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ANSA Phase III

Reflective Java

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Abstract

TThis is a brief introduction to Reflective Java for marketing purpose.

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External Paper

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The material in this Report has been developed as part of the ANSA Architecture for Open Distributed Systems. ANSA is a collaborative initiative, managed by APM Limited on behalf of the companies sponsoring the ANSA Workprogramme.

The ANSA initiative is open to all companies and organisations. Further information on the ANSA Workprogramme, the material in this report, and on other reports can be obtained from the address below.

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Reflective Java

The open, collaborative ANSA programme develops a vision of distributed computing and underpins that vision with proof of concept prototypes. Our vision is based on two important observations:

1. a single distributed computing platform cannot satisfy all application needs

2. programming advanced systems can only be achieved by abstraction and automation

Two projects develop the implications of these observations:

• Flexinet: a flexible infrastructure which can be dynamically reconfigured in response to changing application requirements and changing availability of resources in the network.

• Reflective Java: powerful mechanisms to produce flexible and reusable system software which can be used by application programmers.

Motivation

A dominant characteristic of computing technology is rapid change. Hardware iterations are measured in months, and applications innovations occur at an almost similar pace. To accommodate these changes and to provide optimal performance, system software must be made flexible and customisable at run-time.

With the emergence of new application areas, such as mobile computing and Web applications, system software needs to meet ever increasing user demands and expectations. Because applications have varying and even contrary requirements, the *one size fits all* design strategy becomes obsolete.

Mobile computers define a dynamic computing world with intermittent communications, time varying capacities and important new cost considerations. Ultra-large interconnections offer a huge diversity of data, and optimal access is dependent on resource limitations, communication connectivity and the user's needs. High-speed workstation networks must use adaptive resource exploitation to suit the needs of individual applications. Multimedia applications and distributed databases entail differing, and often conflicting, expectations on system services. In each case, run-time flexibility, that is the ability to specialise or optimise, is needed, and system software should provide mechanisms to support this flexibility.

Object-oriented programming and language theory has suggested methods for building flexible system software components. It is time to begin to transform these ideas from interesting proposals to mature technology, suitable for day-to-day system software development.

Reflective Java

The combination of reflection and object-oriented programming in the form of a metaobject protocol (MOP) provides a powerful mechanism that is needed to produce flexible and reusable system software. Reflection makes it possible to open up a system's implementation without revealing unnecessary implementation details. Object-oriented programming allows the resulting

model of the system's implementation and behaviour to be locally and incrementally adjusted.

Java has been adapted as a language for the Internet because of its ability to simplify the development of flexible, portable applications with high-level graphical interfaces. Using Java, a user can write code once and run it in any platform, which is a key requirement in the Internet where one program should be capable of running on any computer in the world.

In the ANSA programme, the Reflective Java project makes some features of Java reflective, thus enabling Java-powered system to be customised dynamically, flexibly and transparently. For example, when the same application is run in different situations, the policies regarding distribution or concurrency can be adjusted dynamically according to the environments.

Applications

Mobile Computing

The challenge of mobile computing is that many attributes of the application environment vary as the computer is moved from place to place. Moreover, the degree of variability is enormous. For example, available network bandwidth may vary by five orders of magnitude. Adapting to this variability should be done transparently and flexibly. We believe that the use of Reflective Java will both make the problem tractable and will provide a framework for separating an application from the concerns of its environment.

Transaction Systems

The concept of transactions is an important programming paradigm for simplifying the construction of reliable and available applications, especially those that require concurrent access to shared data. However, an application may require different concurrency and recovery policies in different run-time environments. For example, when only a few applications access the shared data concurrently, an optimistic concurrency control policy would increase system performance. On the other hand, when competition to access the shared data is high, a pessimistic policy would be more suitable. By using Reflective Java, an application can change concurrency policy dynamically according to the run-time environment.

Flexible Networks

By using Reflective Java, it becomes easier to build a constantly evolving network, which allows to update any component at any time according to a particular application.

Benefits

- Easy to upgrade product in order to adapt to changes; either in hardware or application requirements

- Flexibility to customise policies dynamically to suit run-time environment

- High-level transparency to applications

- Write an application once, run it anytime, anywhere, in any environment, with any "-ability"

- Free choice of components

- Flexible configuration

Background of the ANSA programme

The ANSA programme has a proven track record: in 1988 the ANSA programme correctly predicted the development of distributed platform technologies such as OSF DCE and OMG CORBA. The programme has spent much effort in developing standards and market ahead of exploitation by its partners. In 1994 ANSA released ANSAware/RT: a real time distributed computing platform which allows programmers to manage the use of computing and network resources. The release of distributed systems technology which accommodates multimedia streams is imminent. In late 1995 and early 1996 the programme delivered a number of CORBA-Internet-WWW interoperability solutions, again ahead of the market.

Partners in the ANSA programme benefit from the output of ten researchers at a cost of less than one. They use the results to competitive advantage, either in products or services. ANSA results are also used to derive strategic direction and to proactively influence the standardisation process.

The ANSA programme is managed and operated by APM for a group of computer companies (Fujitsu, HP, ICL), telecommunications companies (Bellcore, BT, France Telecom, GPT, Nortel, Telefonica Spain), systems integrators (APM, GEC-Marconi, ICL) and end-users (UK Defence Research Agency, Eurocontrol).

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