TESTING THE INFRASTRUCTURE THAT SUPPORTS SPACE EXPLORATION

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The European Space Agency

Mission control at Darmstadt
(ESA/L. Guilpain - CC BY-SA IGO 3.0)

Lisa Pathfinder
(ESA–P. Sebirot, 2015)

Close-up of comet 67P
(ESA/Rosetta/Navcam – CC BY-SA IGO

Malargüe tracking station
(ESA/D. Pazos - CC BY-SA IGO 3.0)

Ariane 5
(ESA/CNES/ARIANES
PACE-Optique Video du CSG, S. Martin)

Titan as seen by Hygens
(ESA/NASA/JPL/University of Arizona)
Reusing technology

Venus express

Mars express

Rosetta

Ground segment

Ground segment

Ground segment

Ground segment software infrastructure

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TESTING NEEDS
Evolution of the GS Sw infrastructure

Launch: 2003
Downlink: 230 kbps
Daily data volume: 1~5 Gb
Operating system: Solaris
Platform: Sun Sparc
User interfaces: C++ toolkit

Mars Express preparing for launch (copyright ESA/STARSEM-S.Covaja)

Launch (expected): 2016
Downlink: 697 kbps-2146 kbps
Daily data volume: 1.7~92 Gb
Operating system: Suse Linux Enterprise Server
Platform: virtualised
User interface: Java SWT

Exomars vibration testing (copyright ESA-S.Covaja)
Rosetta’s journey (ESA)
The challenge

Add test automation to a system…

…that was not designed for test automation…

…and evolve
TEST AUTOMATION
Test automation: accessing the software under test

- Test execution (test commander)
  - Test programme
  - Script
    - Python stubs
- Test generator (Atos TEMPOPO Designer)
- API
  - Model (business logic)
  - View (presentation logic)
- omniORB compiler
Test automation: Basic tools

Atos TEMPPPO Designer (formerly IDATG)

ESA’s Test Commander

Sync tool
Test automation: accessing the GUI

- Test execution (test commander)
  - Test programme
  - Script
    - Python stubs
      - GUI test driver
        - GUI Test tool (SWTBOT)/Jubula
        - Model (business logic)
          - API
          - CORBA
          - View (presentation logic)

- Test generator (Atos TEMPPO Designer)
### Test automation: GUI recorder

#### Severity

<table>
<thead>
<tr>
<th>Severity</th>
<th>Message</th>
<th>Type</th>
<th>Log Time</th>
<th>Event Time</th>
</tr>
</thead>
</table>

#### Type of event

<table>
<thead>
<tr>
<th>Type</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUI Event</td>
<td>Click on Item</td>
</tr>
<tr>
<td>GUI Event</td>
<td>Select from Menu</td>
</tr>
</tbody>
</table>

#### Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Rule</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node</td>
<td>node102</td>
<td>eud.application.manualstack</td>
</tr>
</tbody>
</table>

#### Application

- focusShell, 2a3a0cb0-fa86-4c67-a4d0-7a4afdae0ca, esa.egos.s2k.eud.application.manualstack
- .manualstack

#### Object map (automatically generated)

![Object map image]
Test automation: full cycle

- **Test execution (test commander)**
  - Test programme
  - Script
    - Python stubs
  - Model (business logic)
  - CORBA

- **Test generator (Atos TEMPOPO Designer)**
  - GUI test driver
    - GUI Test tool
      - (SWTBOT)/Jubula
  - View (presentation logic)
  - GUI recorder

**CORBA** Model (business logic)
Scalability

- Test suite 1
  - TEMPPO Designer file
  - Scripts
  - System A
- Test suite 2
  - TEMPPO Designer file
  - Scripts
  - System B
- Test suite 3
  - TEMPPO Designer file
  - Scripts
  - System C
- Test suite 4
  - TEMPPO Designer file
  - Scripts
CONCLUSIONS
Summary: test automation a posteriori

• Design and plan a strategy
• Use existing tools and languages where possible
• Expand the tools when needed
• Establish collaboration with the vendors
• Enforce integration with existing systems
• Beware of scalability problems
• Listen to the stakeholders
• Start small, but...

• Think big
Questions?

Thanks for your attention!
Testing example: pass operations

- Manual stack
- Telecommand history display
- Time-tagged Commands are sent in previous pass
- Status is received during Current pass

<table>
<thead>
<tr>
<th>Network interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground station back-end</td>
</tr>
<tr>
<td>Frequency conversion equipment</td>
</tr>
<tr>
<td>Spacecraft simulator (running on-board software)</td>
</tr>
</tbody>
</table>

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Critical manoeuvres example

Philae descent over comet 67P

(ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)

Image of asteroid Lutetia

(Besse et al (2014); image: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)
Test automation: integration in SDE

Software development environment

- DOORS (requirement management)
- HP-quality center (test management)
- Reporting system

Sync tool
- Jenkins scripts (continuous integration)

Test design (TEMPO Designer)
- Test plans

Test execution (test commander)
- Test results