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INTERNATIONAL STANDARD

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Internet of things (IoT) – Real-time IoT framework



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INTERNET OF THINGS (IoT) – REAL-TIME IoT FRAMEWORK

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
JTC1-SC41/216/FDIS	JTC1-SC41/229/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

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INTRODUCTION

This document addresses a special kind of IoT system operating in real-time that is called real-time IoT (RT-IoT) systems.

The correct behaviour of a real-time system depends not only on the logical correctness, but also on the timeliness of its actions. Design and development of a real-time system are different from conventional computer systems in terms of real-time OS, embedded development, task scheduling, etc.

[1][1] emphasizes the requirements of timeliness and predictability in real-time systems as follows.

"The challenges and trade-offs faced by the designers of real-time systems are quite different from those who design general purpose computing systems. To achieve the fundamental requirements of timeliness and predictability, not only do conventional methods for scheduling and resource management have to be redesigned, but new concepts that have not been considered in conventional systems need to be added. New paradigms are necessary to specify and validate real-time systems."

Lack of understanding of real-time systems could lead to unsuccessful RT-IoT system deployment where real-time computation is required. A deployment of an RT-IoT system based on the very general real-time capabilities defined in ISO/IEC 30141 [2] is not enough to fully support real-time requirements. Therefore, it is important to complement the real-time capabilities of IoT reference architecture for RT-IoT systems.

Basically, an RT-IoT system has features of a typical IoT system except real-time capability. ISO/IEC 30141 explains real-time capability of an IoT system as follows:

– a characteristic of a system or mode of operation in which computation is performed during the actual time that an external process occurs, in order that the computation results can be used to control, monitor, or respond in a timely manner to the external process

Considering the characteristics of real-time capability, any IoT system embraces real-time aspects to some extent simply because it continuously interacts with the physical world.

Requirements for real-time capability depend on the peer that an IoT system interfaces with. For example, a human–machine interface guarantees a maximum delay of 250 ms in presenting responses to humans, whereas 150 ms is sufficient in a telephone service. Any IoT system interfacing with physical things guarantees some extent of timeliness because any event in the physical world demands timely adjustment from the IoT system.

This document focuses on real-time capability in addition to very general description given in ISO/IEC 30141, because failing on timing constraints could cause serious damage to an IoT system or to its environment, including injury or even death of people involved. Certain RT-IoT systems, such as industrial IoT (IIoT) systems and cyber-physical systems (CPS), consider time as of high importance.

The purpose of this document is to provide a guideline for deploying an RT-IoT system to avoid pitfalls that usually occur during real-time system developments.

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[1] Numbers in square brackets refer to the Bibliography.

INTERNET OF THINGS (IoT) – REAL-TIME IoT FRAMEWORK

1 Scope

This document specifies the framework of a real-time IoT (RT-IoT) system, including:

– RT-IoT system conceptual model based on domain-based IoT reference model defined in ISO/IEC 30141;

– impacts of real-time parameters in terms of four viewpoints (time, communication, control and computation).

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
real-time IoT
RT-IoT
IoT system with timing constraints

Note 1 to entry: Correct behaviour of an RT-IoT system depends not only on the logical correctness, but also on being able to meet timing constraints.

3.1.2
timeliness
property of meeting timing constraints, finishing before the deadline and giving compulsory response

3.2 Abbreviated terms

2G/3G/4G	second/third/fourth generation mobile networks
5G	fifth generation mobile networks
AI	artificial intelligence
ASD	application and service domain
CPU	central process unit
IoT	Internet of Things
LAN	local area network
OMD	operation and management domain
PED	physical entity domain