Model-driven Development of Component-based Systems in Cadena

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http://cadena.projects.cis.ksu.edu

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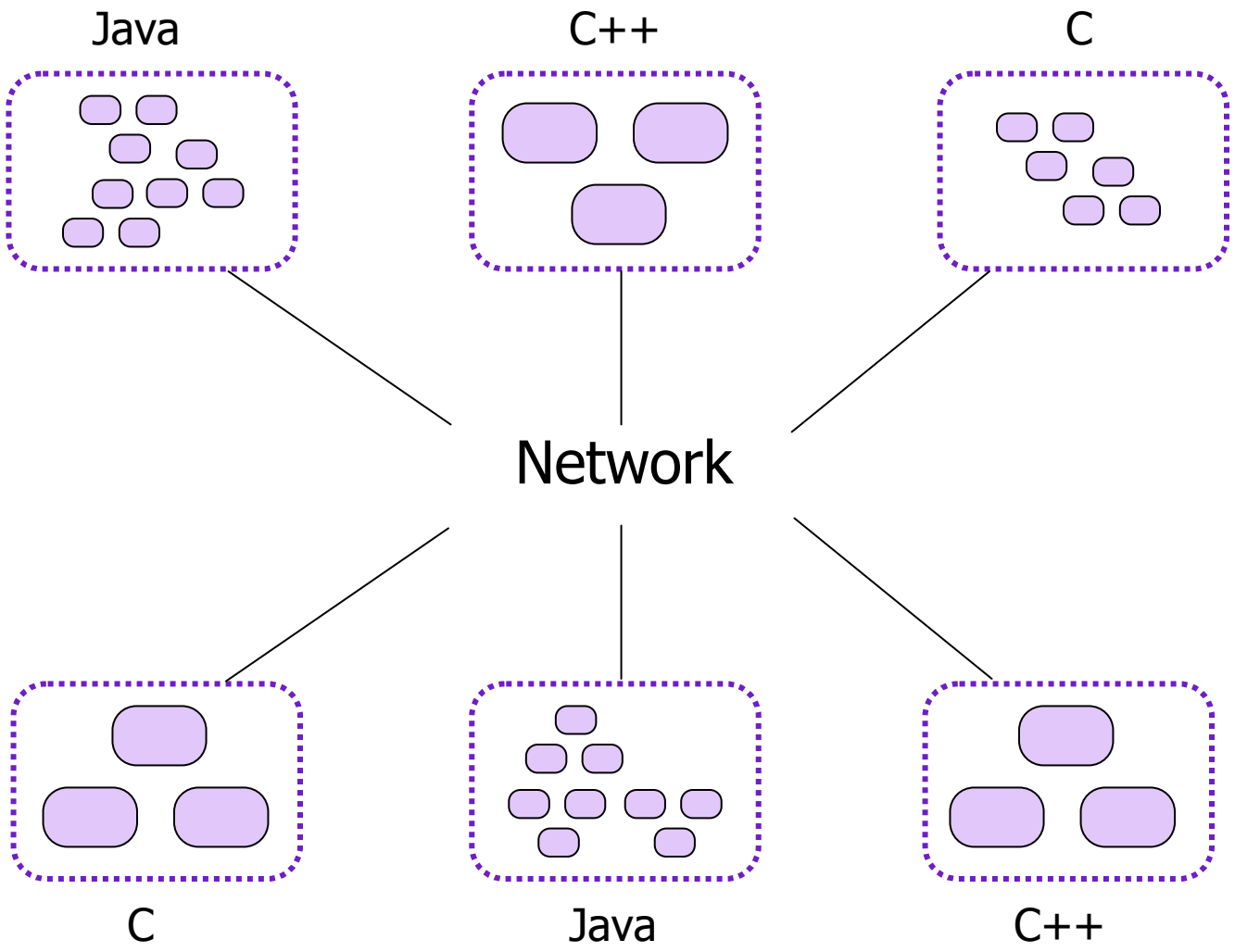
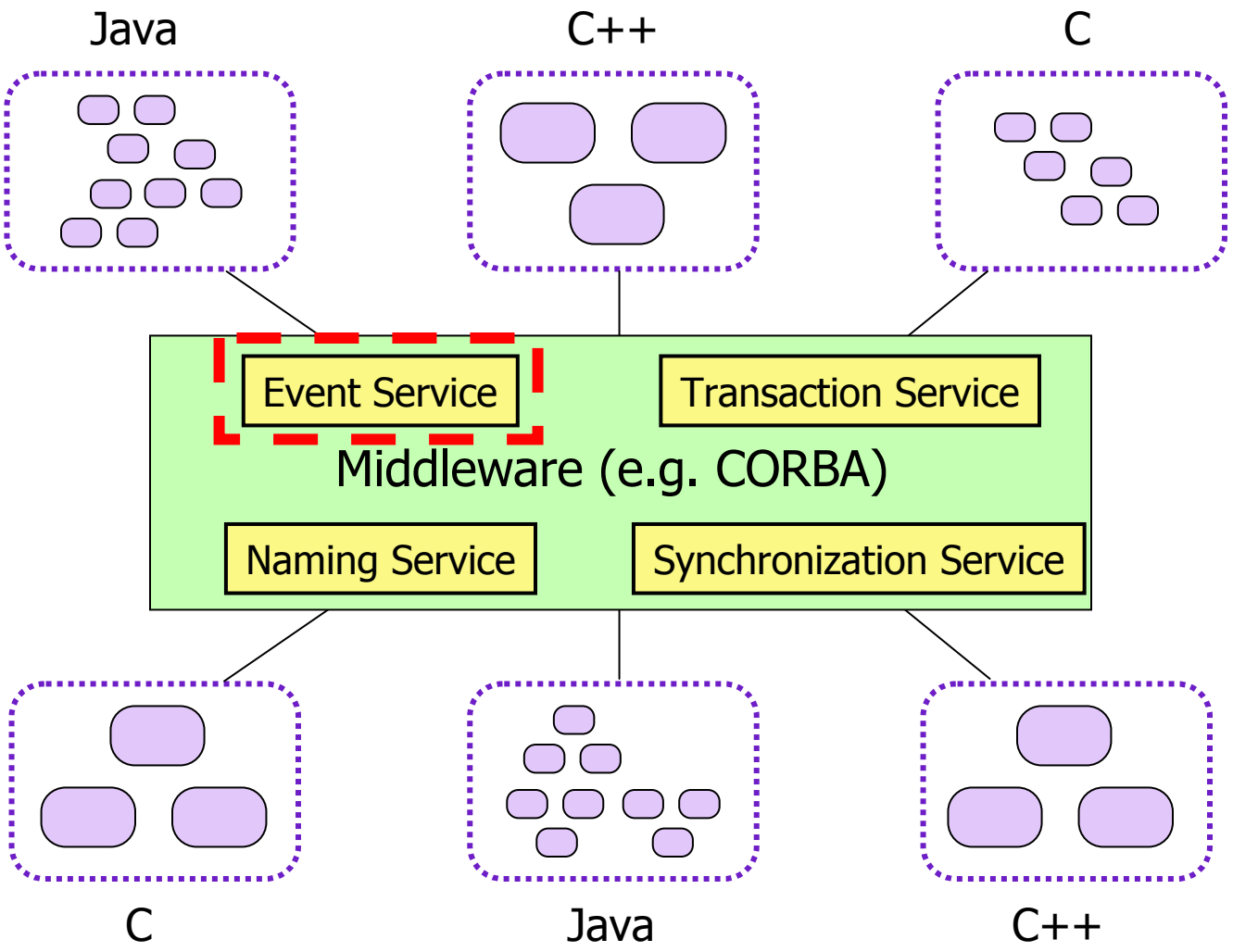
IBM Eclipse
Lockheed Martin
Rockwell-Collins ATC

