Marc-Olivier Killijian Thesis

«Fault-Tolerance on Corba using metaobject protocols and reflective languages»

Abstract

The goal of this dissertation is to design and implement a metaobject protocol adapted to fault-tolerance in Corba applications. No currently available metaobject protocol is satisfactory in this context. We define a protocol that enables dynamic control of (a) the behaviour and internal state of Corba objects, and (b) client/server and object/metaobject links. The implementation we propose is well adapted to a standard Corba platform thanks to the use of open languages and compile-time reflection. These tools allow the compilation process to be customized to obtain information that is necessary for fault-tolerance. Another benefit of compile-time reflection is it enables the enforcement of programming conventions thanks to the filtering of application source code. This protocol, well integrated with Corba, can also benefit from reflective properties of the underlying language runtime, such as the limited reflection provided by Java for object serialization. When the language runtime is not reflective, as for C++, compile-time reflection can be used to implement methods for saving and restoring the internal state of objects. The various properties of this metaobject protocol are illustrated in an architecture proposal which allows fault-tolerance mechanisms to be integrated with the application in a flexible way. This approach offers useful properties such as separation of concerns between the application and the non-functional mechanisms implemented as metaobjects, dynamic links between objects and metaobjects, composability and reuse of mechanisms, and user transparency. Finally, this metaobject protocol is sufficiently generic to take advantage of any openness, in a reflective sense, of the platform's underlying software (operating system and middleware).