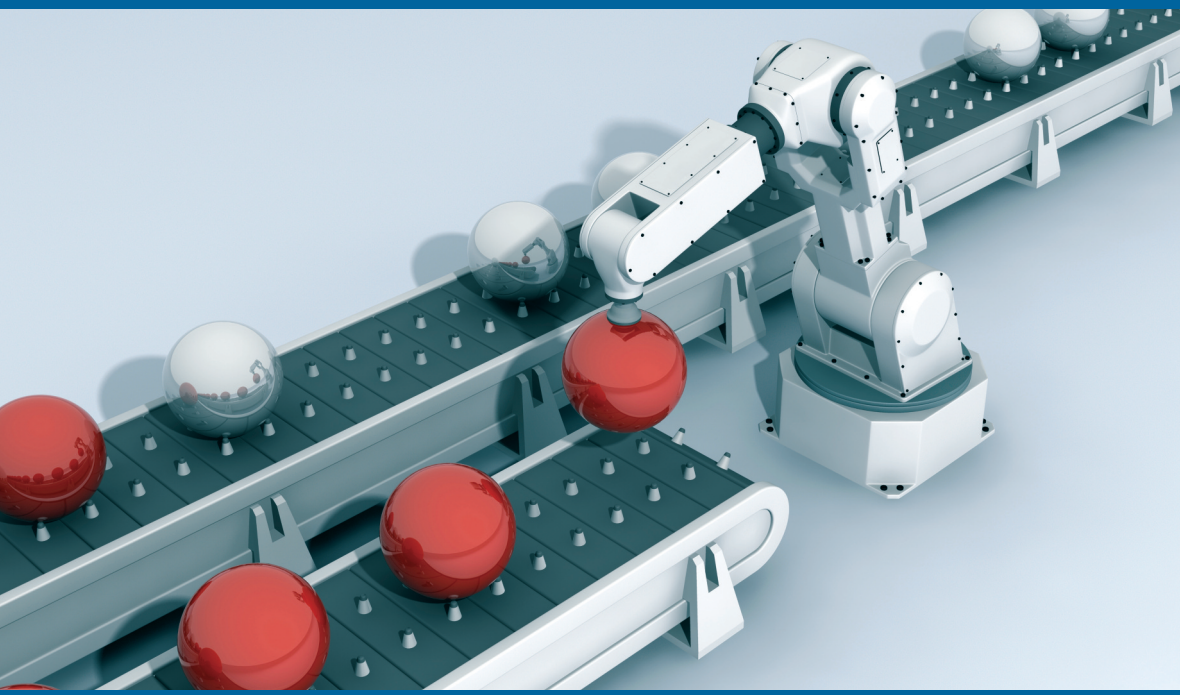
NETWORKS AND TELECOMMUNICATIONS SERIES

Real-time Systems Scheduling 1

Fundamentals

Edited by Maryline Chetto



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Preface

We refer to a system as real-time when it has to meet deadlines when reacting to stimuli produced by an external environment. Punctuality therefore constitutes the most important quality of a real-time computer system, which, moreover, distinguishes it from conventional computer systems. We refer to a system as embedded when it is physically integrated into a physical device whose control and command it ensures, which have a particular impact on its sizing and the selection of its components.

The rapid evolution of microelectronic techniques and communication infrastructures in recent years has led to the emergence of often-miniaturized interconnected embedded systems (wireless nodes processing data coming from sensors), leading to the birth of the concept of the "Internet of things". The real-time qualifier therefore remains relevant for all these autonomous and intelligent objects as it was in the 1970s with the advent of microcomputers, when this qualifier was restricted to industrial process controlling systems.

The large variety of appliances in which real-time systems are now integrated requires increasingly strict constraints to be taken into account in terms of physical size, computational power, memory capacity, energy storage capacity and so on,

in their design. It is therefore in this direction that research efforts have turned for several years.

Every piece of software with real-time application is composed of tasks, programs whose execution requires a concurrent access to shared resources limited in number (processor, memory, communication medium). This raises the central issue of scheduling whose solution leads to a planning of tasks that respects the time constraints.

Since the early 1970s, in particular following the publication of the crucial article by Liu and Layland, research activity in the field of real-time scheduling, both through its theoretical results and integration in operating systems, has allowed us to overcome numerous technological barriers.

Real-Time Systems Scheduling constitutes a learning support regarding real-time scheduling intended for instructors, master's degree students and engineering students. It also aims to describe the latest major progress in research and development for scientists and engineers. The book groups together around 30 years of expertise from French and Belgian universities specialized in real-time scheduling. It was originally published in French and has now been translated into English.

This book is composed of two volumes with a total of 13 chapters.

Volume 1 entitled *Fundamentals* is composed of six chapters and should be of interest as a general course on scheduling in real-time systems. Reading the chapters in order, from 1 through to 6, is recommended but not necessary. Volume 1 is structured as follows: Chapter 1 constitutes a conceptual introduction to real-time scheduling. Chapters 2 and 3, respectively, deal with uniprocessor and multiprocessor real-time scheduling. Chapter 4 discusses results on scheduling tasks with resource requirements.

Chapter 5 relates to the scheduling issue in energy-constrained systems. Chapter 6 presents the techniques of computing the worst-case execution time (WCET) for tasks.

Volume 2 entitled *Focuses* is composed of seven chapters. This volume aims at collecting knowledge on specific topics and discussing the recent advances for some of them. After reading Chapter 1 of Volume 1, a reader can move to any chapters of Volume 2 in any order. Volume 2 is structured as follows: Chapter 1 highlights the newer scheduling issues raised by the so-called energy-autonomous real-time systems. In Chapter 2, the authors consider a probabilistic modelization of the WCET in order to tackle the scheduling problem. In Chapter 3, the authors show how automatic control can benefit real-time scheduling. Chapter 4 deals with the synchronous approach for scheduling. In Chapter 5, the authors focus on the optimization of the Quality-of-Service in routed networks. Chapter 6 is devoted to the scheduling of messages in industrial networks. Finally, Chapter 7 pertains specifically to resolution techniques used in avionic networks such as AFDX.

Maryline CHETTO
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