GSAW 2012

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

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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

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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
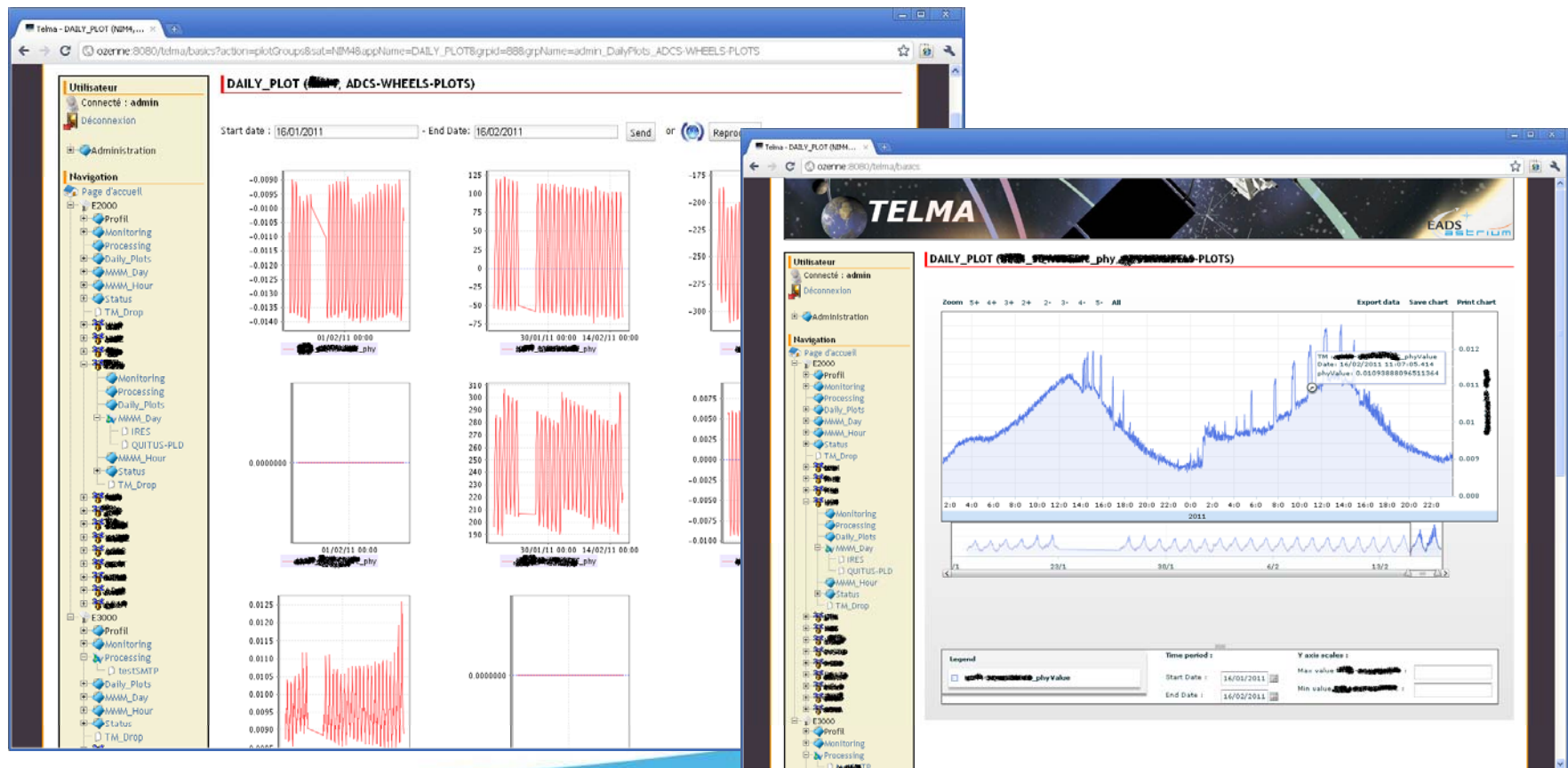 - Insurers reports
  - Yearly satellite health reports

