STANDARD-BASED AUTOMATION:
SCALABILITY, FLEXIBILITY AND EXCHANGE
FOR LONG TERM MISSIONS

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Why?
WHY?

- Communication GS
  - Required for
  - Operating the spacecraft, performing task
  - Sending TCs
  - Receiving TMs
- Critical
  - Failures have grave consequences
  - Complexity increases exponentially.
- Technological gap in SW technologies and architectures
WHY?

- Communication GS
- Increase of involved systems
  - Reuse/Tailoring of systems
    - Licensing problems/Right relation with specific requirements.
    - Heritage (Commercial aspect)
      Reinventing the wheel for each mission
  - Lack of interoperability
- Development of EGS-CC
WHY?

- Communication GS
- Increase of involved systems
- Need for Automation capability
  - Use of Procedures
    - Syntax vs. functionality
  - Multiple applicable standards
  - Understanding of the standards
- Improve HMI and port them to new devices
WHY?

• Communication GS
• Increase of involved systems
• Need for Automation capabilities

• Re-engineer automation systems → SOA, OSGI, HMIs
• Conceptualization of procedure requirements
• Develop of interfaced plug-play automation framework
What?
WHAT? – INFORMATION TO BE HANDLED

• What entails automation?
  • Execute simple/complex tasks without involving the user at every step obtaining deterministic behaviors.
  • Handle data and erroneous situations following a standardized approach.
  • Scheduling tasks depending on data and/or time conditions.

• What is needed for automation?
  • Data Model to be handled
  • Automation Language (i.e. Procedure Language) Editor and compiler
  • Execution Engine
WHAT? – MAIN CONCEPTS (I)

• What entails automation?
• What concepts have to be handled?
  • ECSS-E-ST-70-31 (SSM)

In EGS-CC:
SSM ↔ MCM
WHAT? – MAIN CONCEPTS (II)

- What entails automation?
- What concepts have to be handled?
  - ECSS-E-ST-70-32
WHAT? – MAIN CONCEPTS (III)

• What entails automation?
• What concepts have to be handled?
  • In EGS-CC, requirements of ECSS-E-ST-70-32
WHAT? – SCALABILITY PURPOSES

• What entails automation?
• What concepts have to be handled?
• What is the long-term durability to be provided?
  • Allow future updates in the standards
  • Allow new automation standards
  • Develop new graphical aspects
  • Easy portability of the existing features
  • Loose coupling of new features
How?
HOW? – REQUIREMENTS AND TARGET CLASSIFICATION

**Business support**
- Reduce human errors
- Facilitate standardization of procedures
- Time saving
- Increase the level of automation

**User support**
- Interfaceable with legacy Systems
- Execute all types of Activities
- Graphical Editor Interface
- Flexible

**Distributed Architecture**
- Open source based application
- Eclipse/Java Developed
- Platform Independent
- Multi-domain
- Service-based
HOW? – AUTOMATION FEATURE BRANCHES

- SSM
  - SSM Editor
  - SSM Consistency Checker

- Activity Type
  - Procedure Editor/Viewer
  - Procedure Debugger
  - Procedure Executor
  - Procedure Scheduler
  - Procedure Validator

- Schedule
  - Schedule Editor
  - Schedule Executor

- Management
  - Configuration Manager
  - Logger
  - Archiver
  - Reporter
  - Formation Flying Controller

Java AP Language

MCM
HOW? – ARCHITECTURE MODULES

Eclipse
JAVA
SOA
ESB
Camel
OSGI

EMF
ORM
Xtext
XSD
SQL
HOW? – PROCEDURE HARMONIZATION (I)
HOW? – PROCEDURE HARMONIZATION (II)

ORM

BPM

Requirements Specifications

Conceptual Data Model

Logical Model
HOW? – PROCEDURE HARMONIZATION (III)
HOW? – PROCEDURE HARMONIZATION (IV)

EMF

XMI

DB

Xtext

Procedure returns Procedure:
  <PROCEDURE> (procedureDeclarationBody = Procedure_declaration_body)? (precondition = Precondition)?

Procedure_declaration_body returns ProcedureDeclarationBody:
  <DECLARE> (eventDecl = EventDeclaration)? </DECLARE>

EventDeclaration returns LocalEvent:
  <EVENT> name = ID ('DESCRIPTION') eventDec = STRING '</DESCRIPTION>?> </EVENT>

PreconditionsBody returns PreconditionsBody:
  <PRECONDITIONS> (expression = Expression) </PRECONDITIONS>

ConfirmationsBody returns ConfirmationsBody:
  <CONFIRM> (expression = Expression) </CONFIRM>

WaitStatement returns WaitStatement:
  <WAIT> (expression = Expression) </WAIT>

Timeout returns Timeout:
  <TIMEOUT> expression = Expression </TIMEOUT>
Where?
WHERE? – SPACECRAFT INFORMATION (SSM)
WHERE – PROCEDURE EDITORS AND COMPILERS
WHERE? – ACTIVITY EXECUTION ENGINE
WHERE? – MONITORING TELEMETRY DISPLAY

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So...what now?
SO...FUTURE WORK

- Support for non-space automation standards
- Support for programming language scripts
- Developing a space HMI library
- Increasing the set of features
  - Scheduling
  - User Management
  - Security Management
SO...FUTURE WORK....TOWARDS THE EGS-CC

- Adaptation between the ASE5 and EGS-CC:
  - DSLs to/from EGS-CC AP Format
  - Driver between ASE-5 and EGS-CC engines
  - Router between SSM and MCM models
  - Transformation from SOA WS to OSGI Services
Any Question?...