Fuel your Automotive Innovation with IBM Rational platform for automotive industry.

Learn about adoption experiences and results achieved by top OEMs and T1s.
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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user’s job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.
Agenda

- Many tools for many tasks multidisciplinary engineering with Rational
- Adoption Experiences from leading OEMs and suppliers
Technological fusion for next-gen automotive technology:

According to AberdeenGroup, 68 percent of manufacturers cite synchronization of mechanical and electrical design representations as a key product development challenge.

Engineering merger:
- New fundamentals derive from existing know-how
- New technology can rapidly evolve if existing assets are well managed
Multiple Parallel Vs running multidisciplinary engineering

- Brand Portfolio
- Model Functions
- Requirements
- Functional Networks

- Logical Architecture
- Software
- Network / COM / BSW
- Electrical / Harness
- Mechanical MCAD

- Automobile
- E/E network
- Application SW
- Basic SW
- ECU

- SW Architecture
- SW Design & Implementation
- SW Deployment on ECU

- Driver / Field Test
- Functional Test
- E/E system tests
- E/E system integration
- Sub-system-tests
- Sub-system integrations
- ECU tests
- SW tests

Rational Software Platform for Systems

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Rational Solution for Automotive Engineering

3 Integrated Dimensions

DEVELOPMENT LIFECYCLE
IBM Rational solution for Systems and Software Engineering

ECOSYSTEM

AUTOSAR
Extends out base S&S Accelerator with AUTOSAR for ECU software implementation

ISO26262
Extends base S&S Accelerator with support for Automotive Functional Safety standard, ISO 26262. Provides process, practice guidance and tooling that support ISO 26262

OSLC
Rational Solution for Automotive Engineering

Dimension 1 - Lifecycle

Systems and Software Engineering

- BEST PRACTICES & SERVICES
- REQUIREMENTS MANAGEMENT
  Rational DOORS
- QUALITY MANAGEMENT
  Rational Quality Manager
- ARCHITECTURE & DESIGN
  Rational Rhapsody
- COLLABORATION, PLANNING & CHANGE MANAGEMENT
  Rational Team Concert

search query report metrics process admin

GENIVI AUTOSAR ISO OSLC XML BUILT ON eclipse.

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Open Services for Lifecycle Collaboration

Simplifying collaboration across the software delivery lifecycle

An industry initiative for making it easier to use software delivery tools in combination.

Current Membership Includes

- BigLever
- General Motors
- Boeing
- IBM
- EADS
- Northrop Grumman
- Ericsson
- Siemens

Open interfaces. Open possibilities.

Barriers to sharing resources across the software lifecycle

- Multiple vendors, open source projects, and in-house tools
- Private vocabularies, formats and stores
- Entanglement of tools and data

The Open Services initiative is

- **Building** a community of software vendors, open source projects, integrators, and corporate IT teams, operating at open-services.net
- **Creating** public specifications of resources and services for sharing the things that software teams rely on, like change requests, test cases, defects, requirements and user stories
- **Delivering** loosely coupled resource formats and services with “just enough” standardization
OSLC and Jazz: An open architecture for lifecycle tool integration

- **Built for the 21st century**: designed using Web architectural principles, implemented with Web technologies
- **Realistic**: recognizes that customers will not replace their current investments wholesale
- **Pragmatic**: allows tools and services to be upgraded independently, without sacrificing rich integration
- **Open**: supports the requirement to have a variety of tools from different sources
Example Deployment for a Jazz-based Engineering Platform

IBM tool

3rd party

RTC, RQM, DOORS

Components, Streams, Work items, Test artifacts, Requirements

Design Mgr

Model elements

Organize, Visualize, and Analyze across artifacts & configurations

Navigator

RTCArch

Central index

PDM

Mechanical assemblies

ERP

Financial data

EDA Design

PCB, wiring, bus models

Plant Simulation

System, network and software models

Architecture & Software Design

IBM tool

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Rational Solution for Automotive Engineering

**Dimension 2 - Ecosystem**
Multi domain integration: **Harness Design** using MG Capitol and RTC Integrated with OSLC

**Participating in the Change Ecosystem**

Change Order 345:
*Add iPod connector to rear console*

IBM Rational Team Concert used to initiate, plan, assign, and monitor change across multiple domains.