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Users' functions 1/5

- Define and Visualize groups of **statistics plots**

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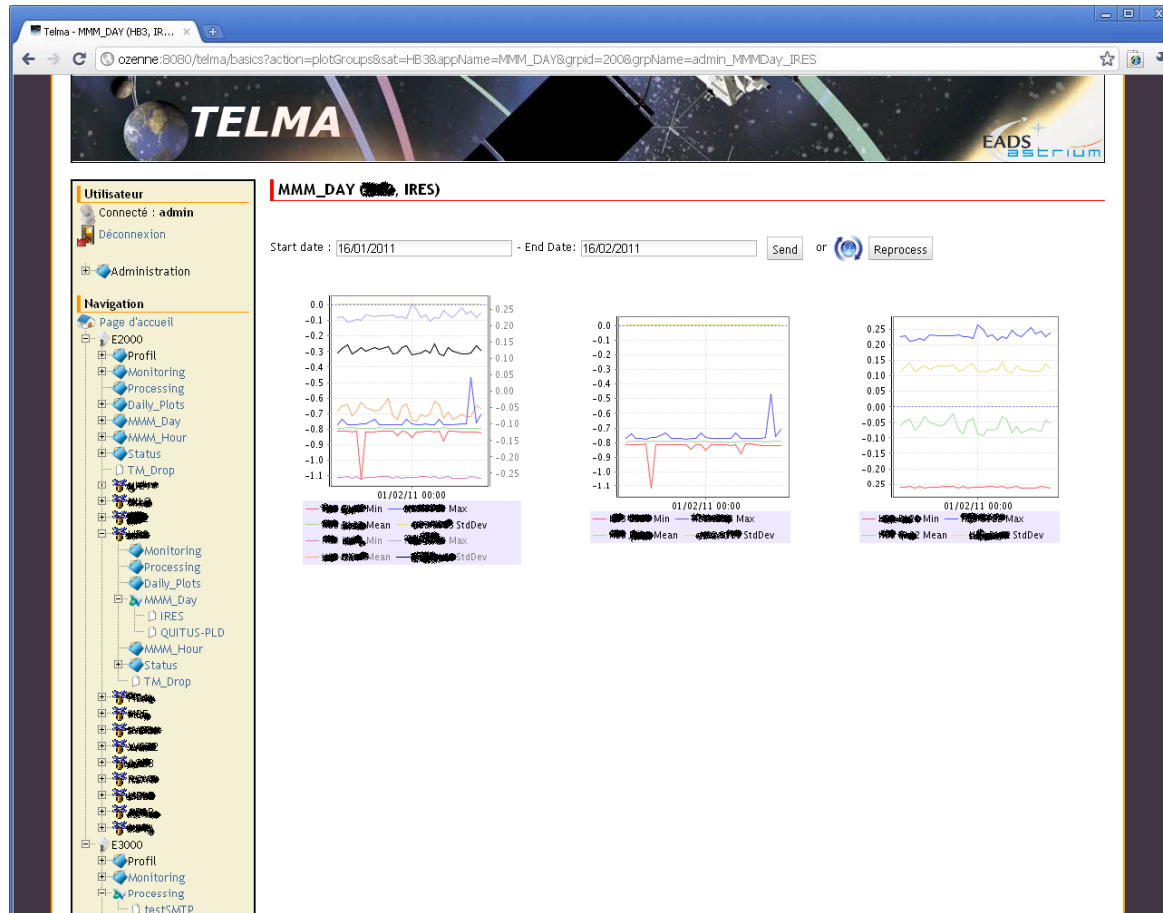
Users' functions 2/5

- Define and Visualize groups of **daily plots**
- Allow fine investigations thanks to interactive plots.

