

DLR's Virtual Satellite Approach Holger Schumann DLR - Simulation and Software Technology SESP 2008, 07.10.08



Outline

- Motivation
- ✓ The Virtual Satellite Project
 - ✓ Implementation
 - → Data Model
 - → Basic Framework RCE
 - ➤ System Component Repository

 - ✓ Automation and Analysis Environment
 - ✓ Experiences with SMP2 and SIMSAT
- → Conclusions



Motivation

- ✓ Decision for starting a DLR compact satellite program in 2007
 - ✓ Series of 100 kg satellites
 - ✓ Based on a generic reusable standard satellite bus (SSB)
 - → AsteroidFinder first mission
 - → Detection of inner Earth objects (IEOs)
 - → Launch around end of 2011
 - → Caused by successful DLR BIRD satellite and OOV-TET
- → Founding of the Institute for Space Systems
 - ✓ Founding of the Concurrent Engineering Facility (CEF)
- ✓ Need for a simulation-based development process for satellites identified





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Deutsches Zentrum DLR für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Holger Schumann 07.10.08

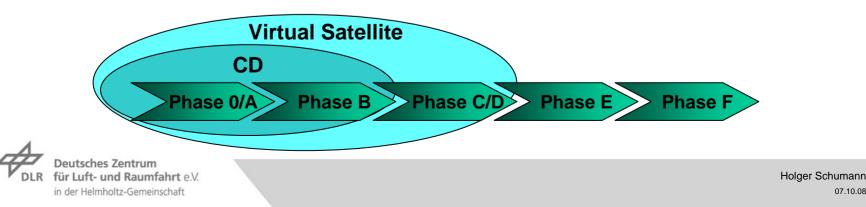
The Virtual Satellite Project **Overview**

Objectives 7

- Evaluation of a suitable system description language
- Definition of a system design model 7
- Creation of a central System Component Repository for reuse of 7 models

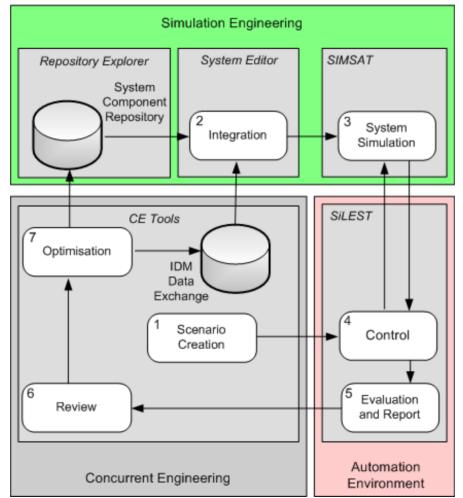
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- Support for a rapid system simulation generation
- Application in DLR's compact satellite program using the CEF
- ✓ Scheduled for 2007 2009
- Budget nearly 1000 kEur 7



The Virtual Satellite Project

Overview of process and supporting tools





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Implementation Data Model

- ✓ Requirements
 - ✓ Unique central data model for all phases
 - ✓ IDM and ECSS E-TM-10-25A compatible
 - ✓ Parameter assigned to System Components (object orientation)
 - Hierarchy of System Components (derivation and composition)
 - ✓ References to files (e.g. SMP2 binaries)
 - ✓ Design options, projects, versioning
- Implementation based on work of the Technical University Munich (Institute of Astronautics)



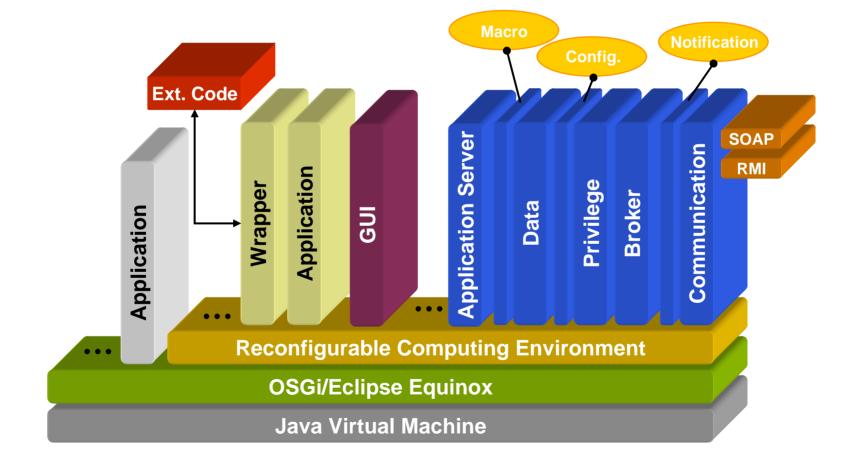
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Implementation Basic Framework RCE

- Many projects need similar software components
 - Data management, graphical user interface, distributed computing, service-oriented communication, …
- Reinventing basic software components each time is a waste of time
 Idea: Use a general purpose integration platform
- Reconfigurable Computing Environment (RCE)
 - "Standing on the shoulders of giants."
 - \checkmark based on OSGi and Eclipse
 - ✓ Developed by Simulation and Software Technology, DLR
 - ✓ Prepared to achieve objectives of ESA's OCDS project



Implementation Basic Framework RCE





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Implementation System Component Repository

- ✓ Objectives
 - ✓ Storage of simulation models and collection of DLR knowledge
 - Provision of ready-to-use SMP2 model binaries
- Composition of a System Component
 - Platform independent description (UML or Catalogue)
 - ✓ Further metadata (version, parameter constraints, usage history)
 - Implementations (SMP2 binaries)
 - → Source Code (C++, Simulink, Modelica)
 - Assembly for components containing a system
- ✓ Repository Explorer tool
 - → Browsing of components, provision of information and binaries
 - ✓ Management of repository (add components, import catalogues)



Implementation System Editor

✓ Objectives

- ✓ Creation of an interdisciplinary system model (according to IDM)
- Provision of a simulink-like editor for assembling System Components (interaction with Repository Explorer)
- Creation of an SMP2 simulation (Assembly, Schedule, simulation architecture)
- ✓ Implementation using modern Eclipse technologies (Ecore, EMF, GMF)



Implementation

Automation and Analysis Environment

Objectives

- Support of formal definition of operation scenarios (simulation inputs and expected outputs)
- Initialisation and control of simulation as well as fetching results
- Automated evaluation of results and report generation

SiLEST (Software-in-the-Loop for Embedded System Test)

- ✓ Nationally funded project, successfully finished in 2006
- Output: Simulation-based test process for embedded systems (e.g. satellites), supporting tools
- Professionally applied by IAV GmbH (automobile industry), TU Berlin (research), and DLR



Experiences with SMP2 and SIMSAT

- Very useful to understand SMP2 (rules-based validation)
- ✓ Not applicable to our engineers
- ✓ Maturity of user interface improvable
- → SIMSAT code generator
 - ✓ Generation of Makefiles very useful
 - ✓ Merge feature very useful, but improvable
- → SMP2
 - ✓ Usage of several Assemblies, Schedules and binaries allowed
 - Problems with inter model communication (interface-based, component-based), Resolver service worked fine



Conclusions

- ➤ Simulation-based design and development process defined
- ✓ Supporting tools based on DLR's RCE framework partly implemented
- ➤ IDM and ECSS compatibility preserved
- ➤ SMP2 used for supporting portability and reusability
- ✓ Application in DLR's compact satellite program using the CEF