- EDS
- MCAD
- Network
- SW
- Components

Multi multidisciplinary integration: **Harness Design using MG Capitol and RTC Integrated with OSLC**

- Work items automatically become Change Orders in Capital
- Individuals can view their open activities
- Participating designs will become associated with work items
- Status of participating designs changed – eg completed

[Rational Team Concert](http://s3.mentor.com/events/iesf/detroit/presentations/2012/cracking-the-change-management-problem.pdf)
Multi domain integration:

Harness Design using MG Capitol and RTC Integrated with OSLC

Change Propagation in the Flow

Entire and fully automatic

User selected and automatic

Multi domain integration: **PLM using Siemens and RTC Integrated with OSLC**

Interoperability Scenario (as is)

**An Open Services (OSLC) Approach to ALM and PLM Integration for Systems Development**

**Rainer Ersch**  
*Senior Research Engineer, Siemens*  
rainer.ersch@siemens.com
Multi domain integration:

Modelica Plant Model

Simulink model computation algorithm

UML based behavioral model

EDA Asic Model

PLM Model

SysML Architecture Model

Design Manager

Open Services

Jazz platform
The need for integration: Cyber Physical Systems (CPS)

- The term cyber physical system refers to the integration of computation with physical processes.
  
The need for integration

- UML and SysML are well suited for
  - Specifying and analyzing requirements (requirements, use cases, actors, etc.)
  - Specifying system and software structures (blocks/classes, parts, connectors, ports, associations, etc.)
  - Specifying processes spanning across multiple classifiers using activity diagrams
  - Specifying complex reactive behaviors using state machines
  - Specifying procedural behavior using activity diagrams

- Simulink is well suited to describe continuous transformational behavior
  - Continuous algorithms for control systems
  - Continuous plant behavior describing physical processes

- MATLAB is an efficient tool to perform complex computations using vector algebra
- MATLAB Symbolic Math Toolbox is a Computer Algebraic System (CAS) able to solve equations symbolically
Rational Rhapsody integration points with the Mathworks products

<table>
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| Hosted Simulation              | 1. Generate executable code from a Rhapsody model with parts implemented in Simulink  
   1. The Simulink code may represent either:  
      ▪ Algorithms implemented in the system  
      ▪ The behavior of the environment (plant)  
   2. Models can be animated if code is instrumented  
   3. Rhapsody references code generated from Simulink by Embedded Coder | MATLAB, Simulink, Real-time workshop with Embedded Coder     |
| S-Function Generation          | Generate an S-Function block to be used in Simulink models from a UML class / SysML block                                                                                                                    | MATLAB, Simulink                                            |
| Plant Model Integration        | Generate and simulate a Simulink model from a structured SysML block/UML class that consists of SysML/UML parts connected to parts implemented in Simulink                                                        | MATLAB, Simulink                                            |
| Parametric Constraint Evaluation| 1. Solve SysML parametric diagrams using MATLAB Symbolic Math Toolbox  
   2. Include MATLAB expressions for computations                                                                                          | MATLAB, MATLAB Symbolic Math Toolbox                       |
Integration points usage on the “V-Model”

- Requirements Analysis
- Functional Decomposition
- Design Synthesis
  - Trade Study
  - Component/Subsystem Spec.
- Analysis
- Design
- Implementation
- Parametric Constraint Evaluation (PCE)
- Plant Model Integration
- Hosted Simulation (algorithmic integration)
Parametric Evaluation using MATLAB expressions and Modelica equations

SysML Parametric Diagrams – constraints are expressed using a subset of the Modelica language or MATLAB expressions

Constraint View – a spreadsheet-like editor to control the evaluation

More information is available in the PCE tutorial: https://www-304.ibm.com/support/docview.wss?uid=swg27018723