Distributed Components



Distributed Components



Goals of the Cadena Project

An Integrated Development Environment for Analysis, Synthesis, and Verification of Component-based Systems

I. Platform for real-world experimentation with technologies for building high-assurance distributed systems using Component Middleware Frameworks

- … robust tool environment suitable for industrial experimentation
- … model-based development, middleware configuration, and code synthesis
- … pluggable light-weight specification, analysis, and verification techniques
- … rich architecture description language for create domain-specific modeling environments

II. Avenue for collaborating with industrial research teams and middleware experts to guide next-generation component/middleware technology

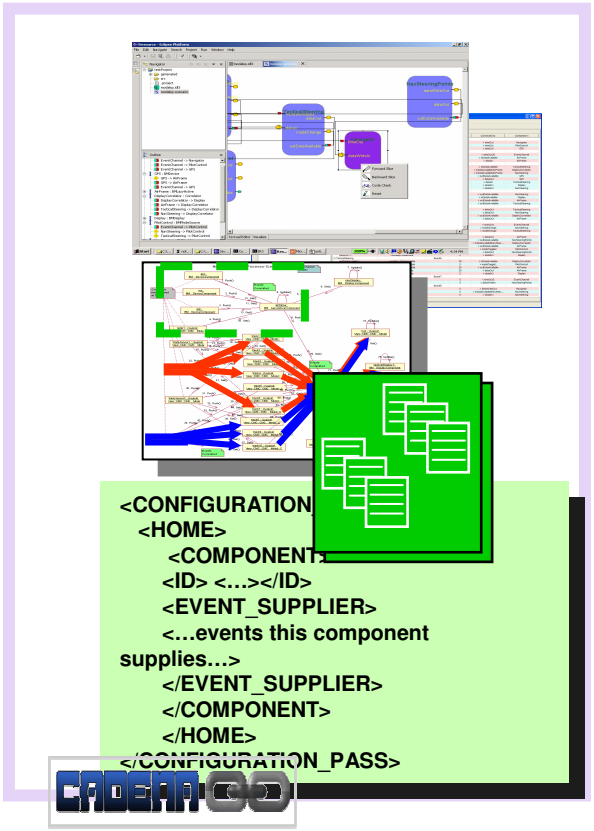
- … interacting with groups at Lockheed Martin, Boeing, and Rockwell-Collins, to develop techniques that match fit into development process
- … collaborating with middleware experts (e.g., ACE/TAO RT-middleware) to make frameworks more amenable to model-based configuration and analysis

