

IBM Software Group

IBM Rational Rhapsody

Model-Driven Development of Technical,
Embedded and Real-time Systems and Software

January 2010



Innovation for a smarter planet

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Agenda

- Systems Development for a **Smarter Planet**
- The challenges of *smarter* products – a user's perspective
- The Rational solution for building smarter products
- What are our markets



Products are getting increasingly *smarter* to meet more demanding and unique needs of customers

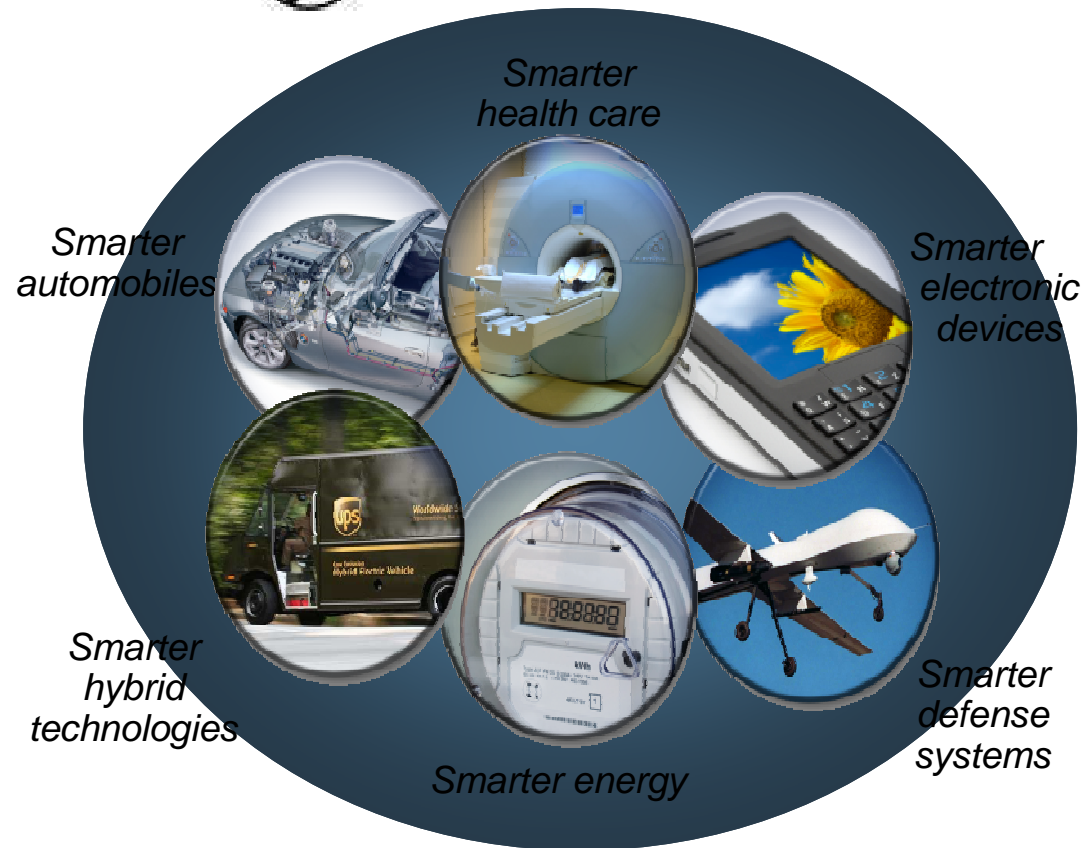
By 2010, there will be a billion transistors per human, each costing one ten-millionth of a cent. The technology is being embedded into billions of devices – cars, appliances, roadways, etc.

By 2011, an estimated 2 billion people will be on the Web – connected to devices in an unprecedented way.

90% of innovation in modern cars is based on electronics; 80% of this is based on embedded software.

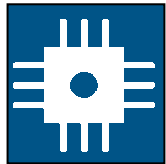


Innovation for a smarter planet.



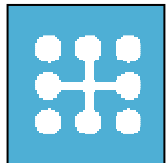
What makes a product smarter? How do they deliver value?

Embedded Computing is the driver in the innovation in products and systems



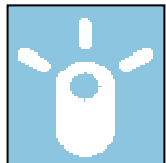
INSTRUMENTED

They can detect and measure the exact condition of their environment



INTERCONNECTED

They enable people, systems and other products to communicate and interact with each other in new ways



INTELLIGENT

They can quickly and accurately respond to changes, and get better results by predicting and optimizing for future events



Smart products transcend “one-size-fits-all” products, enabling customers to get exactly what they want - tailored to their unique needs



Customer Success

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



Think Rational
One of many ways Rational enables a smarter planet.

