IBM Rational Software Development Conference 2008
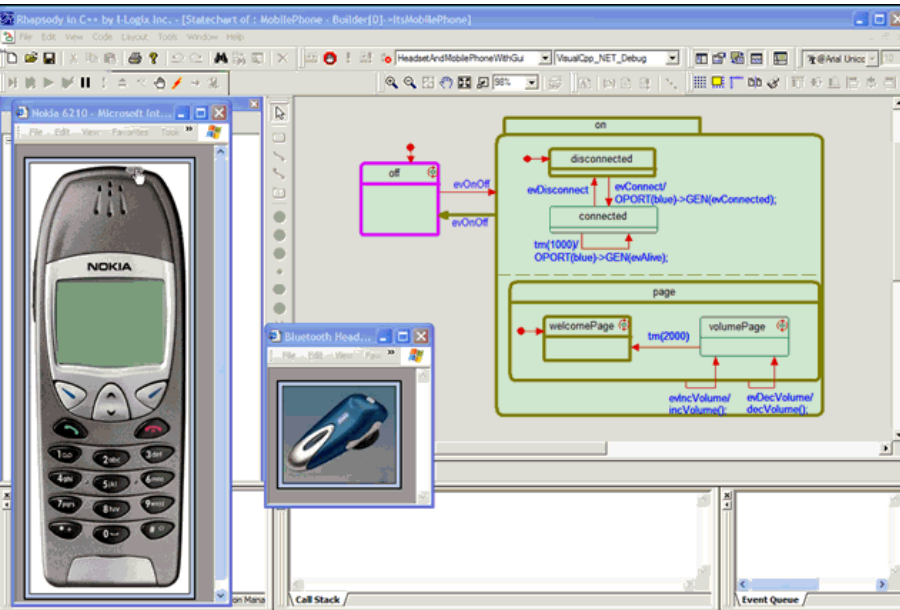
WHERE TEAMS ARE R-HEROES

Being Rational about Complex Systems Development

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SD02

Rational. software | Telelogic
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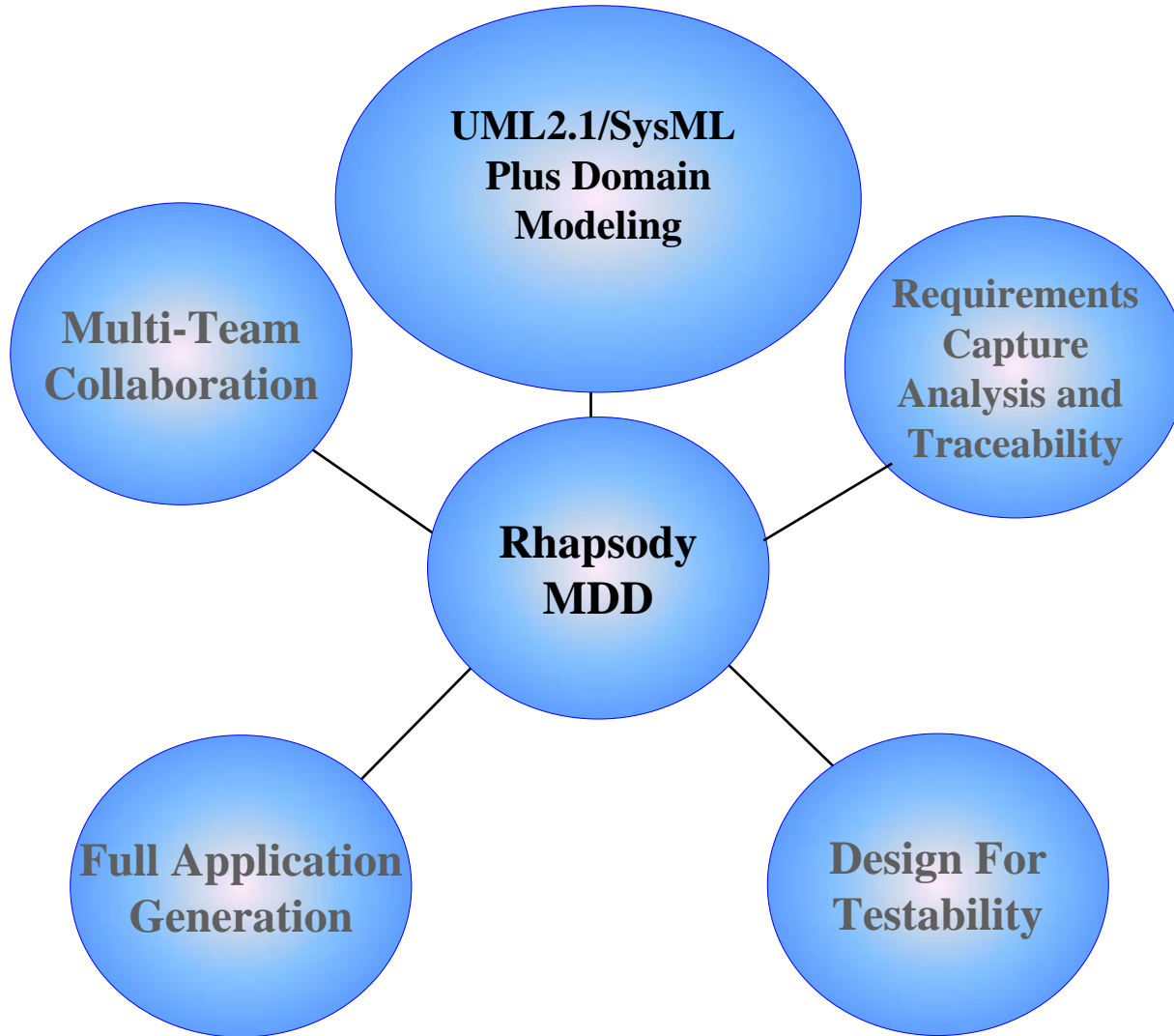# Model-Driven Development for Embedded Systems Telelogic Rhapsody

Capabilities

▸ Systems design and software development with UML 2.1, SysML, DoDAF and AUTOSAR

▸ Validate and verify designs with model based simulation and test throughout the process

▸ Produce complete C, C++, Java and Ada applications; developing in either the code or model while ensuring the two remain in sync

Benefits

▸ Optimized communication and collaboration ensures the right product is built

▸ Eliminate defects early and increase quality by iteratively testing the design as it is built

▸ Reduce development time by automatically generating applications and documentation

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Better communication through formal models

UML2.1/SysML
Plus Domain
Modeling

Multi-Team
Collaboration

Requirements
Capture
Analysis and
Traceability

Rhapsody
MDD

Full Application
Generation

Design For
Testability

Conceptual Collaboration in Text

Developer 1: (American)

"Ok. Here's how it works. Thread A will pass event X to thread B and that will change B's state to Running from what it was before which was Init. When B changes to Running it will send back an event Y to A and then wait for 2 second and then go back to Idle. Thread A will have started in Idle also and will go to Run after B sends back event Z which happens after the 2 seconds before going to Idle. All this should happen in less then 5 seconds."

Developer 2: (Chinese)

"Huh ?" What are you talking about?

Conceptual Collaboration in MDD

American

"Here look at this Sequence Diagram."