Cadena Development

This will be the focus of my STRESS lectures

Cadena I

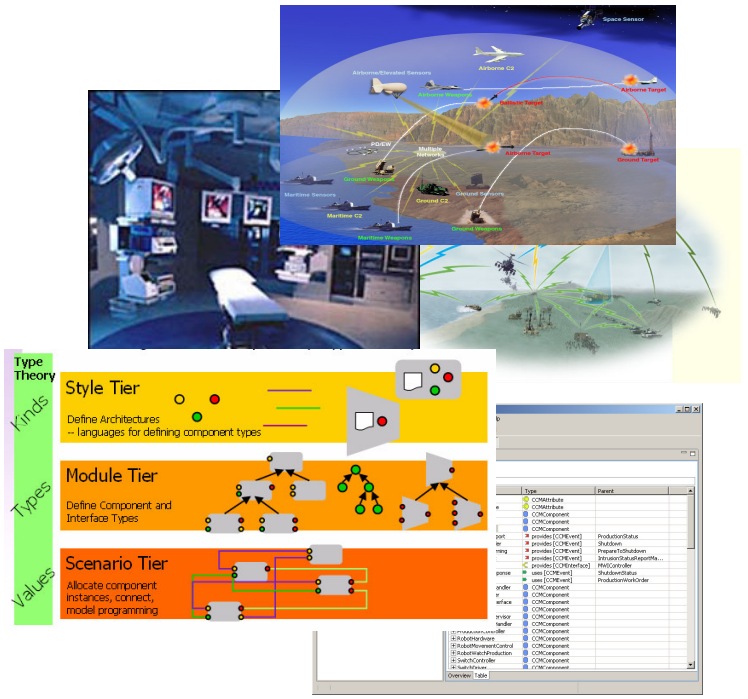
…tailored to CCM



June 2002 – May 2005

Cadena II

…full meta-modeling (CCM. EJB, PRiSM, etc.) for product-line architectures



Jan 2005 – …

Current and Past Cadena Users

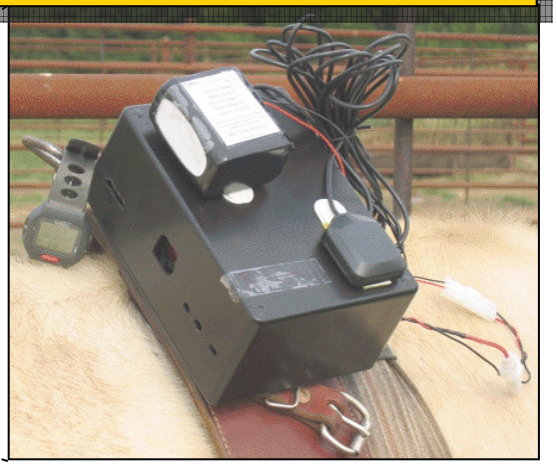
- Boeing research engineers working software product-lines for avionics mission control systems
- Lockheed Martin (Eagan) research engineers building tools chains to illustrate their vision of model-driven develop
- Lockheed Martin (Cherry Hill) research engineers working on model-integrated computing solutions to building very large scale "systems of systems"
- A variety of users from academic and industry sites

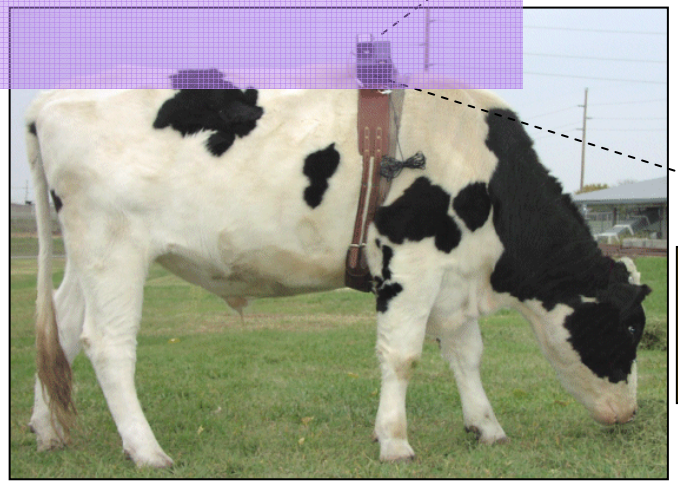
Current and Past Cadena Users

- Interdisciplinary teams at Kansas State University designing product-line development environments for sensor networks in the following domains

- ❑ Sensors worn by cows
- ❑ Monitoring stations at congregation points
- ❑ Local precursory analysis
- ❑ Extensive offline analysis to identify trends
- ❑ Correlated with other sensor data
- ❑ Feedback to cattle producers
- ❑ Authenticated disease reports for regional veterinarians.