"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."

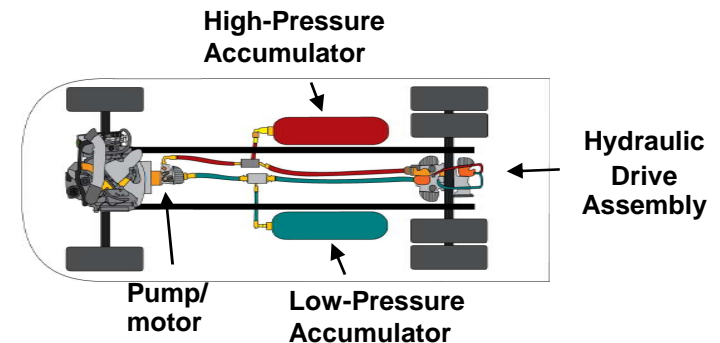


“Smarter” often means More Complex



The systems engineering challenge:

- ▶ Eaton's – maybe the world's – most complex hydraulic hybrid system ever
- ▶ Unproven, complex and mixed domain technologies must interoperate and depend on each other (electrical, mechanical, hydraulic, human, safety, etc.)
- ▶ *Manual attempts to specify the system fell short*



The software development challenge:

- ▶ Controlling this system requires relatively complex software for the pump motor and associated monitors
- ▶ Eaton's Hybrid Power Group had little experience developing and testing code of this type
- ▶ *Eaton needed to directly tie its software development to the overall systems design*



Eaton's Solution



Needs: Overcome major *complexity* challenges

Reduce cost of prototyping and developing next-generation hydraulic hybrid vehicles (HHV) and the software that controls them

Solution: Using Rational Rhapsody with Rational DOORS, Eaton was able to achieve:

- ▶ Sharpened focus on requirements and how they define the system
- ▶ Visualization of complexity through iterative systems design, simulation & testing
- ▶ Lifecycle traceability to prove that all requirements have been satisfied
- ▶ Iterative software engineering to specify and create tuned, accurate source code

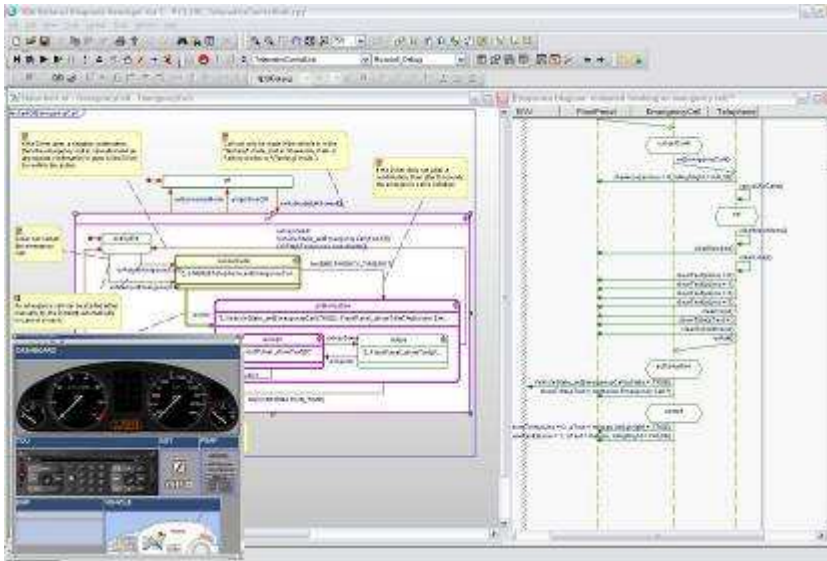


[Watch the YouTube video](#)



Model-Driven Development for Systems & Software

Rational Rhapsody®



"Using Rhapsody software improves the quality of the application software that is integral to the series hydraulic hybrid system development process."