Chinese:

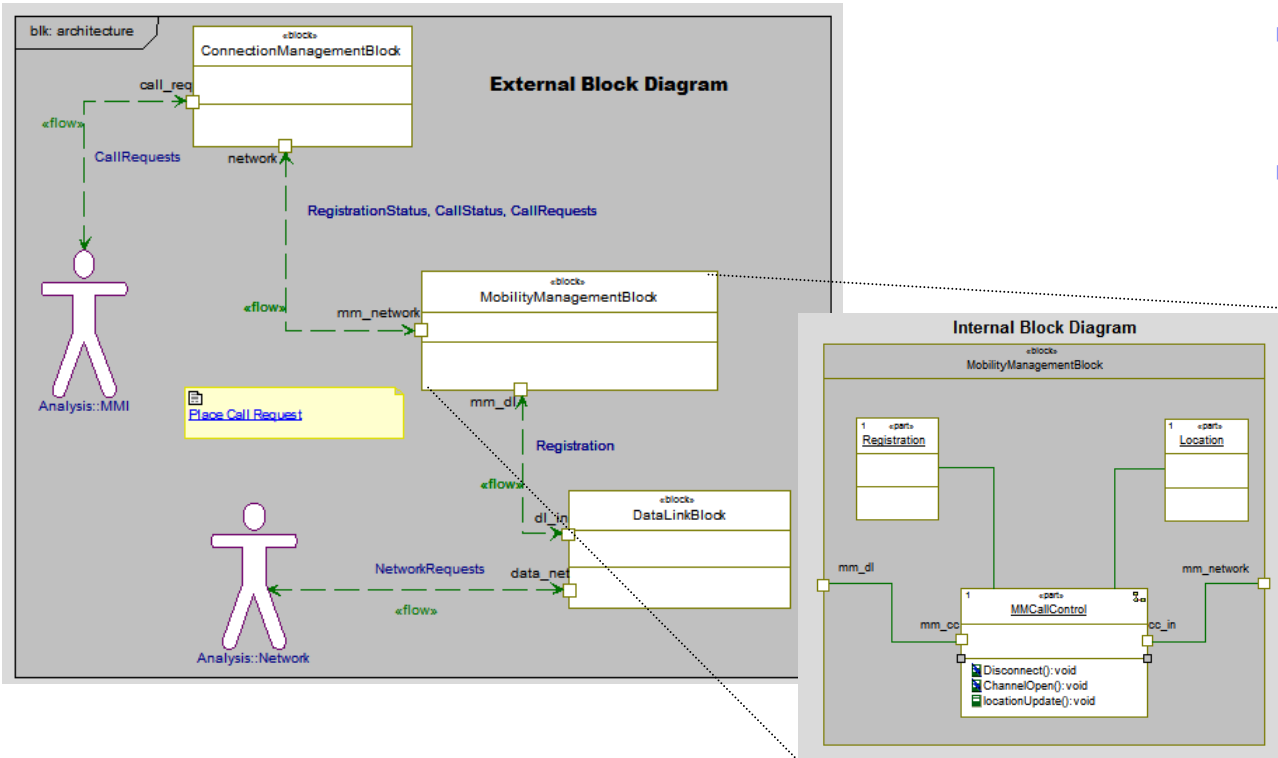"Ahhh, now I see!"
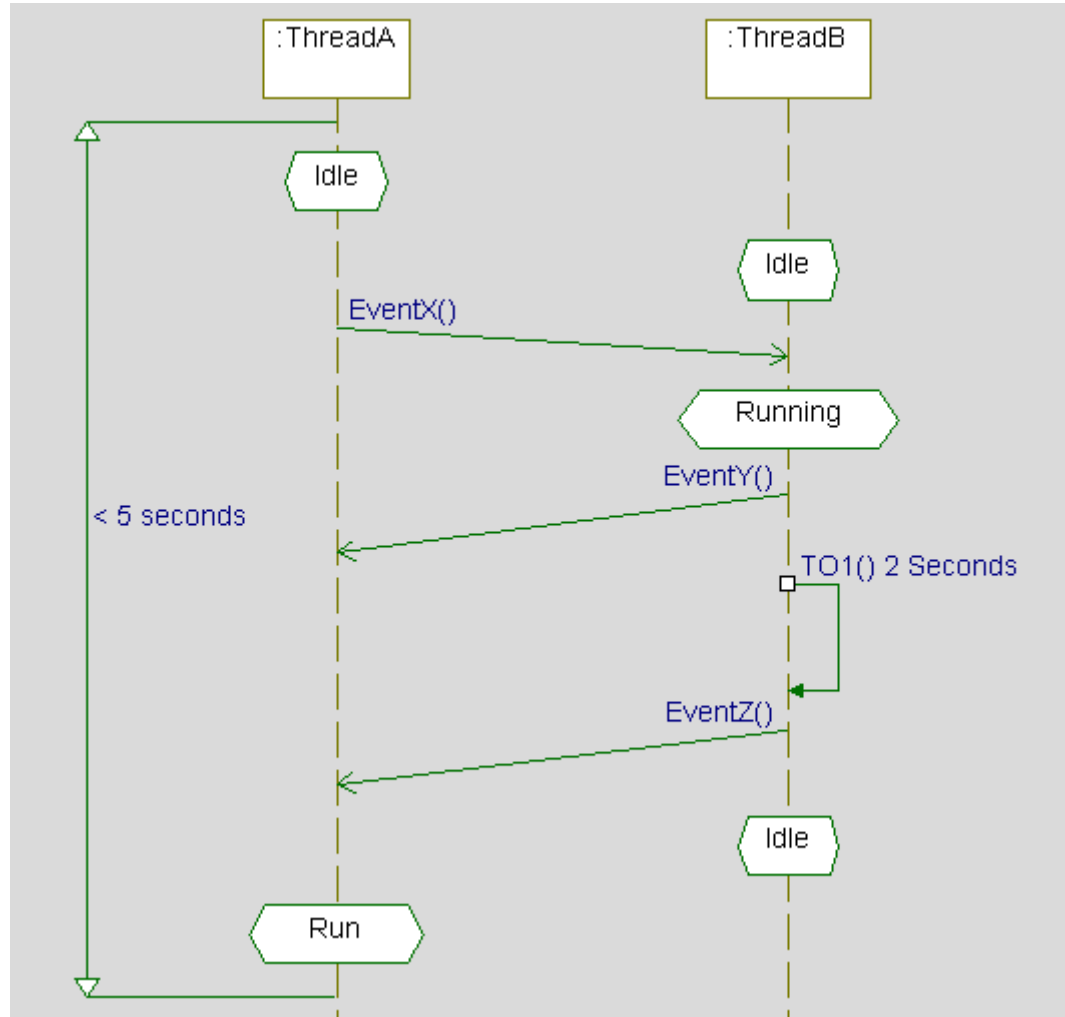
UML 2.1
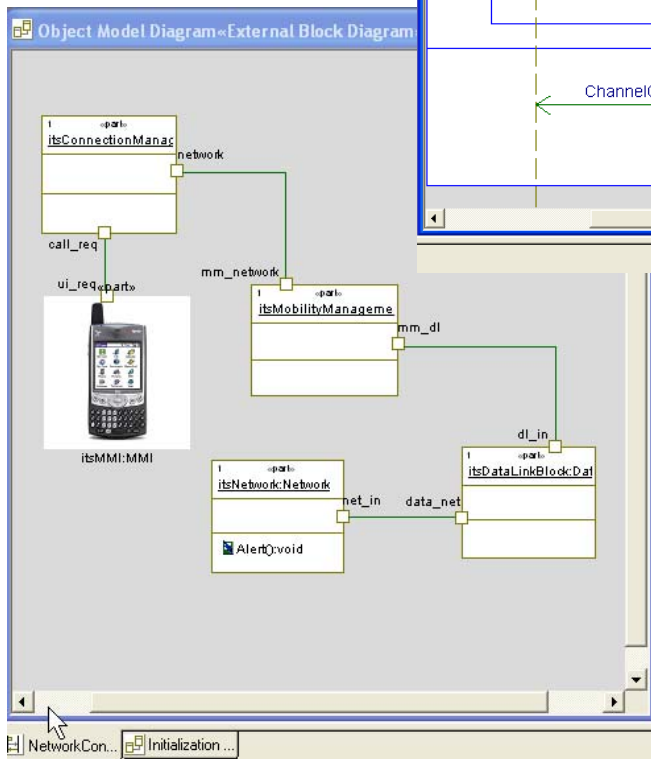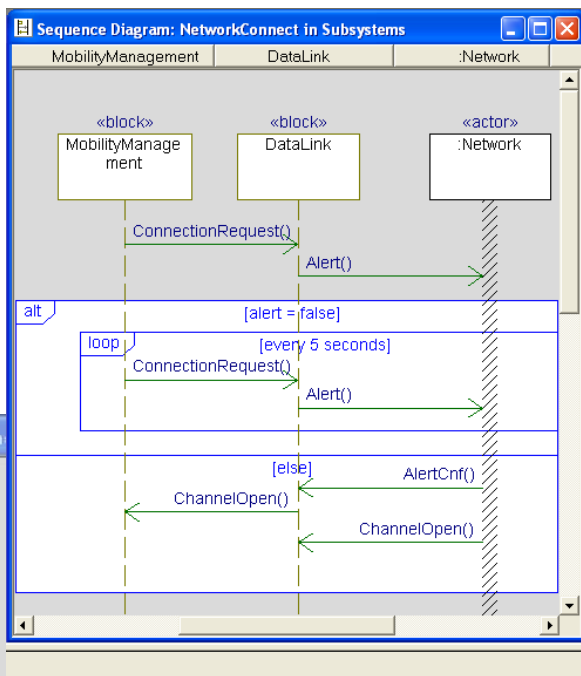
UML Views

