

Distributed Real-Time Computing for Microcontrollers - the OSA+ Approach

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Abstract

New applications introducing restrictions in power consumption, heat, costs and available space lead to small microcontrollers becoming more and more important in distributed real-time systems. Traditional real-time middleware architectures don't fit very well for these small devices. The paper presents an ongoing approach of constructing middleware for small devices by adapting the microkernel concept known from operating systems to middleware. This middleware called OSA+ is service oriented and consists of a small core, basic-, extension-, and user-services. The core provides only a restricted functionality, while the basic and extension services adapt and scale the system according to the application environment. A first (quick and non-optimal) prototype implementation offers a core size of about 60 kBytes and an average size of about 10 kBytes for a basic service. We consider this as a basis for further optimizations leading to yet smaller sizes.

1. Introduction

Distributed real-time systems are state of the art. Real-time middleware helps to simplify the development, operation and maintenance of such systems. New applications introduce restrictions in power consumption, heat, costs or available space thus leading to very small microcontrollers becoming more and more important in the field of distributed real-time computing. Traditional middleware architectures are not very suited to support such small devices. This paper presents the OSA+¹ approach. Based on microkernel concepts, a

new middleware dedicated to small low power devices is introduced. The work described here is ongoing. Section 2 gives a general overview of the OSA+ concepts and architectures. Section 3 deals with the real-time issues and section 4 gives an application case and first results. Finally, section 5 concludes this paper.

2. An Approach Using a Scalable Microkernel Real-Time Middleware

OSA+ is a scalable middleware for real-time systems. It facilitates the development of distributed real-time applications in a heterogeneous environment. In contrast to object oriented middleware architectures like CORBA [1], DCOM [2] or RMI [3] and message based architectures like JMS [4], OSA+ is a service based architecture. Services communicate by exchanging jobs. A job consists of an order and a corresponding result. The order tells what and when to do this (release times, deadlines, priorities). The result is returned after the job has finished execution. This is more than pure message exchange (like in JMS), because the execution of the services is scheduled according to the priorities or deadlines of the jobs. A more detailed description of the job scheduling can be found in section 3. Because OSA+ is dedicated to small systems, a simple interface is necessary. Figure 1 shows the service interaction based on only six functions: two functions to send and execute an order or to return a result (SendOrder, ReturnResult), two blocking functions for synchronous reception of an order or a result (AwaitOrder, AwaitResult) and two non-blocking functions for asynchronous reception (ExeOrder, ExistResult). These functions form a simple, but flexible interface, which can be used directly or be a foundation to build object oriented interfaces, if necessary.

¹ OSA+ : Open System Architecture – Platform for Universal Services

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Fifth IEEE International Symposium on Object-Oriented Real-Time Distributed Computing (ISORC 2002) Luiz Bacellar,Peter Puschner,Seongsoo Hong,2002 **Proceedings** ,2002 This text contains information on database and information systems presented at the 5th IEEE international symposium on Object Oriented Real Time Distributed Computing ISORC 2002 **Proceedings** ,2002 Handbook of Real-Time and Embedded Systems Insup Lee,Joseph Y-T. Leung,Sang H. Son,2007-07-23 Real time and embedded systems are essential to our lives from controlling car engines and regulating traffic lights to monitoring plane takeoffs and landings to providing up to the minute stock quotes Bringing together researchers from both academia and industry the Handbook of Real Time and Embedded Systems provides comprehensive covera **Composition of Embedded Systems. Scientific and Industrial Issues** Fabrice Kordon,Oleg Sokolsky,2008-01-11 This book constitutes the thoroughly refereed post proceedings of the 13th International Monterey Workshop on Composition of Embedded Systems Scientific and Industrial Issues held in Paris France in October 2006 The 12 revised full papers presented were carefully selected during two rounds of reviewing and improvement from numerous submissions The workshop discussed a range of challenges in embedded systems design that require further major advances in technology **Proceedings, Sixth IEEE International Symposium on Object-Oriented Real-Time Distributed Computing** Peter Puschner,Tatsuo Nakajima,Arif Ghafoor,2003 ISORC 2003 strives to present state of the art research in ORC reflecting various perspectives of ORC from programming and system engineering topics such as ORC paradigms and object models to Web based applications and system evaluation techniques The diversity of the topics highlights the importance of ORC in today s high tech world **Proceedings** ,2005 Middleware for Communications Qusay Mahmoud,2005-06-10 A state of the art guide to middleware technologies and their pivotal role in communications networks Middleware is about integration and interoperability of applications and services running on heterogeneous computing and communications devices The services it provides including identification authentication authorization soft switching certification and security are used in a vast range of global appliances and systems from smart cards and wireless devices to mobile services and e Commerce Qusay H Mahmoud has created an invaluable reference tool that explores the origins and current uses of middleware highlighting the importance of such technologies as CORBA J2EE and JMS and has thus compiled the roadmap to future research in this area Middleware for Communications discusses the emerging fields of Peer to Peer P2P and grid middleware detailing middleware platforms such as JXTA and the Globus middleware toolkit shows how Middleware will play a significant role in mobile computing presents a Platform Supporting Mobile Applications PLASMA a middleware platform that consists of components for location event and profile handling of Location Based Services introduces middleware security focusing on the appropriate aspects of CORBA J2EE and NET and demonstrates how to realize complex security capabilities such as role based access control RBAC and mandatory access control MAC discusses how Quality of Service QoS component middleware

can be combined with Model Driven Architecture MDA technologies to rapidly develop generate assemble and deploy flexible communications applications This incomparable overview of middleware for communications is suitable for graduate students and researchers in communications and computing departments It is also an authoritative guide for engineers and developers working on distributed systems mobile computing and networked appliances Pattern Languages of Program Design 5 Dragos-Anton Manolescu,Markus Voelter,James Noble,2006 The long awaited fifth volume in a collection of key practices for pattern languages and design *Proceedings* Luiz Bacellar,Kane H. Kim,Luigi Romano,Stefano Russo,2004

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