Steve Zielinski, Eaton chief engineer for software

Capabilities

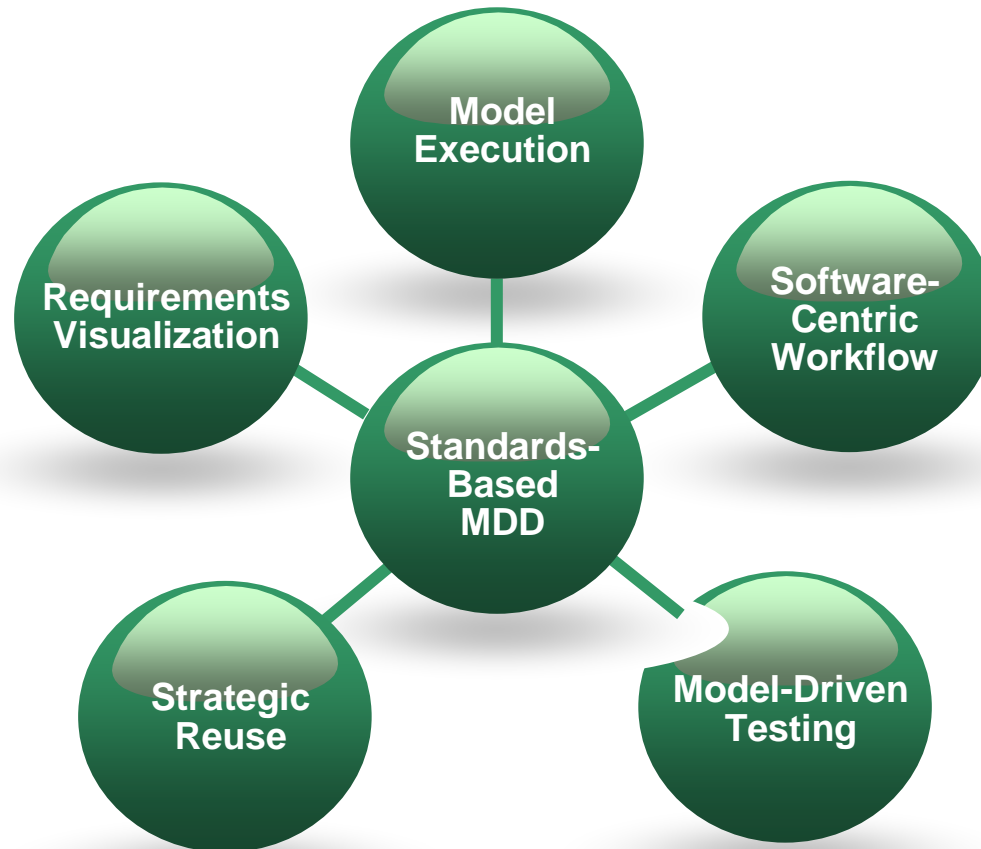
- Requirements-driven analysis and design for technical, embedded or real-time solutions, including those based on *multi-core* architectures
- Rapid design validation and verification with frequent simulation and testing
- Development and deployment of *complete* C, C++, Java and Ada applications

Benefits

- **Build the right product** through non-ambiguous communication and frequent collaboration
- **Eliminate defects early** and increase quality by continually testing the design
- **Reduce development time** by automatically generating applications and documentation
- **Re-use and adapt existing technology** through reverse engineering and product line engineering