- **Structure**
  - ▸ Structure diagram
  - ▸ Package diagram
  - ▸ Component diagram
  - ▸ Object model diagram
    - ▪ Class and Object
  - ▸ Deployment diagram

- **Behavior**
  - ▸ Statecharts
  - ▸ Activity diagrams
  - ▸ Use case diagram

- **Interaction**
  - ▸ Sequence diagram

SysML

- **Systems Modeling Language**

- **SysML views**
  - Requirements
    - Requirements diagram
    - Use case diagram
  - Structure
    - External block diagram
    - Internal block diagram
  - Behavior
    - Statechart
    - Activity diagram
    - Sequence diagram
  - Constraints
    - Parametric diagram

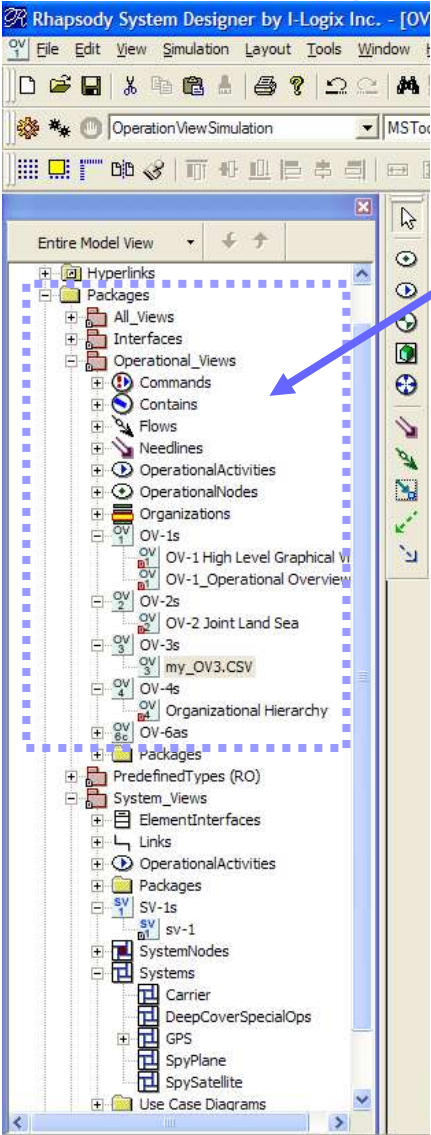- Telelogic has been an leading contributor to SysML right from the very beginning.
  - Member of INCOSE Model Driven Design Workgroup
  - Member of the AP233 Systems Tools Working Group
  - Charter member of SE DSIG
  - Issued a response to the SE DSIG RFI
  - Members of the SysML response to the SE DSIG RFP

Rhapsody DoDAF modeling

Supports native set of DoDAF diagrams

**Rich library of images to use for defense related applications**
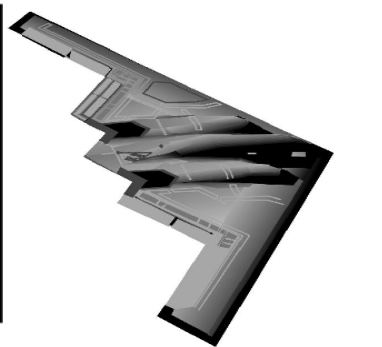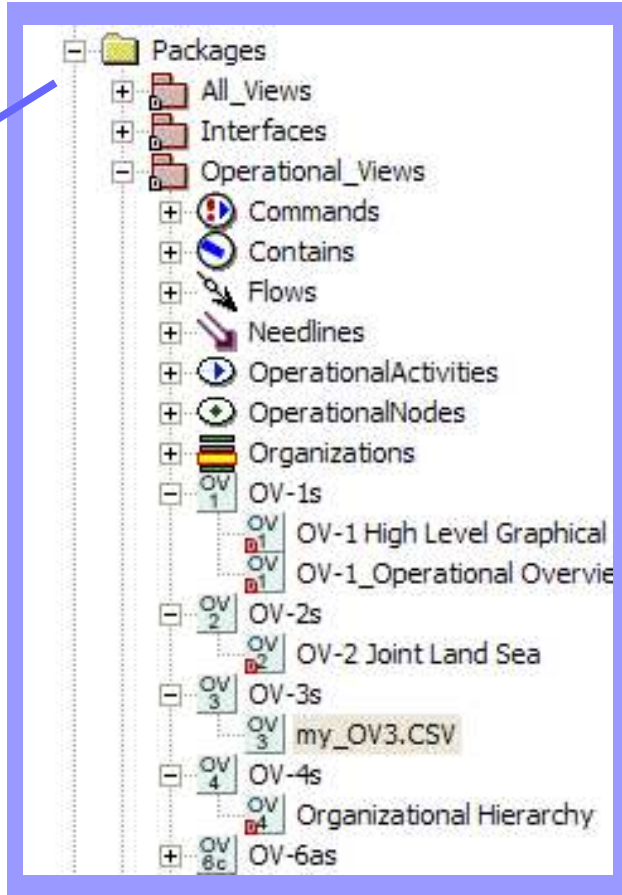
Ensure your design always meets the requirements