Veterinary Monitoring & Telemedicine



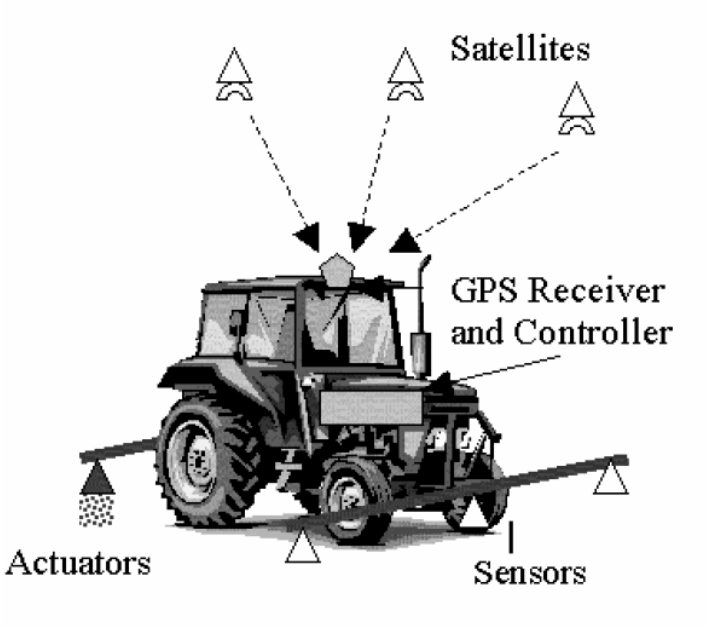


Ambulatory data acquisition with real-time transmission to a base station

Current and Past Cadena Users

- Interdisciplinary teams at Kansas State University designing product-line development environments for sensor networks in the following domains

Precision Agriculture

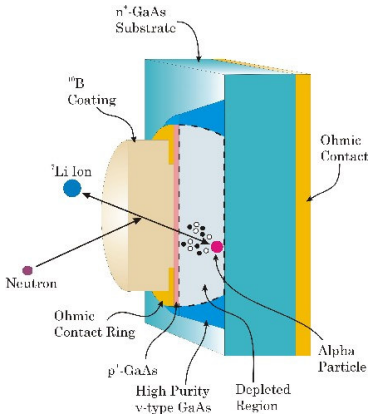


Current and Past Cadena Users

- Interdisciplinary teams at Kansas State University designing product-line development environments for sensor networks in the following domains

Nuclear Radiation Sensing

The KSU Semiconductor Materials and Radiological Technologies (S.M.A.R.T.) Laboratory



2005 R&D 100 Award from R&D Magazine for being one of the top 100 most technologically significant products introduced into the marketplace during 2005.

Potential Cadena Users

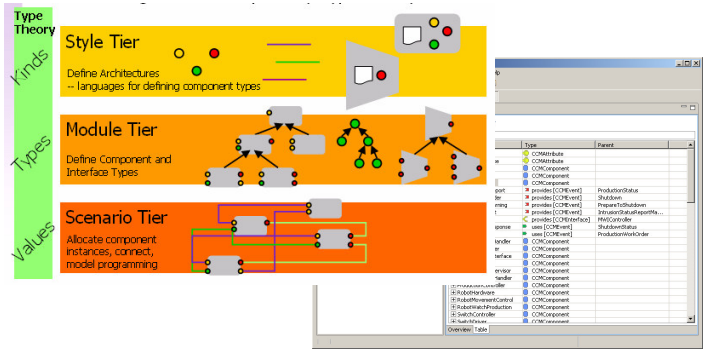
You might be interested in using Cadena if…

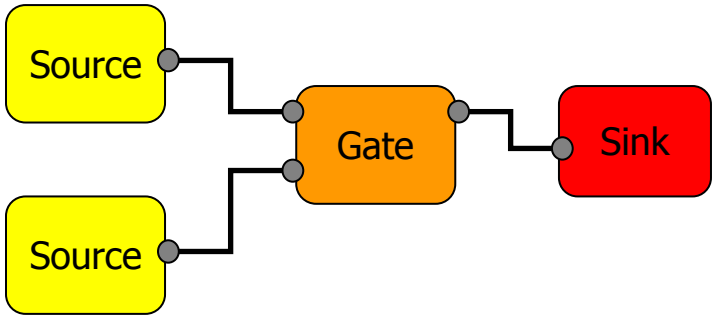
- …you want to create your own model-driven development environment for a particular component-based framework or domain
- …you want to develop applications using existing (and forth-coming) Cadena end-to-end development environments (e.g., for CCM, sensor networks)
- …you're carrying out research in the following areas and you want a flexible robust framework into which you incorporate your tools
  - formal methods and analysis for component-based systems
  - software architectures and software product-lines
- …you're teaching a course on software architectures and component frameworks and you want a nice flexible framework in which many notions from software architecture can be demonstrated