Rhapsody Key Enabling Technologies



Domain-Focused Model-Driven Development

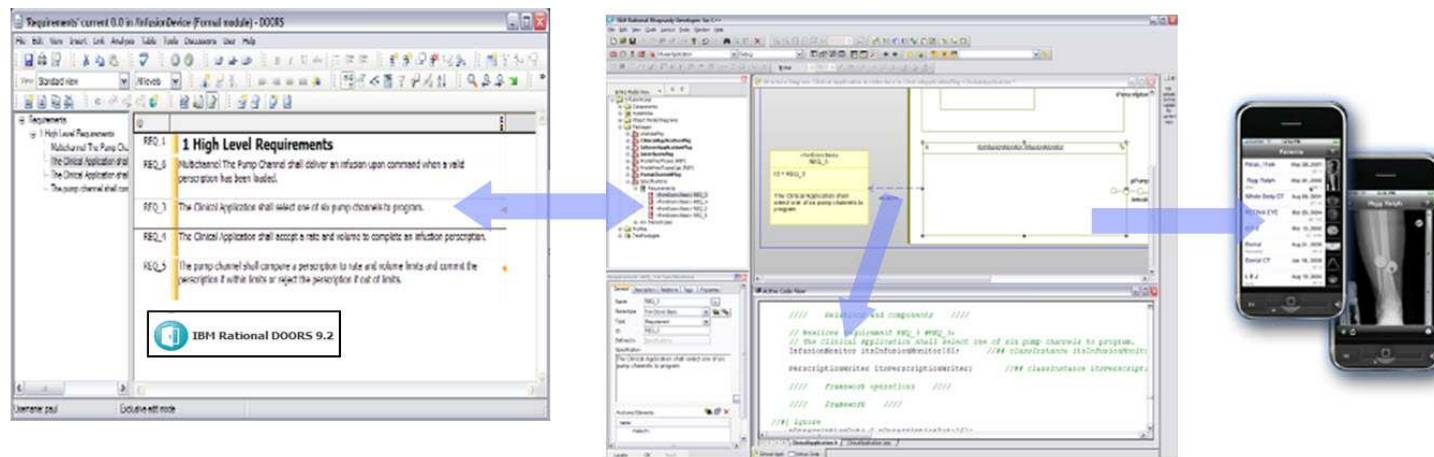


- Unified Modeling Language – UML 2.x
 - ▶ Industry-standard notation for specifying, visualizing, and documenting systems and software designs
- Systems Modeling Language - SysML
 - ▶ Extends/specializes UML to address needs of the Systems Engineer
 - ▶ Open standard published by the OMG and INCOSE
- Visualize:
 - ▶ Use cases
 - ▶ Requirements
 - ▶ Structure
 - ▶ Behavior
 - ▶ Interaction
 - ▶ Constraints
 - ▶ Tests
 - ▶ ...
- Domain-focused notations include:
 - ▶ DoDAF
 - ▶ MODAF
 - ▶ UPDM
 - ▶ AUTOSAR
 - ▶ MISRA
 - ▶ MARTE
 - ▶ ...



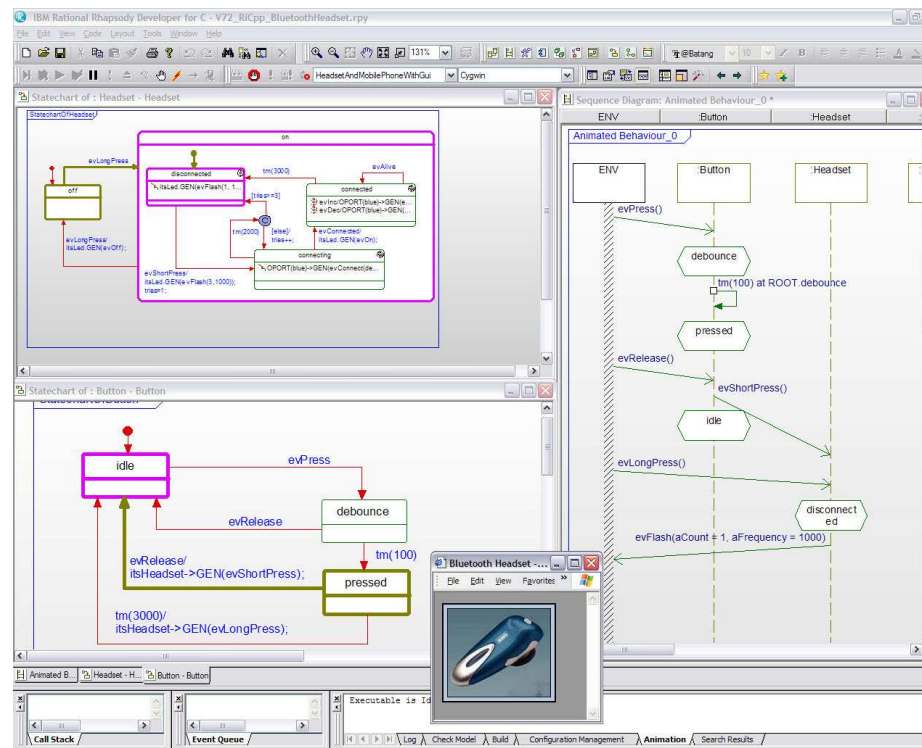
Visualize Requirements in Context

- Create the system design through imported requirements
 - ▶ Bi-directional integration with DOORS, RequisitePro and other requirements tools
 - ▶ Link requirements with the design for coverage and impact analysis
- Visualize how implemented features relate to requirements
 - ▶ View requirements in design model and source code
- Establish comprehensive traceability
 - ▶ Support regulatory compliance
 - ▶ Produce documented audit trails



Simulate & Animate

- Validate requirements and design early with continual simulation and testing
- Analyze system functionality for correctness and to determine next steps
- Visually demonstrate and communicate intended behavior to customer and stakeholders