Computer Algebra System (CAS) – MATLAB Symbolic Math Toolbox or MAXIMA
Plant Model Integration Canonical Workflow

- **Rhapsody**
  - Draw BDD - Specify SystemBlocks
  - Identify Simulink Blocks to be developed
  - Define inputs and outputs of blocks in the form of atomic flow ports and possibly other features
  - Export block to Simulink

- **Simulink**
  - Import/Synch Simulink Model
  - Identify Existing Simulink Blocks to be reused
  - Skeleton Simulink Block
  - Complete the Simulink model

- **Simulink Model**
  - Simulink Model of the composition
  - Simulate the (sub-)system

[Diagram showing the workflow]
Hosted Simulation canonical workflow
Creating a skeleton Simulink model from a stub SysML block

(In Development for Rhapsody next)

Note: In the current Rhapsody version, one needs to specify the Simulink model first and then synchronize it into the model (see next slide)

New:
- Data Structures are transformed into Simulink buses and vice versa
- Support for enumerated data types

Must be stereotyped «SimulinkBlock»
Importing a Simulink model into Rhapsody (with or without implementation code)

- For hosted simulation one needs to generate code from the Simulink model and then import/synch
  - Requires Simulink embedded coder

- For plant model integration one needs to import/synch only if the ports were modified in the Simulink model, **there is no need to generate code from Simulink**
S-Function Generation

- MATLAB/Simulink S-Function is a user defined block implemented in C/C++ or other programming language.
  - The S-Function code must conform to the S-Function standard in order for Simulink to understand its interfaces and to interact with it.
  - Simulink models can have S-Function blocks which are using these user defined action.
- Rhapsody can generate C/C++ code corresponding to blocks stereotyped «S-FunctionBlock» along with a mex option file to generate an S-Function simulink block
  - The generated code conforms to the S-Function standard and transforms the ports accordingly
- The S-Function generation capability is used by the Plant Model integration
Simulation in Simulink (aka “plant model integration”)

- «StructuredSimulinkBlock» are blocks that contain parts typed by «SimulinkBlock» in their hierarchy.

- A «StructuredSimulinkBlock» is transformed to a Simulink model that consists of an S-Function block for the SysML/UML parts and usages of the Simulink models represented by the «SimulinkBlock» parts or other «StructuredSimulinkBlock» parts (involves code generation of S-Function).
Model execution in Rhapsody (aka “hosted simulation”)

- Once the import/synch is done for the blocks (Simulink model and generated code), simply generate / make / run to execute
- If the configuration is set to Animation, the non-Simulink parts of the model will be animated
  - The Simulink blocks are treated as “black box”
Integrating Simulink in Rhapsody Design Manager

- It is possible to publish Simulink models into Rhapsody Design Manager (RDM) and create links to the model
  - In RDM Next we plan to automate a creation of an OSLC link between the SysML Simulink Block and the Simulink model based on the information in the Rhapsody model that references the Simulink model file. In the current version this link can be created manually.
Summary

- Several integration points are available between Rhapsody and MATLAB/Simulink
- The integration allows design and simulation of cyber physical systems
  - UML/SysML provides the high level design capabilities and discrete behaviors
  - MATLAB/Simulink provides the means to describe continuous behavior
  - PCE allows solving equations and performing MATLAB computations in the context of the design model
- Bringing Simulink into RDM enables a distributed model accessible over a web interface as well as leveraging the advantages of the Jazz platform for Simulink

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Agenda

- Many tools for many tasks
  multidisciplinary engineering with Rational

- Adoption Experiences from leading OEMs and suppliers
General Motors leverages Rational tools to develop innovative products

IBM helps GM develop smarter products like the Chevrolet Volt

What's smart?