UML2.0/SysML/ C Modeling

Multi-Team Collaboration

Requirements Capture Analysis and Traceability

Rhapsody MDD

Full Application Generation

Design For Testability
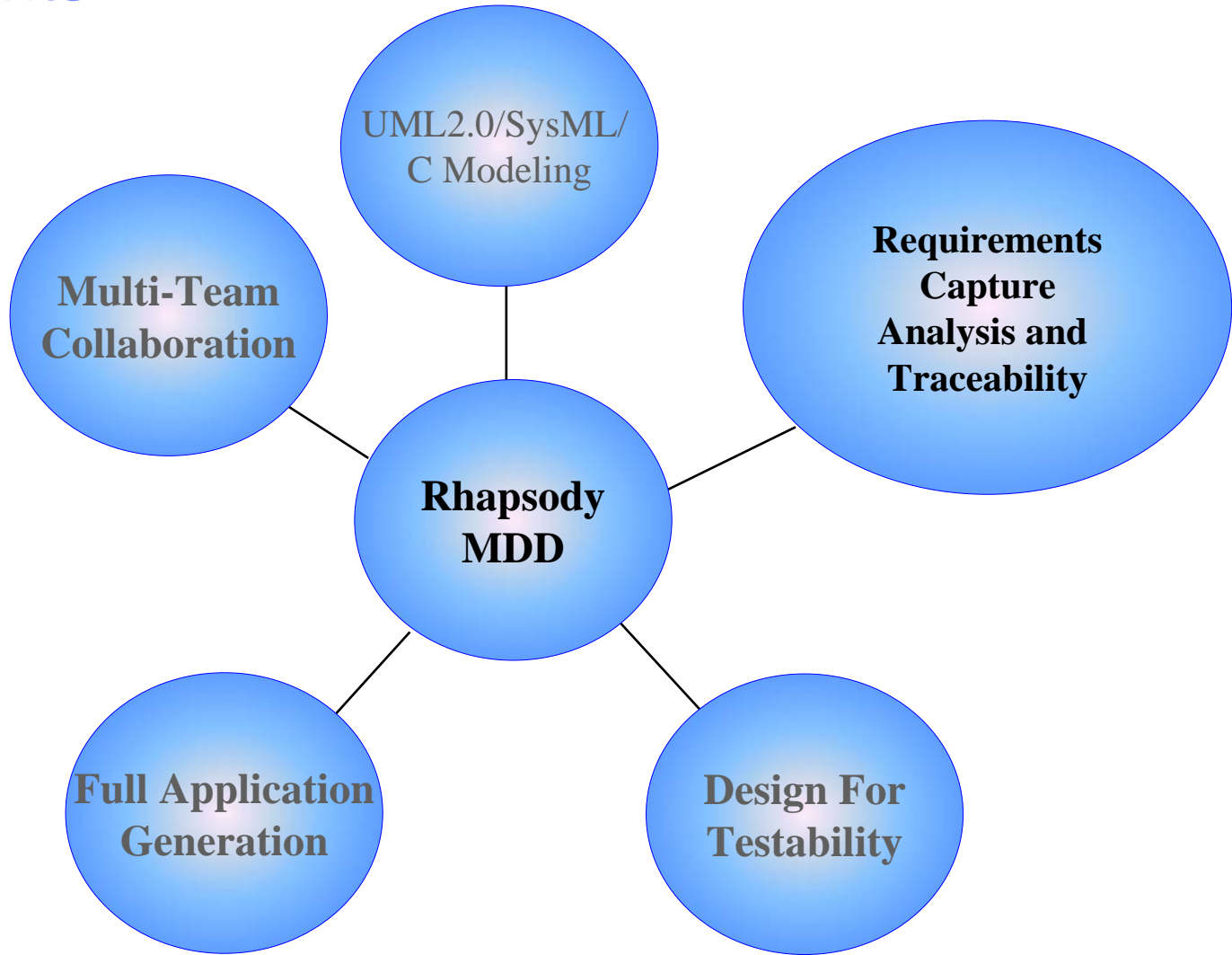
Visual requirements capture

- Use Requirements and Use case diagrams to define Requirements.
- Supplement definitions and descriptions with Tags and Constraints
- Describe requirements behavior using Sequence, Activity and State diagrams
- Include advanced graphics and icons with domain specific modeling
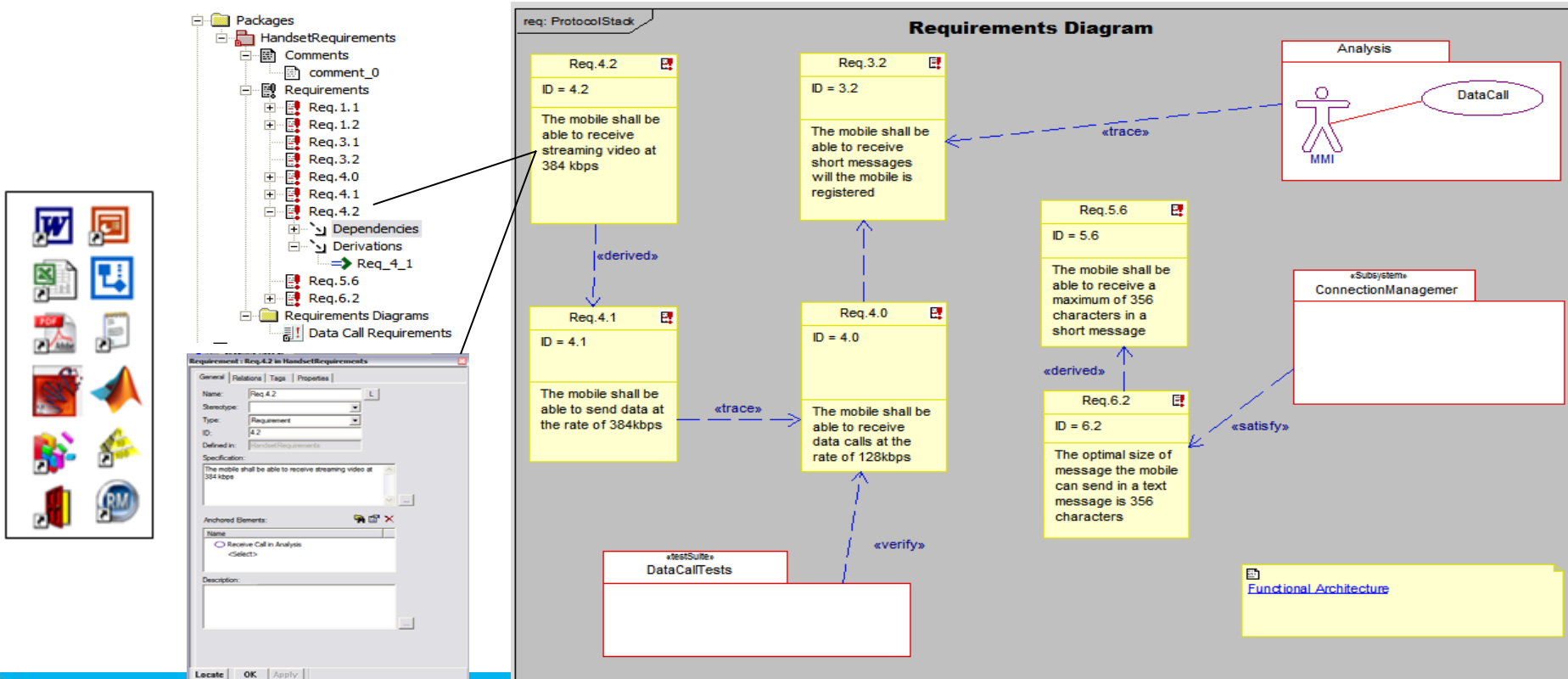
Requirements coverage analysis

- Identify requirements that have not been addressed in the Rhapsody design
- Find Rhapsody design elements not justified by a requirement

Change impact analysis

- Locate elements potentially impacted by a requirement change
- Determine requirements possibly impacted by a design change