STRESS Lectures Outline

Lecture I: Overview of Cadena's Architecture Definition Language and Meta-modeling Framework

- Explain Cadena's 3-Tiered modeling strategy for…
  - defining architectures for component-based systems
  - defining domain-specific modeling environments
- Illustrate the above with a toy domain – domain of Logical Gates (boolean circuits)

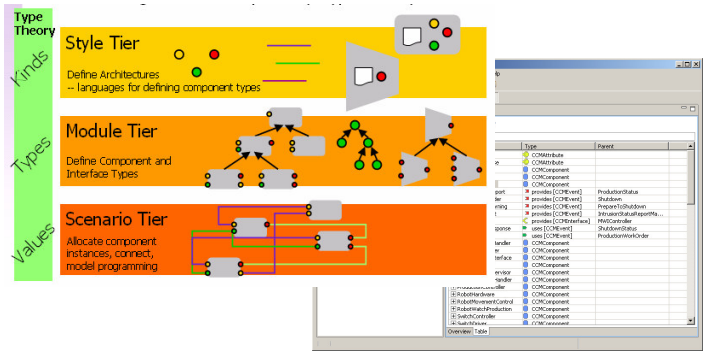


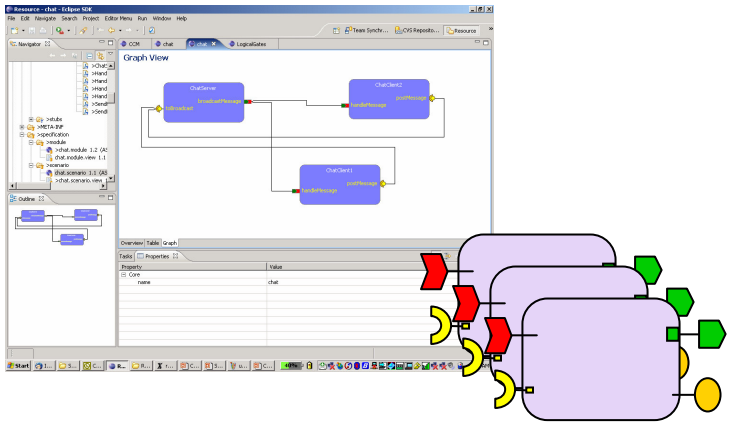


STRESS Lectures Outline

Lecture II: Using Cadena to build an end-to-end development environment for the CORBA Component Model – an industry standard.

- Overview the CORBA Component Model (CCM)
- Illustrate to define CCM architecture as a Cadena style
- Illustrate the use of plug-ins for the CCM style to build an simple end-to-end development environment for CCM