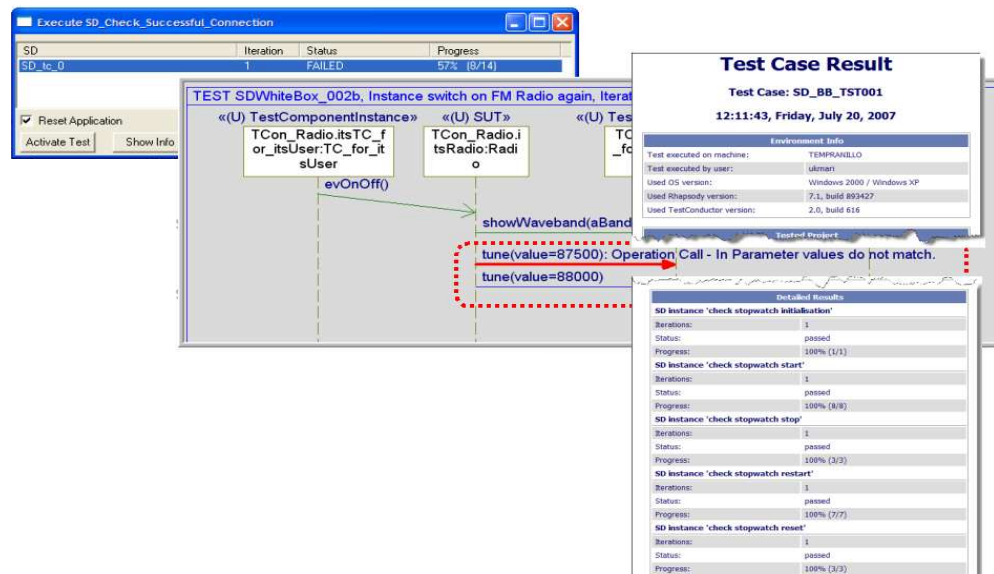
Increase Productivity through Continual Testing



Model-Driven
Testing

- Eliminate errors as they are introduced
 - Before they become too expensive to find and repair
- Simulate often to validate functionality and verify correctness
- Automatically create and execute tests against design model or target platform
 - Create test harnesses for unit testing
- Manage test cases using Rational Quality Manager

Powered by *Jazz*



The image displays a screenshot of the Rational Quality Manager interface. On the left, a window titled "Execute SD_Check_Successful_Connection" shows a table with columns for SD, Iteration, Status, and Progress. The table contains one row: SD_tc_0, Iteration 1, Status FAILED, Progress 57% (8/14). Below the table are buttons for "Reset Application", "Activate Test", and "Show Info".

In the center, a test case diagram is visible. It shows two test components: «(U) TestComponentInstance» and «(U) SUT». The diagram includes a sequence diagram with a callout box containing the text: "tune(value=87500); Operation Call - In Parameter values do not match. tune(value=88000)".

On the right, a "Test Case Result" window is shown for "Test Case: SD_BB_TST001" at "12:11:43, Friday, July 20, 2007". It includes an "Environment Info" section with the following details:

Environment Info	
Test executed on machine:	TEMPANELLO
Test executed by user:	ulmar
Used OS version:	Windows 2000 / Windows XP
Used Rhapsody version:	7.1, build 893427
Used TestConductor version:	2.0, build 616

Below the environment info is a "Detailed Results" section with the following data:

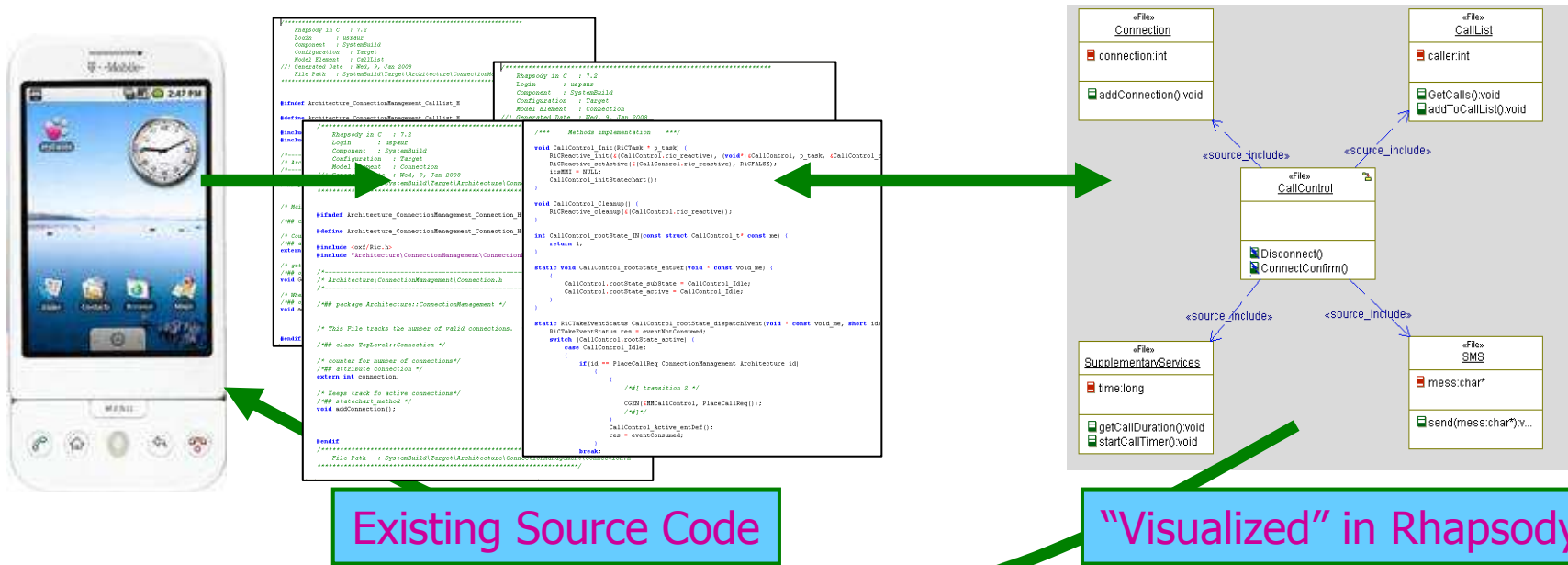
Detailed Results	
SD Instance 'check stopwatch initialization'	
Iterations:	1
Status:	passed
Progress:	100% (1/1)
SD Instance 'check stopwatch start'	
Iterations:	1
Status:	passed
Progress:	100% (1/1)
SD Instance 'check stopwatch stop'	
Iterations:	1
Status:	passed
Progress:	100% (1/1)
SD Instance 'check stopwatch restart'	
Iterations:	1
Status:	passed
Progress:	100% (1/1)
SD Instance 'check stopwatch reset'	
Iterations:	1
Status:	passed
Progress:	100% (1/1)





Develop Highly-optimized Software

- Build efficient embedded software that exactly matches the design intent
 - ▶ Specify and test deployable source code from the system requirements
 - ▶ Generate complete C, C++, Java, and Ada applications – including behavior
- Maintain automated synchronization between model and code
 - ▶ Simultaneously work with the architecture, software and target
 - ▶ View how a change in any one area is reflected in the others



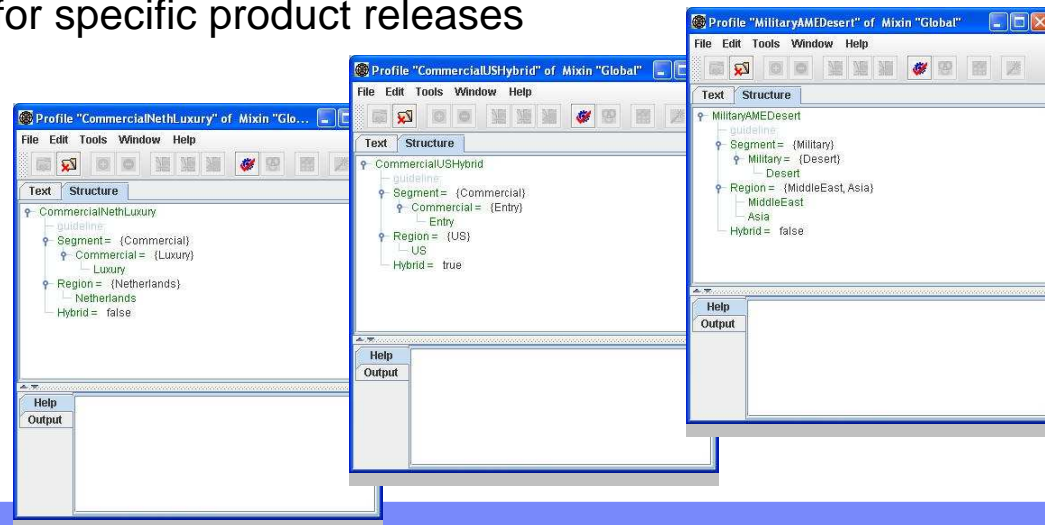
Existing Source Code

"Visualized" in Rhapsody



Maximize Technology and Minimize Effort

- Re-use intellectual property to drive business success
 - ▶ Understand and reapply existing software assets through visualization or reverse-engineering
 - ▶ Recapture valuable engineering from existing source code or models (Rhapsody, Rose or Tau)
 - ▶ Quit “reinventing the wheel” by maintaining a model-based library of design assets
- Develop and maintain product lines and families
 - ▶ Exploit commonality across range of products
 - ▶ Support differing implementations for specific product releases