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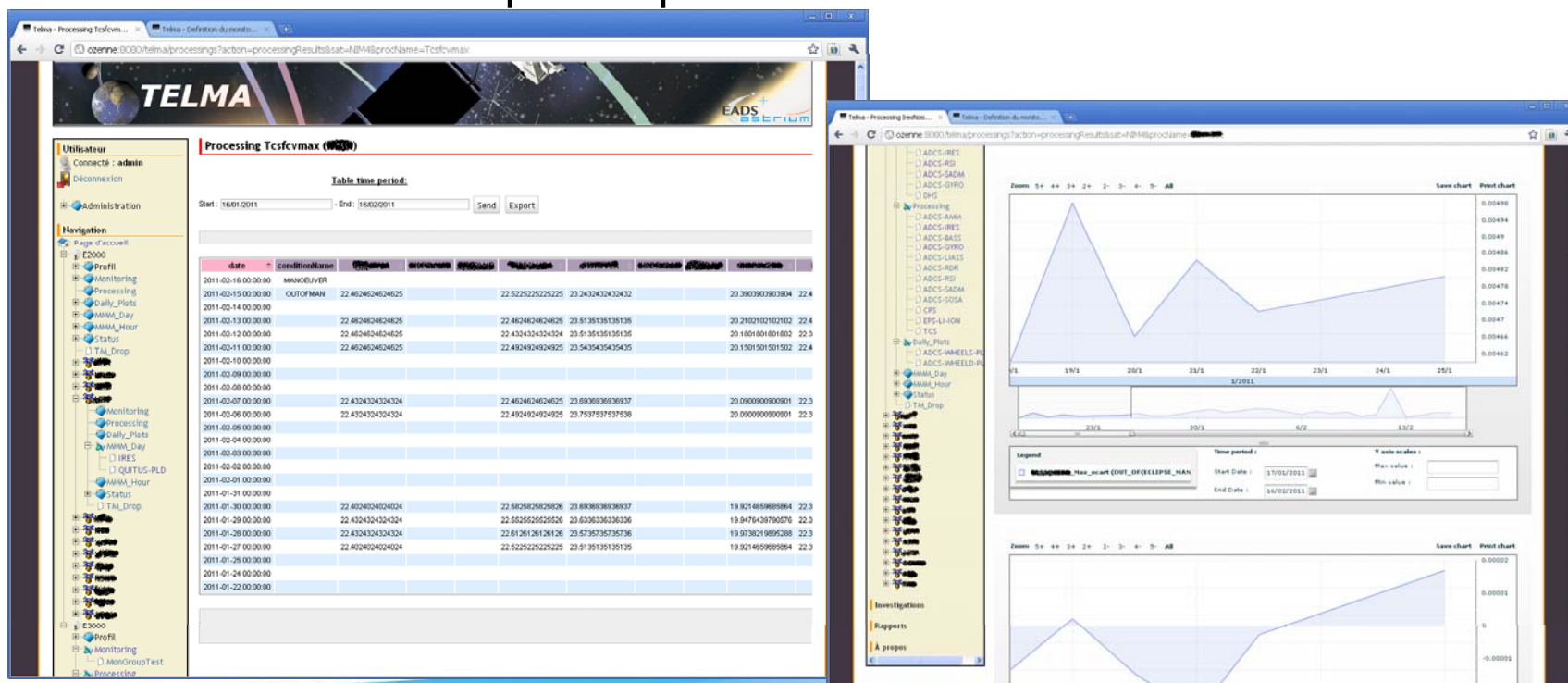
Users' functions 3/5

- 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)

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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

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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