# Eliminate defects early and always validate against the requirements
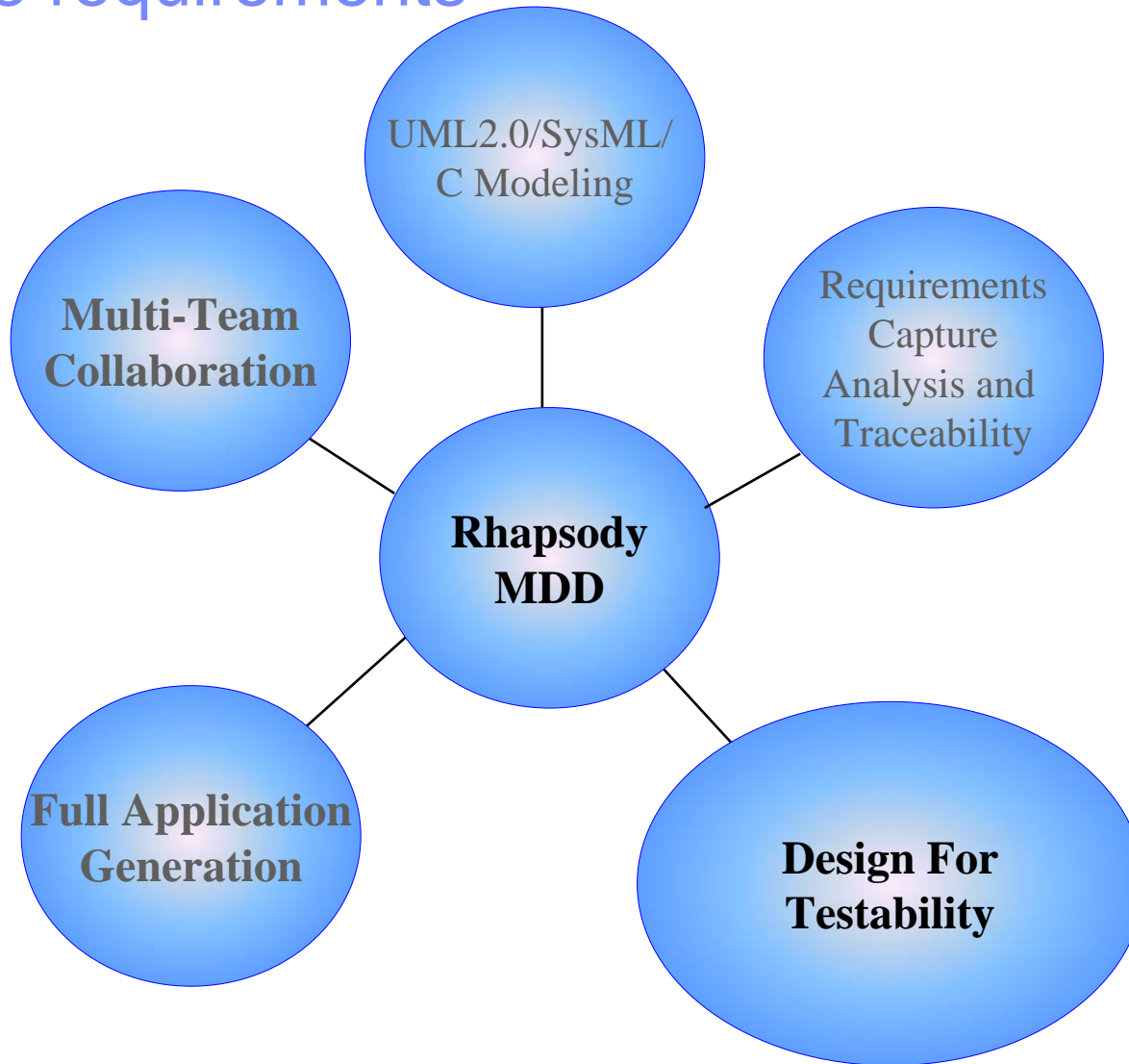
Simulation, Execution & Animation

- Simulate to verify that model is correct
  - ▸ The best way to avoid errors & therefore reduces development cost
  - ▸ Rapid Simulation at the design level or even target level debugging
- Virtual prototype / Panel graphics support
  - ▸ Ideal communications aid for design reviews and to share information.
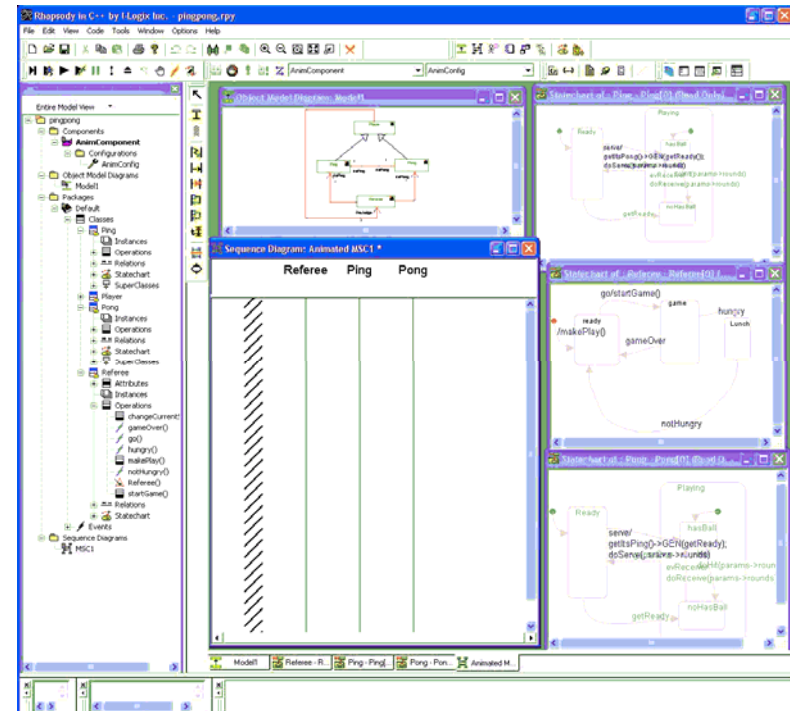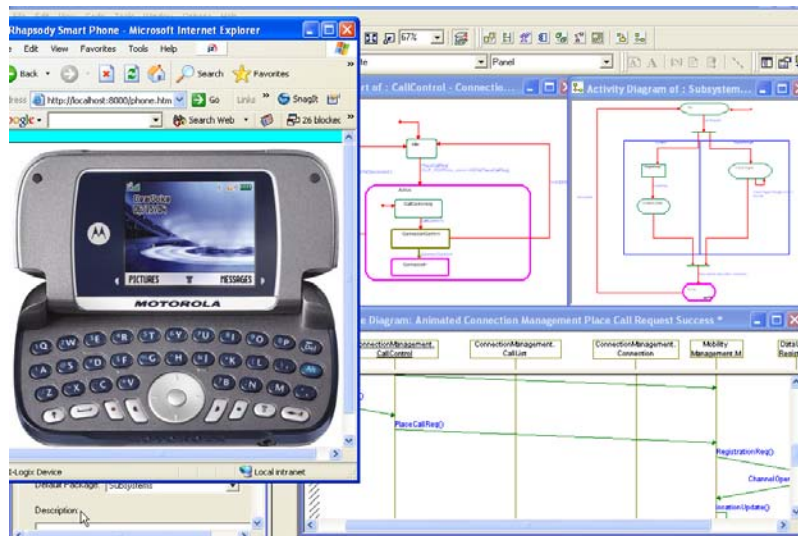
Traditional Code Centric Testing Process

Coding TestBenches Manually...   *Coding TestCases Manually...*   *Code on Host...*   *Code on Target...*
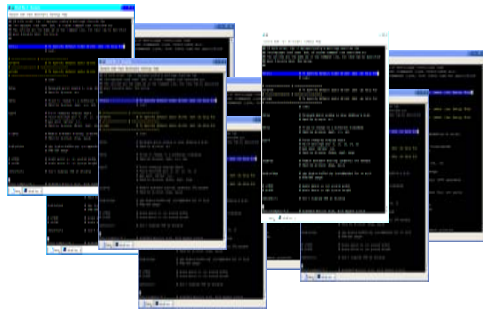
Error Prone;

No fun!

