ISO/IEC TR 30189-1

Edition 1.0 2025-03

TECHNICAL REPORT

Internet of Things (IoT) – IoT-based management of tangible cultural heritage assets –
Part 1: Framework

ISO/IEC TR 30189-1:2025-03(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.200

ISBN 978-2-8327-0271-0

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FOREWORD

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ISO/IEC 30189-1 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of ISO/IEC Joint Technical Committee 1: Information technology. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
JTC1-SC41/480/DTR	JTC1-SC41/492A/RVDTR

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 Technical Report is English.

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

A list of all parts in the ISO/IEC 30189 series, published under the general title *Internet of Things (IoT) – IoT-based management of tangible cultural heritage assets*, can be found on the IEC and ISO websites.

INTRODUCTION

Cultural heritage assets can include museums, historical landmarks, artworks, and other cultural artifacts. Effective management of cultural heritage is crucial for preserving these important assets for future generations. The cultural heritage management can include efforts to preserve and protect cultural heritage assets from damage, deterioration and theft.

The Internet of Things (IoT) technology can be used for management of tangible cultural heritage assets. In particular, IoT-based sensing, monitoring and location tracking can be performed for management of tangible cultural heritage.

In the status monitoring, IoT technology can be used to monitor the condition of cultural heritage or assets, such as the temperature and humidity of a museum. This is important because certain environmental conditions can cause damage to and deterioration of valuable cultural assets. By monitoring these conditions in a real-time manner, it is possible to take corrective action to prevent damage and ensure that the assets are being preserved in optimal conditions.

In the location tracking, IoT technology can be used to keep track of various cultural assets. By applying appropriate IoT sensors to these assets, it is possible to track their location and movement in a real-time manner. This can help prevent theft and ensure that valuable assets are properly protected. For example, if an artifact is removed from its display, the IoT sensor will trigger an alert, enabling museum staff to quickly take actions to secure the asset.

This document describes how IoT technology can be used to effectively manage a variety of cultural heritage assets. This document is purposed to provide useful information or guidelines for development of platforms or services on IoT-based management of cultural heritage.

In particular, this document focuses on management of stand-alone cultural heritage assets. A stand-alone cultural heritage is a single cultural asset that is not part of a larger collection or group of assets. Stand-alone cultural assets can be important to a particular community or group and can be preserved and protected in order to preserve the cultural heritage of that group. In the context of cultural heritage management, stand-alone cultural assets can be treated differently than assets that are part of a larger collection, as they possibly do not have the same level of institutional support or resources available for their preservation.

IEC TR 30189 consists of two parts.

– Part 1 describes a framework for the use of IoT technology for management of tangible cultural heritage assets, which includes the associated functional entities and information flows.
– Part 2 describes a set of use cases for IoT-based management of tangible cultural heritage assets, based on the framework, which include implementations and experimentations for the associated services.

INTERNET OF THINGS (IOT) – IOT-BASED MANAGEMENT OF TANGIBLE CULTURAL HERITAGE ASSETS –

Part 1: Framework

1 Scope

This document describes a framework for the use of IoT technology for management of tangible cultural heritage assets, which includes the associated functional entities and information flows.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

3.1
cultural heritage
legacy of physical objects and intangible attributes of a group or a society that are inherited from past generations, maintained and protected in the present and preserved for future generations

[SOURCE: ISO 18461:2016, 2.1.3]

3.2
Internet of Things
infrastructure of interconnected entities, people, systems and information resources together with services which processes and reacts to information from the physical world and virtual world

[SOURCE: ISO/IEC 20924:2024, 3.2.8]

4 Symbols and abbreviated terms

CCTV	closed circuit television
CHM	cultural heritage management
GPS	global positioning system
IoT	Internet of Things
JSON	JavaScript Object Notation
JWT	JSON Web Token
MQTT	Message Queue Telemetry Transport
OAuth	Open Authorization
RDBMS	relational database management system
URL	Uniform Resource Locator

5 General

5.1 Cultural heritage management

Cultural heritage represents national or world-wide heritage that has been artificially or naturally formed. Among the properties that have been preserved for a long period of time and passed down to the present day, those with great historical, artistic, and academic value are designated as cultural heritage assets.

Figure 1 shows examples of the famous cultural heritage assets in the world. These cultural heritage assets exist indoors or outdoors, and their sizes vary greatly.

Figure	Name	Location	Indoor / Outdoor	Size	Era
	Statue of Liberty	New York City	Outdoor	Large	1886
	The Great Wall	China	Outdoor	Large	259 BC to 210 BC, 1368 to 1644
	Stupa of Buddhist Monk Soyo at Yeongoksa Temple, Gurye	Korea, republic of	Outdoor	Small	1650
	Seokguram Grotto	Korea, republic of	Indoor	Large	751 to 774
	Holy Crown of Hungary	Hungary	Indoor	Small	1000 to 1920
	Bracelet with Four Bells	Thailand	Indoor	Small	300 BC to AD 150

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Figure 1 – Examples of cultural heritage assets

Cultural heritage management is the process of preserving and managing the material and immaterial aspects of cultural heritage assets that include historic buildings, archaeological sites, monuments, artifacts, and documents.

In general, cultural heritage management is associated with identification, conservation, and public engagement. Identification of cultural heritage is the first step in cultural heritage management. This involves identifying and documenting the cultural assets within a community. This process can be achieved through surveys, inventories, and other data collection methods. The identification of cultural heritage is essential to understanding its value and significance, as well as determining appropriate management strategies. Next, the conservation is the process of preserving cultural heritage for future generations. This involves a range of activities, such as stabilizing, repairing, digitizing, and protecting cultural assets from damage, decay, and deterioration. Conservation can also involve preventive measures, such as climate control, security, and monitoring. Finally, the public engagement is a critical aspect of cultural heritage management. This involves the development of partnerships and collaborations with communities, stakeholders, and other organizations. Public engagement is essential for ensuring that cultural heritage management is responsive to the needs and aspirations of the community, and that it is sustainable over the long term.

5.2 Management of stand-alone cultural heritage assets

Cultural heritage assets are the common heritage of humankind and thus it is important that they are preserved and protected for a long time. However, these cultural heritage assets can be damaged for various reasons.

Figure 2 gives some examples of damage to tangible cultural heritage assets. A cultural heritage can be damaged for various reasons such as natural damage (e.g. worn-out), destruction (e.g. broken), and theft. Such damage will lead to a great loss of value. To preserve cultural heritage assets and prevent damage to the cultural heritage assets, it is important that a variety of services for cultural heritage management is used, as shown in Figure 2. These management functions include the status monitoring of cultural heritage assets, the surveillance of cultural heritage damage by humans or animals, the prevention of intentional theft, and the location tracking for stolen cultural heritage assets.

Figure 2 – Management for conservation of tangible cultural heritage assets

Most famous cultural heritage assets are usually registered with a cultural heritage management authority (e.g. cultural heritage administration), and are located and managed in a relevant place (e.g. museum or tourist attraction). On the other hand, a number of cultural heritage assets are not under the management of cultural heritage management authority. These cultural heritage assets are referred to as "stand-alone" cultural heritage assets in this document.