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# Resource Management for Internet of Things



Springer

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# Preface

The emergent paradigm of Internet of Things (IoT) promises to take the integration of people with communications and sensing technologies to a new level. With the possibility of addressing each physical object individually and making it part of a global network, the IoT will enable new applications that can revolutionize human behaviour and interactions. The IoT has the potential to provide novel value-added services to make life easier and healthier for citizens, to increase the productivity of companies and to promote the construction of more intelligent and sustainable cities, environments and countries. Despite the great interest on IoT, there is yet to be an agreed definition of such a concept. The IoT concept is difficult to capture and shape, owing to the complex ecosystem formed not only by the variety of its constituent elements but also by the vast possibilities of interaction models that arise in such an environment. In order to effectively take advantage of the vast number of connected things, applications need to be built that exploit the data generated by IoT devices and transform them into information capable of assisting decision-making processes and ultimately into valuable knowledge for users. The wide range of software and hardware elements required for processing, analysing, transmitting, and temporarily or permanently storing the data produced by things compose an IoT ecosystem. In addition, since the ultimate goal of IoT applications is to provide services to end-users, the human being is also an integral part of this ecosystem. Their needs, social habits, desires, characteristics and context of daily activities should be considered when building a truly useful IoT system.

Despite its potential benefits, there are still many challenges to be overcome to leverage the wide dissemination of the IoT paradigm. One major challenge is efficiently managing the resources involved in an IoT ecosystem. From the acquisition of physical data to its transformation into valuable services or information, there are several steps that must be performed, involving the various players in the complex IoT ecosystem. Such transformation consists of a process that demands resources from the system. IoT devices, such as sensors, have limited computing and energy resources, and they are not able to perform sophisticated processing and storing large amounts of data. Therefore, it is often necessary to rely on more powerful devices to fully perform the transformation process required by

IoT applications. Such devices can vary from smartphones to gateway nodes to geographically distributed data centres of different scales. Indeed, with its vast capacity of processing and long-term storage, cloud computing comes hand-in-hand with IoT to create complex, large-scale, distributed and data-oriented ecosystems. Therefore, the interplay of IoT devices, gateways, cloud nodes and other elements to achieve the final goal of producing useful information to end-user gives rise to a management problem that needs to be wisely tackled.

This book focuses on the resource management problem in IoT systems from a broad perspective. The core issue of this problem is how to allocate the resources available in the heterogeneous IoT system to accommodate the requirements imposed by applications. At the first glance, this issue is similar to the typical resource allocation and task scheduling problems, which have been exhaustively studied in several areas of computing systems. However, resource allocation for IoT poses new challenges that call for novel solutions, tailored for such an emerging scenario. The huge heterogeneity of the participant devices (from tiny sensors to powerful data centre nodes), the highly dynamic execution environment, the specific nature of the data generated by IoT devices, are examples of issues that make IoT a very peculiar ecosystem. Moreover, there are several activities that, although not in the core of the problem, are required to support the resource allocation, such as resource discovery and monitoring. We believe that resource management (including allocation and scheduling decisions, but not limited to these) is a key issue to deal with the diverse nature of IoT resources and to optimize the overall system performance, thus benefiting both end-users and infrastructure/device owners. Considering the relevance of this subject and its complexity, in this book we present a thorough study of the activities encompassed in a holistic resource management process for IoT, with emphasis on resource allocation. This book does not focus on the algorithmic solutions for resource allocation, but instead on the different functionalities and architectural approaches involved on a basic workflow for managing the life cycle of resources in an IoT system.

This book should be of interest for researchers, students, professional developers who are interested in studying the IoT paradigm from the perspective of how to manage the dynamic and heterogeneous resources involved from the data acquisition to the delivering of value-added services for the end-user.

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