Systèmes d'Objets Répartis
(Distributed Object-Support Systems)

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Project Description

The general theme of our work is operating system support for object-oriented systems, especially in distributed environments [1]. We have developed two systems: SOS [2, 3, 4] and COOL [5, 4]. In addition we have done work on structuring operating systems, especially virtual memory support [6], and OS support for distributed garbage collection [7].

A key concept for structuring distributed systems is "Fragmented Objects" [8, 9]. Fragmented Objects (FOs) extend the object concept to a distributed environment. The abstract view of a FO is a single, shared object, of which the distribution is hidden to clients. In the concrete view the FO designer controls (if wished) the distribution of data and function and of the communication between fragments.

FO programming is supported by the FOG language, an extension of C++, and by a toolbox of predefined FOs. The FOG compiler ensures distributed type-safety of both the external and internal interfaces, verifies the encapsulation of FO instances, and automatically generates whatever coercions are necessary for marshalling/unmarshalling between layers. Currently, the toolbox contains mainly classes of primitive FOs such as RPC and multicast communication channels.

Every system service in SOS is a fragmented object, and SOS has plenty of support for user-level fragmented objects. There is also language support if you use FOG [10], an extension of C++ for fragmented objects.

SOS also supports local ("elementary") objects of course. You can declare elementary objects to the system, store them persistently [11], or migrate them between addressing domains or between machines. Migration and storage preserve the data, the structure, and *the type* of the object: even though SOS as an OS has no concept of type, it maintains "prerequisites", allowing the C++ run-time to implement dynamic type checking and linking. The structure and management of elementary objects are decribed in [2, 4]. The mechanics of the dynamic type checker and linker are described in [12].

SOS has been implemented in C++, on top of Unix. It supports object migration, persistent object, dynamic linking, and arbitrarily complex user-defined objects (written in C++ or FOG). Existing system services (all structured as fragmented objects) are: a distributed object manager [4], a user-centered name service [13, 9], a storage service [11], a communication service (allowing groups to choose from a library of protocol types: datagrams, RPC, multicast, atomic multicast, etc.) [14, 15]. Applications built using SOS include a multimedia document manager and a UIMS.

SOS is thouroughly documented with a reference manual and an introductory programmer's manual. Most of the code is in the public domain, except for a few components derived from AT&T code, for which an ATT licence (Unix and C++) is necessary.

COOL is also an object-support OS. It is less ambitious and more efficient than SOS. Here objects are supported by a manager implemented as a kernel server above the Chorus micro-kernel [4, 5]. COOL was developed specifically for the SEPT "Cidre" application of intelligent circulating documents.

Our current work, Soul [16] is to generalize the previous, to have an object-oriented object-support system, as powerful as SOS and as efficient as COOL.

Many of the references are available by anonymous FTP on nuri.inria.fr [128.93.1.26], directory INRIA/publication/SOR.

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