

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 (ExistOrder, 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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