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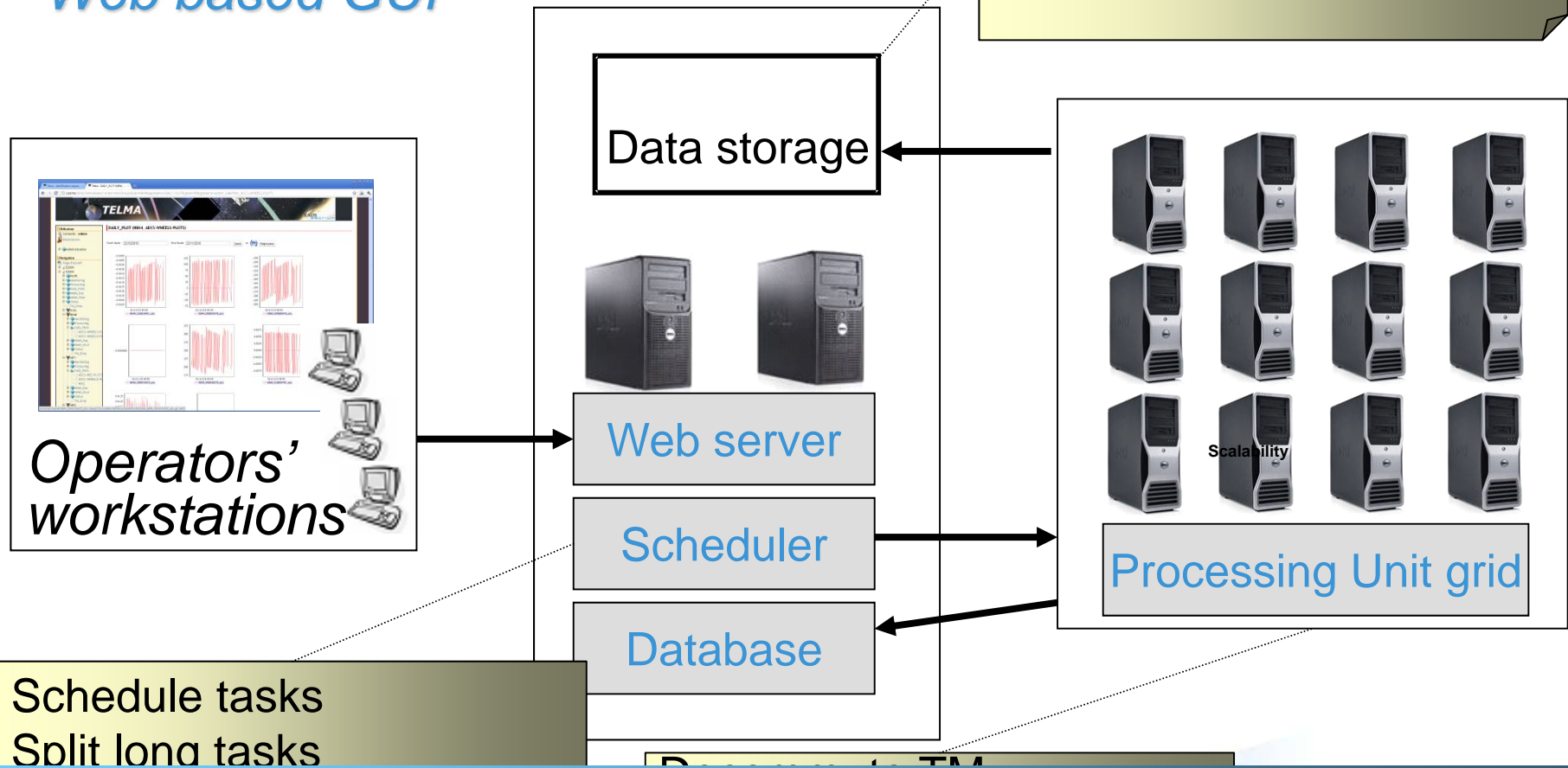AN EADS COMPANY

Other features

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

- **Satellites status overview**

- **Administration functions**

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Architecture

Distributed "grid computing" system
Web based GUI

Raw telemetry
Physical telemetry cache
Processed data

Data storage

Operators' workstations

Web server

Scheduler

Database

Scalability

Processing Unit grid

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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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

