elements,
  - TM Data repositories, (archiva).
  - Scheduling and planning systems, (flexplan).
  - Control centers, (Hifly).
- P-REP Design completed. Design review nearly finished.
- P-REP Data modeling on going. Prototype ready just early next year.
- First target mission Rosetta. BepiCol potential candidate.
- Combined with ROSCOSMOS WSO/UV mission ground segment design (poster ADASS XIX).

Thank you

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