A Language for Multi-View Architecture Description and Control Trinity

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Software Architecture

the "fundamental organization of a system embodied in its components, their relations to each other, and the environment"

Architecture Views

Modules: principal units of implementation

Used to explain system functionality +

Components: elements that have some runtime

A blueprint for code construction

and incremental development

Analysis of code dependency

structure of code base

Show how the system works

& behavior of runtime elements

Guide development around structure

Module

Deployment

presence (processes, objects, clients, servers). Connectors: components' pathways of interaction (protocols, information flows).

Ports: component interfaces that define possible interaction with components. Deployment View: a mapping between

former's environment.

software and non-software elements in the

Environmental elements: hardware,

network elements, and their capabilities

To reason about performance and reliability

Analyzing actual runtime performance, reliability, and security SW elements: CnC elements

The Problem

It is hard to determine whether the logical relationships between entities in architecture diagrams are present in system implementations.

Previous Solutions

Architecture Description Languages (ADLs)

- (-) Description: Inferred by the name, ADLs only describe software architectures; they do not prescribe, or enforce conformance to them
- (+) Analysis: ADLs are focused on system analyses
- (+) Formal Notation: Currently, ADLs are the most formal mainstream architecture tools available

ArchJava Java extension unifying architecture and implementation

- (+) Conformance: Checks for architecture conformity
- (-) Distributed Systems: No conformance checks in distributed systems (ArchJava supports multiple systems via custom connectors, but does not enforce conformity)
- (-) Multiple Views: Lacks support for multiple architecture views; focuses only on Component-and-Connector view

Trinity's Approach

- Make software architecture a "live" component of Trinity systems
- Trinity enforced architecture conformance complements ADL analyses
- Support architecture conformance and communication integrity in distributed systems
- Directly translate the conceptual entities from multiple views into code-enforced constructs
- Support all three software architecture views (module or code, CnC, and deployment)

Design

Implementation Concepts

Architecture concepts are translated into runtime entities in Trinity

Trinity Architecture Components

component: a runtime entity that may interact with other components through ports.

connector: interaction pathways that join two compatible component ports.

port: component access points that can allow interaction with other components.

attachments: declarations that enable connections between compatible components to be made entryPoints: a program starting point that permit execution.

Demonstrated Principles

Trinity's design demonstrates the following principles:

Readability

System architecture is contained in a single file and is prescriptive, uniting design and implementation.

Reuse and Adaptability

Compatibility checking and code generation make switching, adding, and removing architecture elements easier and more secure.

Communication Integrity in Distributed Systems ifdlkasifdklasfis

Example

component Client port getInfo: requires CSIface

component Server port sendInfo: provides CSIface

external component DB port dblface: target DBModule

connector JDBCCtr val connectionString: String architecture components Client client Server server

> connectors JSONCtr jsonCtr attachments Connect client.getInfo and server.sendInfo with jsonCtr

entryPoints Client: start