Difficult!

*Poor coverage
is the norm…*

Puzzling;

*Time
consuming!*

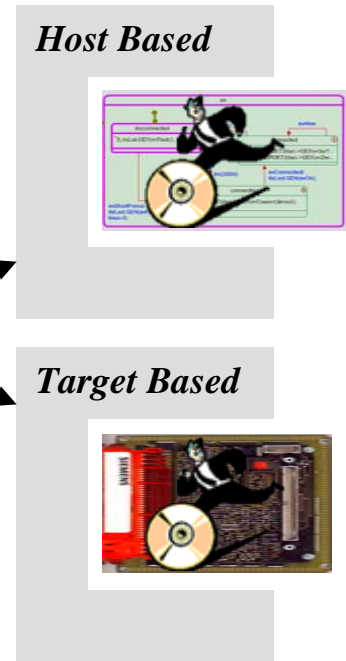**Frustrating;**

Expensive!

Model Driven Testing Process

Coding TestBenches Manually...   *Coding TestCases Manually...*   *Code on Host...*   *Code on Target...*

Rhapsody Design

AutoGen.
Graphical
TestBench

UML Testing Profile

Host Based

AutoGen.
TestCases

Graphical TestCases

Code TestCases

Target Based

Meet time to market pressures producing complete applications faster

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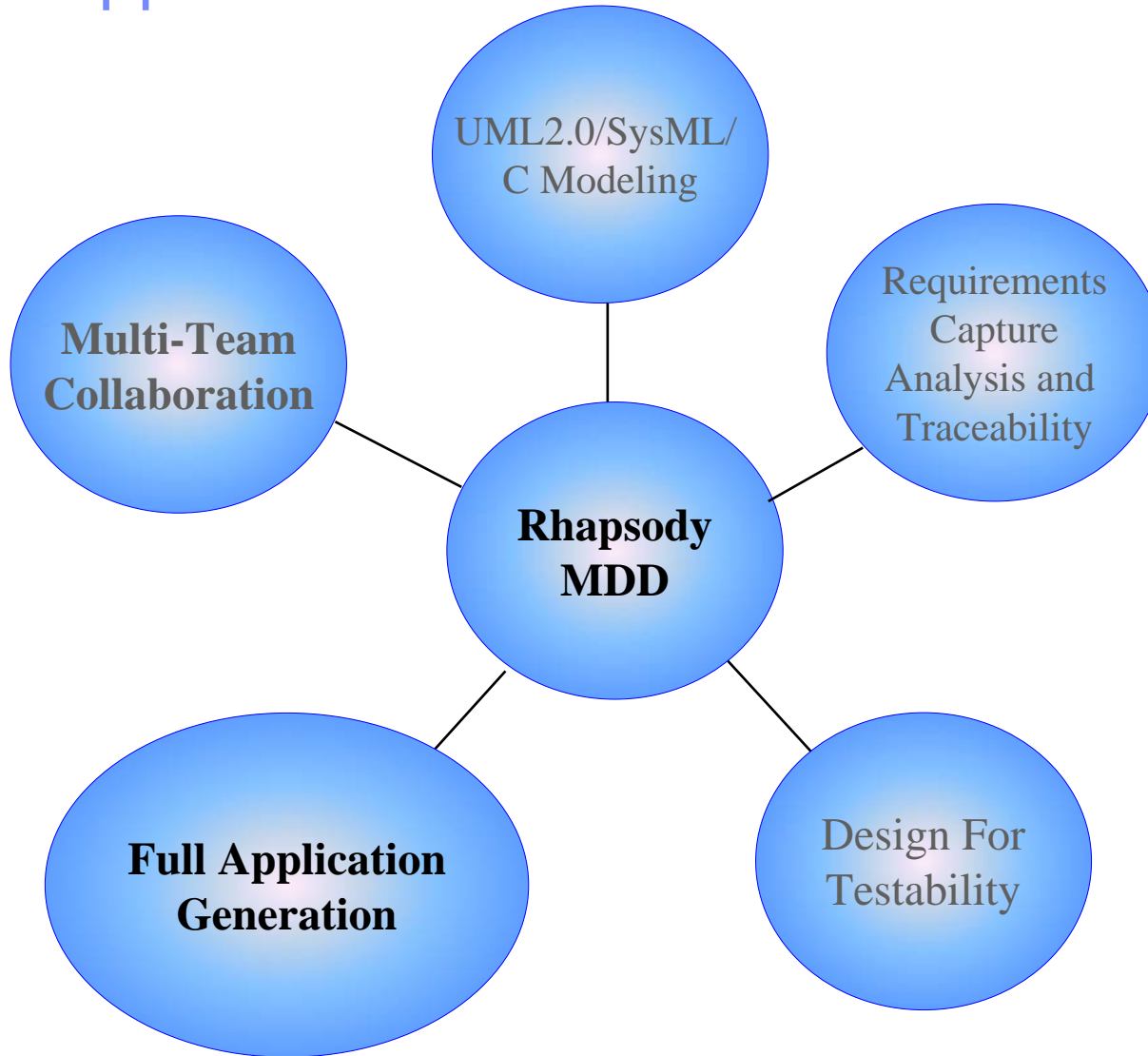
Full application generation

- Rhapsody leverages all structural and behavioral model views to produce an complete executable applications, not frames!

  ▸ Rhapsody generates very clean, readable C, C++, Java and Ada code, easily debugged through any commercial IDE

  ▸ Rhapsody generates all application construction artifacts to provide an integrated build environment

  ▸ Complete customizable code for all behavioral and structural components in your design using rules based technology

  ▸ Generates certifiable code for DO-178B and MISRA C

- Application Generation is not just about code generation. Its about

  ▸ Seamless reuse of existing code using

    - Reverse engineering

    - Code visualization

  ▸ Working the way you want provided by unique Dynamic Model Code Associativity (DMCA)

    - Code centric development allows the coder to code while producing models

    - Model centric development allows the modeler to model while producing code

    - Combine both at the same time to enable model/code developement

  ▸ Rapidly deploy your application to any RTOS or systems with no RTOS enabled by the unique Real time framework

    - Rhapsody generates all application construction artifacts to provide an integrated build environment

Seamless reuse of code (IP)

- Rhapsody can incorporate external code to
  - ▶ Reuse code from other projects
  - ▶ Integrate code developed by a third party
  - ▶ Import code generated from another tool
- Such code can be:
  - ▶ Viewed externally (code visualization)
    - Provides easy referencing from the model
    - Automatically allows graphical visualization of your IP
    - Seamless workflow between model and hand-written code
  - ▶ Automatically reverse engineered to become part of the model

Legacy Code

Rhapsody Generated Code

Rhapsody Real–Time Framework

RTOS

Flexible developer paradigm

- Reduce learning curve and increase effectiveness by working at code or design level

- Design and Code are always kept synchronized: Dynamic Model Code Associativity (DMCA)
  - ▶ Change one view, the others change automatically
  - ▶ Critical for real-time embedded software development