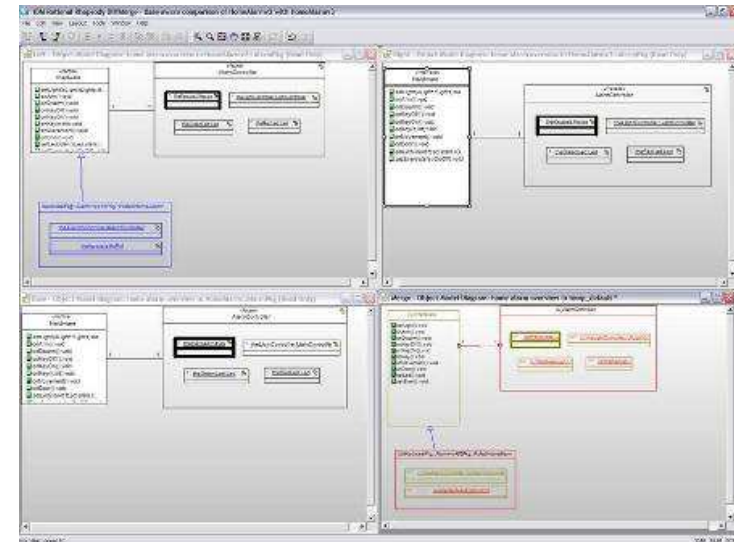


Team Collaboration



- Reduce time and risk associated with parallel development – even across very large, distributed teams
 - ▶ Automated graphical UML 2 differencing and merging
 - ▶ Maintain existing workflows through role-based integration with ClearCase, Synergy and other CM tools
- Automatically generate documentation and reports that match the implementation
- Collaborate through Jazz-enabled integration with Rational Team Concert
 - ▶ Shared views
 - ▶ Collaborative debugging
 - ▶ Linked work items

Powered by *Jazz*



Application Lifecycle Development



Rhapsody offers integrated workflows to suit user-specific needs:

- *Iterative requirements engineering* with **Rational DOORS** or **Requisite Pro**
- *Enterprise systems delivery* with **Rational System Architect**
- *Collaborative development* with **Rational Team Concert**
- *Test management and execution control* with **Rational Quality Manager**
- *Embedded software testing* with **Rational Test RealTime**
- *Team-based configuration management* with **Rational ClearCase** or **Synergy**
- *Automated reporting and documentation* with **Rational Publishing Engine**
- *Requirements import* with **Microsoft Word** or **Excel**
- *Embedded platform development* and multi-core extensions with **Wind River Workbench/VxWorks** and other embedded IDEs/RTOSs
- *Product Line Engineering* with **BigLever Gears**
- and many others...



Ensure Success with Rational

Rational software

Process and methodology

- Process framework workshops
- Rational Harmony family of Best Practices and Processes
- Process training

Implementation services

- Adoption quick starts
- Deployment support
- Project architecture workshops
- Project management
- Planning support
- Escalation/risk mitigation

Training and mentoring

- Product familiarity
- Product expertise and specialization
- Technology transfer
- Adoption mentoring
- e-Learning

Technical services

- Measured Capability Improvement Framework (MCIF)
- Product optimization and customization
- Tool configuration



Rational Rhapsody Focus



- Mechatronic Produkts / Systems
- Embedded Software



Rational Rhapsody for Aerospace/defense applications

Aerospace/defense applications

- Air traffic control
- Avionics
- Displays
- Navigation
- Autopilot
- Cabin systems
- Communications
 - Wireless
 - Secure
- Engine controls
- Flight controls
- Fuel systems
- Hydraulic systems
 - Landing gear
 - Flight controls

Aerospace/defense applications

- Landing systems
- Lighting systems
- Maintenance systems
- Military vehicles
 - Manned
 - Unmanned
- Missiles
- Mission systems
- Power management
- Radar
- Satellites
- Training Systems
- Weapon systems
 - Stores Management
 - Fire Control



Rational Rhapsody for Automotive applications

Automotive applications

- **Body/Cabin systems**
- **Communication busses** (CAN, MOST)
- **Communication Gateways**
- **Displays** (Dashboard)
- **Digital tachography**
- **GPS**
- **HVAC** (Climate control)
- **Keyless entry**
- **Lighting** (interior & exterior)
- **Occupant position**
 - Power Seat
 - Power tilt
 - Power seat belts
- **Power mirrors**
- **Power roof**

