

A Framework for Building Adaptive Distributed Applications *

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Abstract

Our work aims at addressing the complexity of building adaptive distributed applications and systems by presenting a framework that provides a set of integrated tools for monitoring the environment, detecting events, and reconfiguring distributed applications dynamically. The framework supports the construction of distributed adaptive applications, composed of several components spread over a network.

As a proof of concept, we used the framework to add adaptive behavior to a prototype implementation of an information service for mobile users. With this experience, we collected evidence that, besides detecting variations in resource availability, it is also important to monitor the interactions among application components, searching for patterns that indicate the necessity to perform dynamic adaptation.

Our framework model satisfies the following design requirements.

- The framework should be **generic** in order to be used for the development of a wide range of distributed applications.
- It should promote a clear **separation of concerns** between the application's functional code and the adaptation-specific code.
- It should support the development of highly distributed applications, which implies providing mechanisms to **coordinate reconfiguration actions** between distributed components.

- Framework components must be **flexible and extensible** in order to accommodate specific applications needs.
- Framework components to be shared between applications at runtime must **support concurrent execution** of adaptive applications.
- Framework components must provide a **management interface** to allow the user to configure and customize its execution parameters.

The framework model is composed of three high-level packages. The **Monitoring** package is responsible for monitoring the application execution environment. The data collected by the components of this package are saved in persistent storage or sent directly to the **Event Detection and Notification** package. The latter is responsible for analyzing these data and determining the occurrence of relevant events which are of interest for adaptation decision-making. These events are then sent to the **Dynamic Reconfiguration** package, which is responsible for applying the required reconfiguration actions to adapt the system.

The framework is composed of a collection of CORBA objects and services. Our implementation comprises 21,852 lines of Java code and uses JacORB as the CORBA ORB. The framework is available for download as open-source software at <http://www.ime.usp.br/~sidam/software/AdaptationFramework>.

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