Rhapsody works the way you do
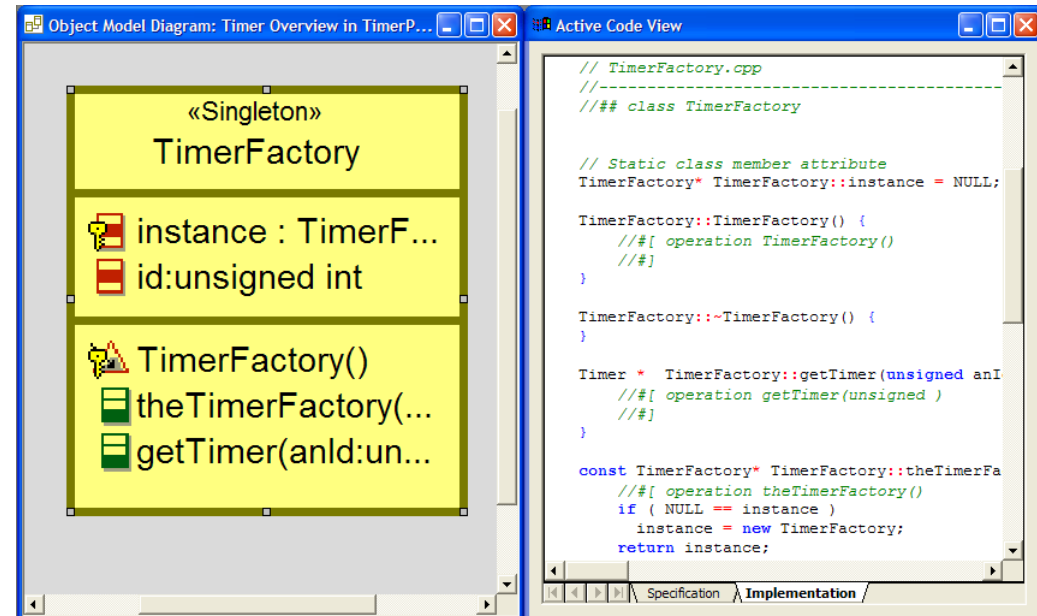
Rhapsody works the way you do

- Dynamic Model Code Associativity (DMCA)
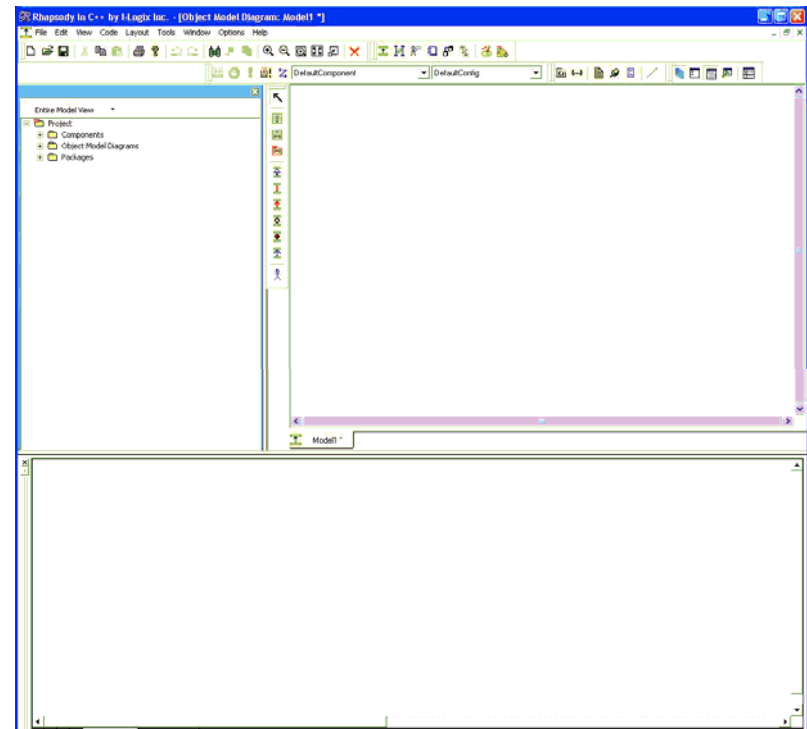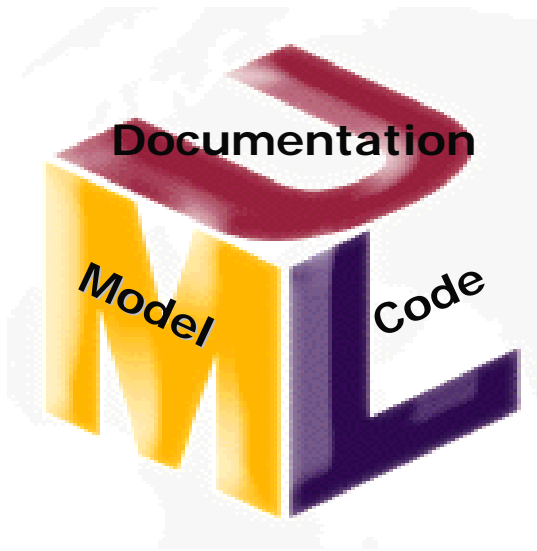
Rapidly deploy your design onto any target

- Rhapsody Real-Time Framework
  - ▸ Provides implementation for real-time semantics
  - ▸ Abstracts away the platform APIs (RTOS)
  - ▸ Allows rapid retargeting to any RTOS or to systems with no RTOS at all
- Key technology in supporting a Model Driven Architecture (MDA)
  - ▸ Provides Platform Independent Models (PIM)
  - ▸ Simply select the proper adaptor to create a Platform Specific Model (PSM)
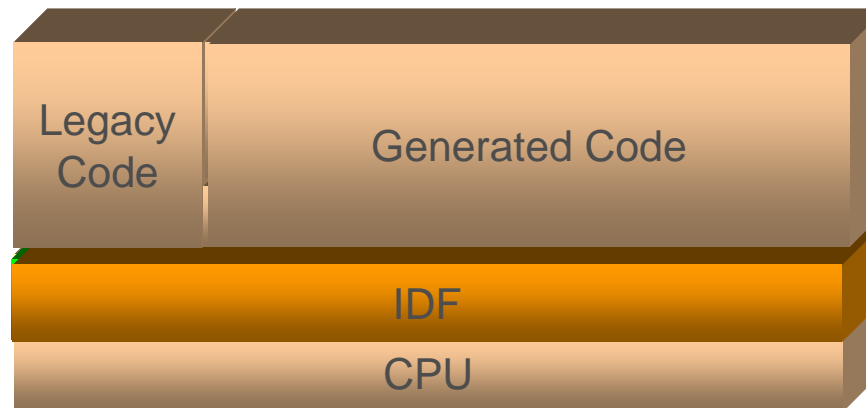
Enables all size teams to effectively communicate and work together

