

# TECHNICAL REPORT



Internet of things (IoT) – Underwater communication technologies for IoT

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# INTERNET OF THINGS (IoT) – UNDERWATER COMMUNICATION TECHNOLOGIES FOR IoT

## FOREWORD

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|-------------------|----------------------|
| JTC1-SC41/183/DTR | JTC1-SC41/203A/RVDTR |

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The language used for the development of this Technical Report is English.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs) and [www.iso.org/directives](http://www.iso.org/directives).

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## INTRODUCTION

Earth is the aquatic planet as water covers 70 % of its surface. Due to the rapid growth of technology, underwater communication technologies can be used for the development of various smart underwater applications. The underwater communication system is one of the fastest-growing fields since many applications such as monitoring applications, military applications, security applications, new resource exploration, etc. are continuously being developed and used. However, many applications still need to be studied in-depth and underwater resources also need to be explored. Therefore, the research in underwater communication technology plays a vital role in the exploration of undersea resources and the development of various underwater applications.

Using the radio frequency (RF) signal, the communication technology in the underwater environment can be extremely influenced by various factors such as environmental noise, pollution, power, etc. This can cause several issues related to attenuation, frequency fading, Doppler shift, multipath effect, etc. Hence, acoustic communication technology has been used by numerous researchers to solve these issues. In the case of high-speed acoustic communication, problems like limited bandwidth, reliability in data, error rate, multipath, etc. remain to be solved.

Optical communication technology is used for high-speed and short-range communication in the underwater environment. The optical communication uses the laser to carry the information through the water. In the case of long-distance communication in the underwater environment, optical communication is not suitable. The magnetic fusion communication in the underwater environment is only used for near-field communication. Therefore, all communication technologies are essential for underwater communication.

The purpose of this document is to provide a technical overview of the different communication technologies in the underwater environment such as acoustic communication, optical communication, Very Low Frequency (VLF)/Extremely Low Frequency (ELF) communication, and Magnetic Fusion Communication (MFC). Correspondingly, this document also provides the characteristics of each communication technology in the underwater environment, trends of underwater communication technology, layered design of underwater technology, and the application development using different communication technologies.