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Decommutation generator

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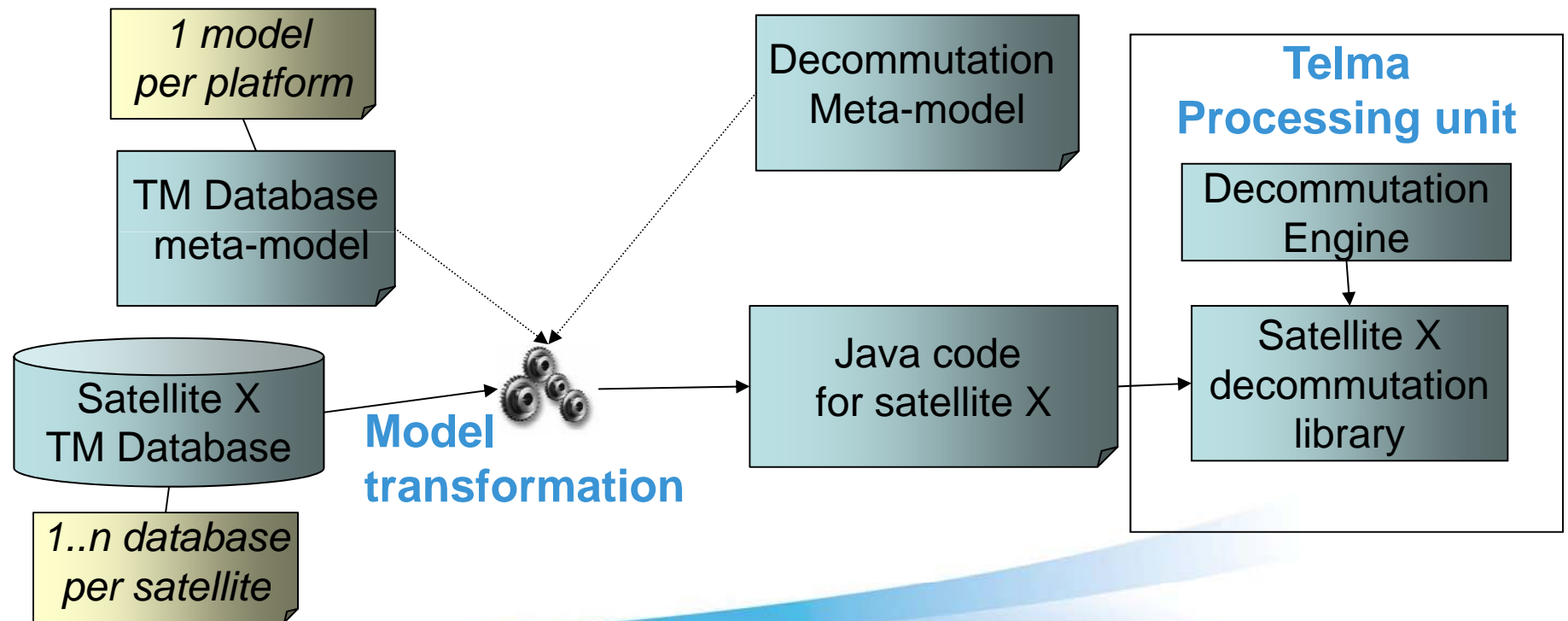
User-defined monitoring and processing

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

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

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

- Future development: graphical definition of functions

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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**

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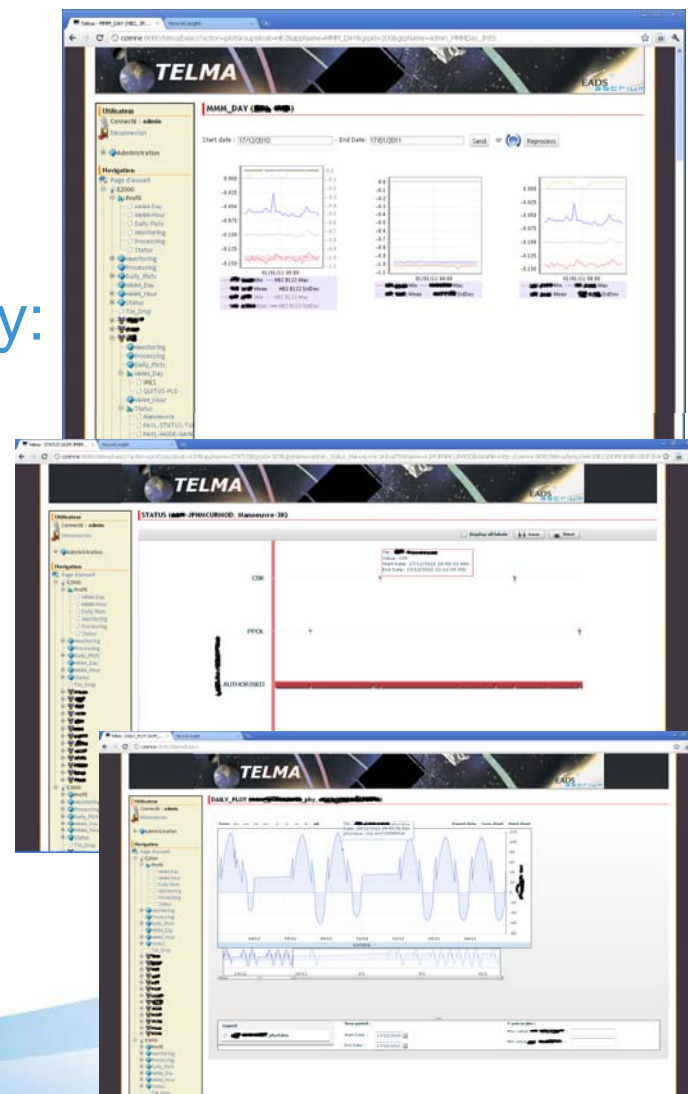
Current status

