TELMA: the Astrium Satellites framework for In-Orbit satellites support

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In-Orbit Support team needs

- Astrium provides In-Orbit Support (IOS) services on a large and growing fleet (currently 38 Telecom satellites)

- Need of tools allowing a fast analysis of the satellites status and trend, including reprocessing of past data on long periods of time:
  - Basic telemetry analysis tools: decommutation, plots generation, statistics elaboration
  - Advanced telemetry monitoring and processing
  - Report generation

=> Need for a new high performance and evolutive system
Challenges

- **End-users configurability**
  - User-defined telemetry monitoring and processing functions.

- **Performance**

- **Scalability**
  - Integration of new satellites as fleet increases
  - Integration of new user-defined processing functions

- **Reliability**

- **Reprocessing capability**

- **Accessibility**
  - From users office via laptop or desktop PC
TELMA overview

A Multi-satellite telemetry data post processing system and a powerful data analysis environment

- Current use: Telecom satellites
  - In-orbit support
  - Monitoring
  - Investigation phases

- High number of automatic monitoring and processing treatments

- Telemetry analysis tools:
  - Statistics (Min, Max, Mean, Standard deviation)
  - Daily plots
  - Status telemetry plots
  - % Availability (cf. TM holes)

- Complex generic / specific reports generation
  - Monthly reports
  - Yearly satellite health reports
  - Insurers reports
Users’ functions 1/5

- Define and Visualize groups of statistics plots
Users’ functions 2/5

- Define and Visualize groups of daily plots
- Allow fine investigations thanks to interactive plots.
Users’ functions 3/5

- Define end-users **monitoring** functions
  - Complex expressions using TM data / generated data
  - Check wrt to thresholds
  - Trigger actions (e.g. send mail to a group of users)
Users’ functions 4/5

- Define end-users **processing** functions
  - Extended programmatic capabilities
  - Use TM data / generated data
  - Generate data / store in database (possibly huge amounts)
  - Generate specific plots
Users’ functions 5/5

- **Word or PDF reports generation**
  - Based on Word templates
  - Plots and tables on-the-fly generation / insertion

- **Reports configuration**
  - Templates -> Only change the date span
  - Data automatically processed / included in report (table, plots)
  - Report editable after generation
Other features

- **TM decommutation function**
  - Various platforms: E2K, E3K, ISRO (future development)
  - Various satellites
  - Several database versions per satellite

- **Satellites status overview**

- **Administration functions**
Architecture

**Distributed “grid computing” system**

*Web based GUI*

- **Raw telemetry**
  - Physical telemetry cache
  - Processed data

**Web server**

**Scheduler**

**Database**

**Processing Unit grid**

**Data storage**

- **Operators’ workstations**

- Schedule tasks
- Split long tasks

- Scalable at any level to support from 1 to tens of satellites

- Execute monitoring and processing functions

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All the space you need

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Technical choices

- **Processing Unit**
  - Java application
  - Dynamic class loading (decommutation libraries, monitoring and processing)
  - Multi-threading
  - Optimization of computing resources

- **Web server**
  - Tomcat + Apache
  - Servlet + JSP
  - Flex for interactive plots
Decommutation generator

- Currently supports 2 different platforms
- Focused on processing performance
  - E.g. avoids indirections to access data.
User-defined monitoring and processing

- **No specific language:**
  - Sub-set of Java + dedicated telemetry and database functions.

- Processing and monitoring functions can be defined, compiled, packaged and integrated to Telma through the web client.

- Applicability can be defined per platform, per satellite, per groups of satellites.

- Future development: graphical definition of functions.
TELMA capacity

- Sizeable from 1 to **60 satellites**
  - 38 satellites end 2011

- Multi-satellite and multi-platform
  - E2000 / E2000+ / E3000 / ISRO (planned)

- For each satellite, computation each day:
  - 3000 MMMS statistics
  - 3000 daily plots
  - 3000 status plots
  - 3000 monitoring functions
  - 750 processing functions

- Sized for 450,000 parameters daily (7000 per S/C)
  ➔ Over 25 billion values per day

- Own TM decommutation
  = SCC independent
Current status

- Fully operational on Astrium telecommunication satellites fleet.
- Daily use / 38 satellites telemetry processed
- Current hardware platform:
  - 4 Linux servers
  - SAN for data storage
  - 15 PCs
TELMA is integrated in Astrium set of interoperable products based on state of the art technologies Pluggable on top of any Control Centre core functions.
Future activities

- New version tailored to fit earth observation satellites needs
- Graphical definition of monitoring and processing functions
- Web Services on top of TELMA