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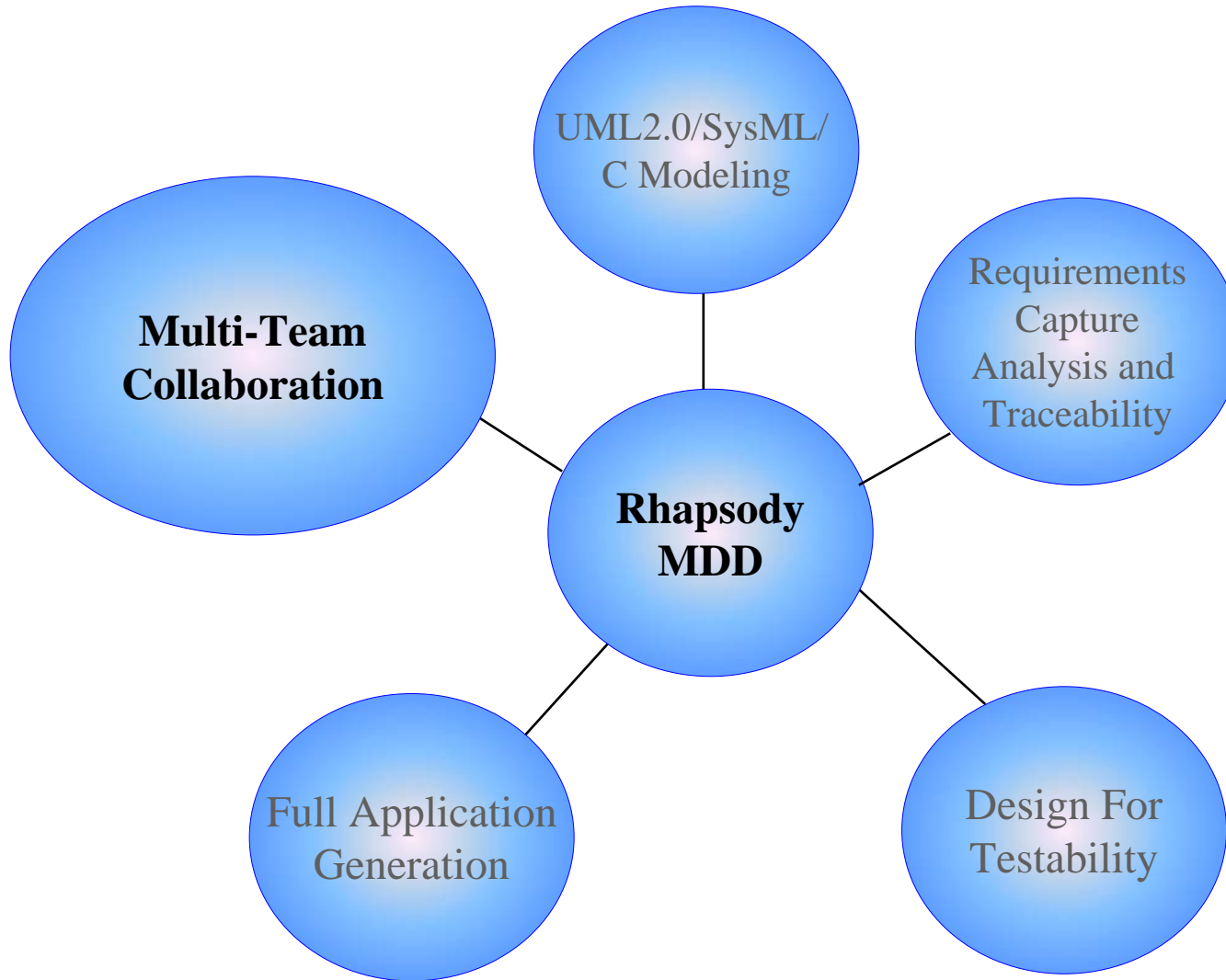
Multi - team collaboration

- Rhapsody promotes concurrent collaborative large scale engineering

- Create, review, share and modify Rhapsody models within a single project, company or globally
  - Interfaces with all the popular CM tools to ensure project data remains synchronized and under configuration control
    - Check in/out model information to the CM system
  - Built in diff/merge capability to graphically understand changes and evaluate different designs
  - Built in Panel graphics Webify communication tool to help better communications

- Promotes both opportunistic and strategic reuse via modeling and automation

Configuration management with graphical differencing and merging

- Tight integration with configuration management tools
  - ▸ SYNERGY, ClearCase, Source Integrity, PVCS Dimensions & Version Manager
  - ▸ Any SCC compliant tool
- Graphically identify differences between versions and evaluate design alternatives
- Quickly accept or automatically and merge changes between multiple versions
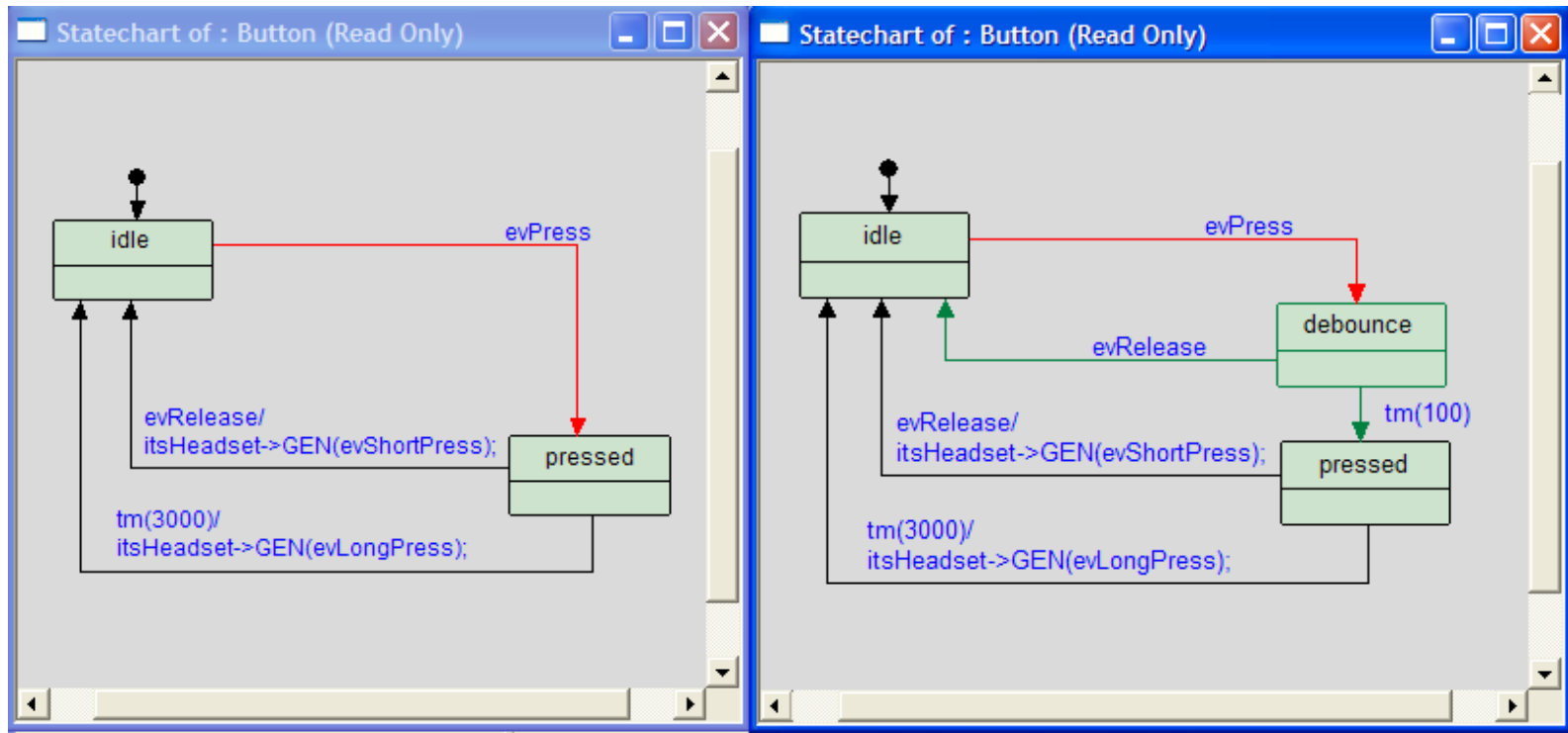
Customizable Automatic Documentation Generation

- Customize reports exactly the way you wish
  - ▶ Wizard-based document generation provides incredible flexibility

- Generates documentation in HTML, PowerPoint, Word, Rich Text Format, etc. from a Rhapsody model
  - ▶ Compatible with most word processing systems via RTF
  - ▶ Creates hyperlinks for fast report navigation

- Wide choice of out-of-the box templates, plus easy customization

- Enables collaboration via sharing of templates and sub-templates

Documentation generation

Automatic DoDAF Product Generation

DEMO
– Rhapsody –