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Information technology — Multimedia Middleware —

Part 4: Resource and quality management

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Partie 4: Management des ressources et de la qualité

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Foreword

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The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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ISO/IEC 23004-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23004 consists of the following parts, under the general title *Information technology — Multimedia Middleware*:

— *Part 1: Architecture*

— *Part 2: Multimedia application programming interface*

— *Part 3: Component model*

— *Part 4: Resource and quality management*

— *Part 5: Component download*

— *Part 6: Fault management*

— *Part 7: System integrity management*

Introduction

MPEG, ISO/IEC JTC 1/SC 29/WG 11, has produced many important standards (MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21). MPEG feels that it is important to standardize an application programming interface (API) for Multimedia Middleware (M3W) that complies with the requirements found in the annex to the Multimedia Middleware (M3W) Requirements Document Version 2.0 (ISO/IEC JTC 1/SC 29/WG 11 N 6981).

The objectives of Multimedia middleware (M3W) are to allow applications to execute multimedia functions with a minimum knowledge of the middleware and to allow applications to trigger updates to the middleware to extend the middleware API. The first goal can be achieved by standardizing the API that the middleware offers. The second goal is much more challenging, as it requires mechanisms to manage the middleware API and to ensure that this functions according to application needs. The second goal can support the first, by reducing the needed standard APIs to those that provide middleware management. Consequently, applications can use these standard management APIs to generate the multimedia system they require.

The aim of M3W is to define a component-based middleware layer in high-volume embedded appliances that enables robust and reliable operation. These types of product are heavily resource constrained, with a high pressure on silicon cost and power consumption. In order to be able to compete with dedicated hardware solutions, the available resources will have to be used very cost-effectively, while enabling robustness and meeting stringent timing requirements imposed by high-quality elements such as digital audio and video processing.

High-volume embedded appliances are considered business-critical devices. Their failure can have important economic implications for the producing company. Hence, they have stringent and demanding quality requirements. Unfortunately, in the software industry misbehaving products are commonplace. However, this is not the case with consumer electronics, home appliances and mobile devices. Users are accustomed to robust and well-behaved devices.

In consumer electronics, there are demanding quality requirements and a need to use the available hardware resources cost-effectively. The term “Application” is used to refer to the software entity that (indirectly) provides certain functionality to an end-user; the Application may include Service Instances that are bound to it. In order to ensure that an Application provides the correct service, it needs to be assigned the hardware resources it requires. This can be achieved by assigning it the “worst case” resources required. However, with many applications, the worst-case resource usage is much less than the mean case. If this worst-case approach is followed, hardware resources will be wasted. On the other hand, problems may arise if the running applications require more resources than can be made available. If the platform follows a typical fair policy for the assignment, the behaviour of the system will be unpredictable, especially for applications that must provide results according to some specified time constraints.

The goal of Resource Management is to assign budgets or resource reserves to Applications. These budgets are guaranteed, so that they are available in any situation. This approach helps to enhance system robustness, because an Application is unable to affect the resource reserves of others.

In order to benefit from Resource Management, Applications participating in Resource Management should be resource-aware (RA). This means that they are aware of the resources they need during their execution and should adapt their behaviour to the resources which are made available. This ensures that applications can function correctly without exhausting all of the system resources that have been allocated to them.

Quality-Aware (QA) Applications are RA applications that are aware of the quality of service that they deliver. Typically, they are capable of providing different quality levels. They are characterized by the quality they provide and the resources needed for this purpose. Usually the higher the quality level, the higher the resource needs. This type of Application is able to dynamically change the provided quality level, depending on the assigned budgets.

Often, QA and RA applications are real-time applications. The assigned budgets allow them to provide a suitable output within some time interval. A hard real-time application can be viewed as QA with only two quality levels: maximum quality or nothing. The Resource Management framework can also deal with Non Resource-Aware Applications (NRA) in the sense that they are assigned a fixed budget all together.

The relation between the Resource Management framework and QA applications is based on a **contract model**. The system provides resources and the Applications commit to generate the required results (outputs) with a specific and stable quality. Budget assignment must be obtainable, which means that it should not be possible to assign more resources than those actually available. Contracts are negotiated with the Applications with the goal of maximizing overall system quality, as perceived by the user. In this process, the "importance" of the Applications is a primary parameter for this operation.

Power is considered to be one of the most important resources to be managed in the next generation of consumer electronics. Its importance is clear for mobile devices, where the goal is to maximize battery life. In stationary devices, it is also relevant for environmental conditions, fan-less operation and to increase the lifetime of the silicon devices. In addition, power management is related to heat control, so that the temperature of different parts of the device can be maintained within a certain threshold.

The basic goals in M3W with respect to power management are as follows.

— Reduce power consumption.

— Increase battery life, for mobile devices.

— Ensure a system-wide limit for heating: If it is detected that the temperature of the device it is too high, it may be required to reduce it.

— Take advantage of power-aware hardware and M3W components.

— Ensure that the system and relevant Applications are always executed, in spite of the power saving policy selected.

Power management is very much related to resource management. A number of techniques for reducing power consumption are based on moving hardware components to less power-consuming modes of operation, which implies reducing/modifying the available resources (CPU capacity, memory size, bandwidth, etc.). This is the case, for example, with CPU voltage and frequency scaling, which can reduce power consumption and consequentially, CPU computational power. For this reason, it is desirable to integrate power management with quality and resource management.

The Resource Management Framework is in charge of achieving the functionality that has been sketched in this introductory clause. Its functions and architecture are defined in this part of ISO/IEC 23004.

Information technology — Multimedia Middleware —

Part 4:
Resource and quality management

1 Scope

This part of ISO/IEC 23004 defines the Resource and Quality Management framework of the MPEG Multimedia Middleware (M3W) technology.

2 Organization of this document

This part of ISO/IEC 23004 has the following high level structure:

— Clause 1 defines the scope of this part of ISO/IEC 23004.

— Clause 3 gives an overview of documents that are indispensable for the application of this part of ISO/IEC 23004.

— Clause 4 gives the terms and definitions used in this part of ISO/IEC 23004.

— Clause 5 provides an overview of and introduction to the Resource and Power Management Framework.

— Clause 6 contains a detailed specification of the interfaces of the Resource and Power Management Framework that are part of the M3W API.

— Clause 7 gives an overview of the realization of the Resource and Power Management Framework.

This part of ISO/IEC 23004 has the following annexes:

Annex A, Dynamic view of the Resource and Power Management Framework, describes the interactions between the different entities of the Resource and Power Management Framework.

Annex B, CPU chief details: The Resource and Power Management Framework distinguishes four different roles that are together responsible for Resource and Power Management:

1) resource chief;

2) resource manager;

3) quality chief;

4) quality manager.

The CPU chief is discussed in this annex. The CPU chief is a specialization of a resource chief. This is the chief responsible for monitoring and enforcing the CPU budgets.

Annex C, Approach to power management: Power is a resource as well. This annex discusses managing this specific resource.

Annex D, Composition of quality information example: Often we need to manage the Resource Consumption and delivered Quality of a composition of entities instead of a single atomic entity. This annex discusses how to compose the Quality and Resource information in such cases.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23004-1, *Information technology — Multimedia Middleware — Part 1: Architecture*