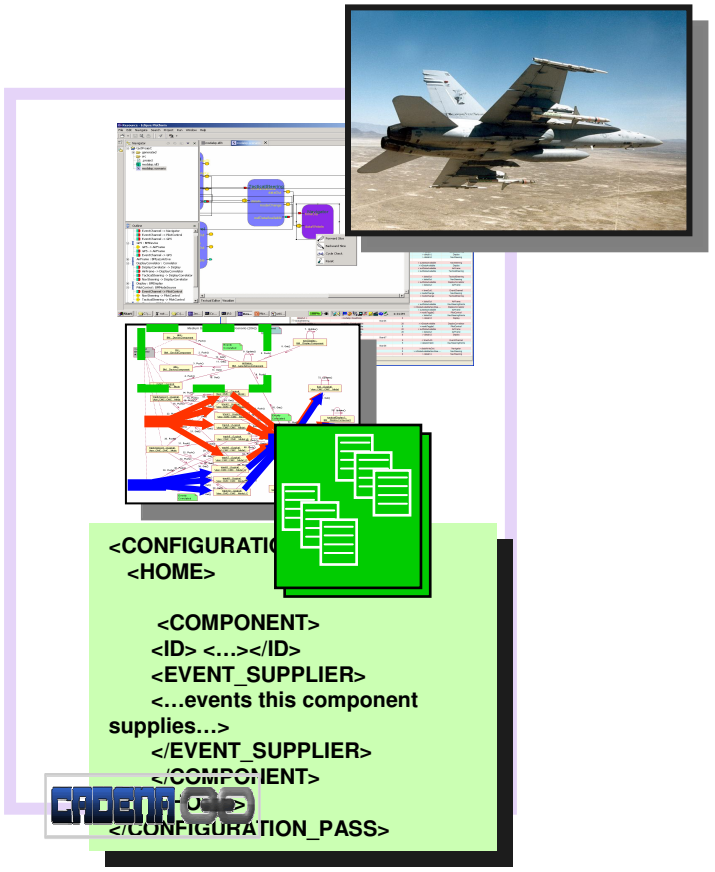




STRESS Lectures Outline

Lecture III: Using Cadena (previous version) in the context of product-line development for Boeing's avionics mission control software

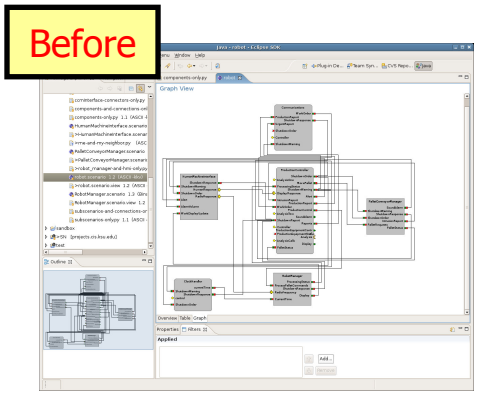
- Overview of the BoldStroke product-line and development context
- Simple BoldStroke Systems
- A variety of plug-ins for lightweight analysis and automated design advice
- Themes of model-driven development for component-based systems

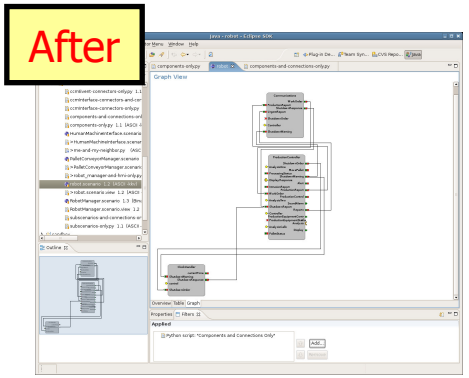


STRESS Lectures Outline

Lecture IV: Advanced Topics – Cadena's Scripting and Architectural Views Framework

- Motivation for scripting facilities within the Eclipse framework
- Using scripts as "model filters" to create customized views to help manage complexities of scale
- Using scripts as "model generators" for generative programming





Lecture Perspective

These lectures are not meant to provide a broad perspective of model-driven development. Instead, the goals are to…

- Focus on one particular modeling tool for component frameworks
  - There are other good tools available. We wanted to go in-depth with one particular modern tool that can connect to real-world application.
- Focus on *structural and architectural* aspects of modeling.
  - Dwyer/Cohen lectures will follow up with additional perspective on *structuring for product lines*
  - Other lectures (Robby, Rajami, Rehof) will focus on behavioral modeling

STRESS Resources

- Cadena download
- Cadena user's guide
- Cadena CCM development tutorial
- Cadena example repository