Automotive applications

- **Body systems**
 - Power Windows
 - Power sliding doors
 - Power locks
 - Radios
 - Security / antitheft
 - Telematics
 - Tire deflation indicators
 - Windshield wipers
- **Chassis control systems**
 - ABS
 - ESP
- **Powertrain systems**
 - Cruise control
 - Glow plug
 - Transmission / gearbox



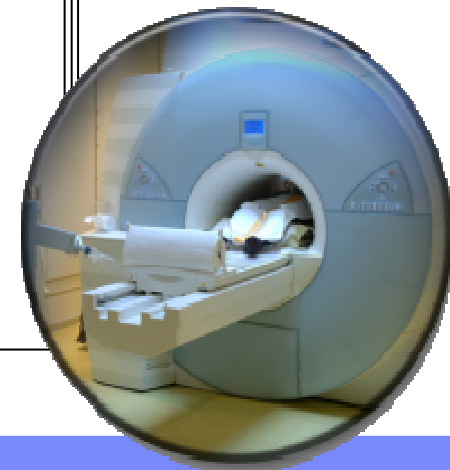
Rational Rhapsody for Medical applications

Medical applications

- Medical imaging
- Intensity-modulated radiation
- CT scanners
- Implantable therapeutic devices
- Blood oxygenation
- Heart lung machines
- Pacemakers
- Defibrillators

Medical applications

- Blood glucose monitors
- PAP test
- Blood analyzer
- Incubators
- Oncology care
- Infusion pumps and systems
- Dental treatment centers



Rational Rhapsody for Industrial automation applications

Industrial automation applications

- Air conditioning systems
- Elevator controls
- Home heating systems
- Pick and place systems
- Semiconductor manufacturing
 - Wafer inspection systems
 - Component handlers

Industrial automation applications

- PLCs
- Letter sorting systems
- Industrial process engineering
- Windmill systems
- Power plant controllers



Rational Rhapsody for Consumer electronics applications

Consumer electronics applications

- Copiers
- DECT phones with SMS/MMS
- Fax machines
- Hard drives
- Image processing
- Multifunction copiers
- Printers

Consumer electronics applications

- Security systems
- TV applications
- Cashless point-of-sale systems
- Mobile data-capturing systems
- Cash dispensers
- Mobile phones



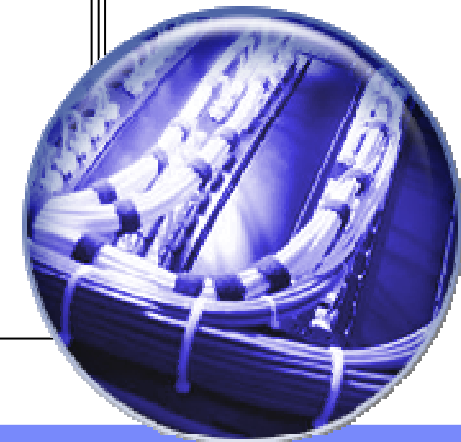
Rational Rhapsody for Telecommunication applications

Telecom applications

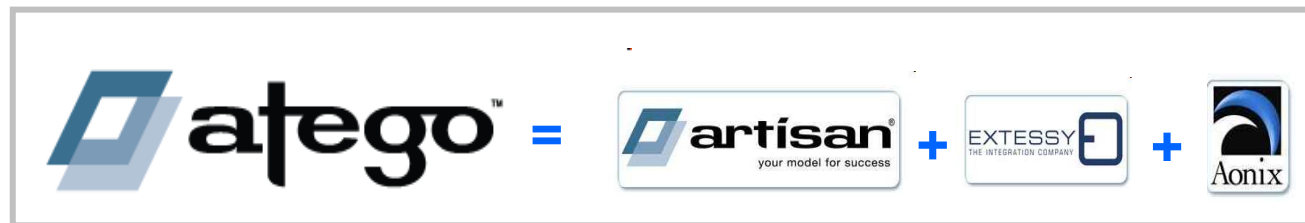
- **Routers / switches**
- **Radio access networks**
- **IP multimedia subsystems**
- **EVDO** (evolution data optimized)

Telecom applications

- **Set-top boxes**
- **Terminal devices** (handsets)
- **Telephony modems**
- **Ultra mobile broadband**
- **Wi-MAX**



Competition / Wettbewerber





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