- 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

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OPSWARE: Operations Unification / Automation

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
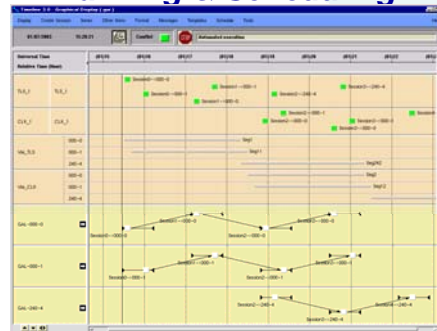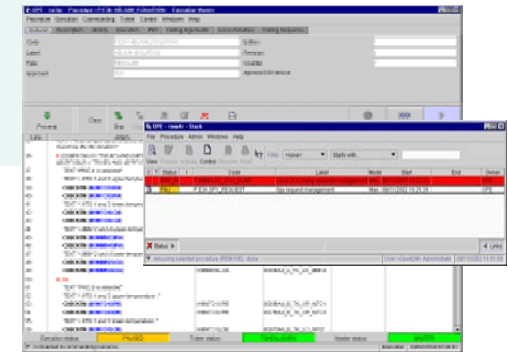
OPSEXECUTER
Procedures Execution

FOST
Satellite Database
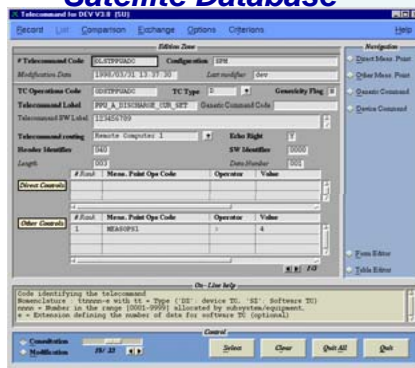
OPSAT
Procedures preparations
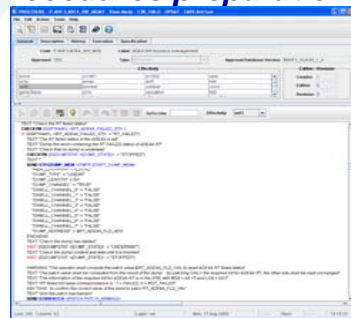
TIMELINE
Planning & Scheduling

MPGATE
TM/TC converter Gateway
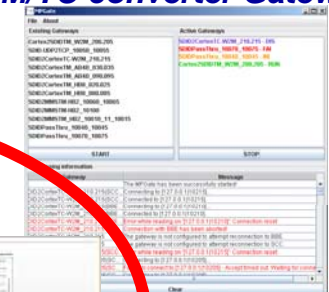
DEXPRO
Offline TM Access

Core functions

C-LOG
Centralized Logbook

TMES
Real Time TM server

DALI
Data Alignment

TELMA
Offline TM Monitoring

OPSTOOLS
Operations Help

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Future activities

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

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