- Innovative electric drive system uses software and electronics to control interaction of electric motors and gasoline engine
  - “System of systems” seamlessly integrates electric drive system with powertrain and body controllers
  - >10 million lines of code in car; nearly 100 microprocessors

Smarter business outcomes

- Smarter products delivered in less time
  - Volt was delivered in <5 years, compared to typical 10+ year development cycle for new vehicle technology

How IBM helps GM develop smarter products

- Rational DOORS for requirements management
- Rational Rhapsody for model-driven development
- Rational Team Concert for team collaboration
- Rational Asset Manager for engineering asset management
- Rational Professional Services for technical services
- IBM Global Services for business transformation services

“The IBM Rational platform enables our globally distributed teams to collaborate in real-time to develop innovative software and electronics for our vehicles. GM’s use of the Rational platform will deliver business results in efficiency, time-to-market, quality, and overall customer satisfaction.”

General Motors
Customer Success: Create and sustain market demand

Hydraulic hybrid delivery vehicles - Eaton & UPS

What’s smart?

- Innovative technology for urban delivery trucks in stop-and-go traffic
- Smart software to optimize energy usage and reduce greenhouse gases

Smarter business outcomes

- 60-70% increase in fuel economy, according to EPA
- 40% reduction in CO₂ emissions

How Rational enables smarter products

- Software modeling to optimize system performance
- Automatic generation of in-vehicle software code

“The suite of Rational tools, including Rhapsody, DOORS, ClearCase and ClearQuest, provides Eaton an integrated software framework that allows us to deliver innovative products more quickly and efficiently.”
Customer Success: Smarter products require efficient processes
Complex systems for automotive - Delphi Corporation

What’s smart?
- First prepackaged airbag assembly within a steering wheel
- Teams in 35 countries collaborating on parallel releases using shared requirements

Smarter business outcomes
- Successful introduction of prepackaged airbag/steering wheel in the Smart Fortwo vehicle made by Daimler

How Rational enables smarter products
- Requirements sharing across globally distributed teams and projects
- Component reuse enabled by automated requirements management

“DOORS has helped Delphi improve development team communication, resulting in meeting customer requirements faster and more accurately.”
Customer Success: Integrated automotive control systems
Continental Automotive Body & Security Group

What’s smart?
- Passive start and entry systems, remote keyless entry, and more - in one integrated system
- Enhanced driver experience with intelligent safety and convenience features

Smarter business outcomes
- Cost-optimized flexible system solution
- Reduced development costs based on use of standardized hardware and software components

How Rational enables smarter products
- Requirements management across development teams and with vehicle manufacturers
- Streamlined development environment with model-driven systems and software development supporting AUTOSAR

“IBM Rational DOORS and Rhapsody are essentially helping us prevent fragmentation of our development environment and enabling us to better manage the complex architectures of our products.”
Get Involved on Jazz.net

jazz.net/projects/design-management

- Technology initiative to...
  - Bring design management capabilities to Jazz
  - Provide a collection of design management services that can be used by any design tool
  - Involve the community in defining the services needed for design management

- You can participate
  - Learn more
  - Register on jazz.net
  - Download and try it out
  - Ask questions and give feedback
  - View plans and dashboards
  - Report defects and request enhancements
A Dr. Dobb's Webcast:
Evolution of Automotive System Requirements - The Increased Need for Collaborative Design Management

Registration Page

Duration: One Hour

In recent years, automotive systems have grown increasingly complex as electronic control units define a greater percentage of vehicle functionality and end-product differentiation. To maintain schedule adherence and satisfy complex system requirements, engineering organizations are increasingly turning toward software and systems lifecycle management solutions as a means of promoting efficiencies and synergies in their development process.

The complexity and rising popularity of standards, such as AUTOSAR and GENIVI, are driving more automotive system manufacturers to improve their current development processes. One way organizations are attempting this is through the use of commercial modeling tools that promote the modularity, traceability, and reusability of the assets under development. Engineering organizations will need to evaluate additional products and methodologies that enable collaboration between engineering groups, manage levels of abstraction, and support any development efficiencies. This webinar discusses how these tools deliver enhanced collaboration to automotive engineering teams.

Featured Speaker:
Christopher Bremaud, Vice President, Embedded Software & Hardware, VDC Research

Neil Patterson, Marketing Manager, IBM

https://www.techwebonlineevents.com/ars/eventregistration.do?mode=eventreg&F=1003713&K=CAA1AC
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