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TECHNICAL REPORT

colour inside

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



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FOREWORD

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ISO/IEC TR 30167 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of IEC joint technical committee 1: Information technology. It is a Technical Report.

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

DTR	Report on voting
JTC1-SC41/183/DTR	JTC1-SC41/203A/RVDTR

Full information on the voting for the approval of this Technical Report 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 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 and 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.

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

1 Scope

This document describes the enabling and driving technologies of underwater communication such as acoustic communication, optical communication, Very Low Frequency (VLF)/Extremely Low Frequency (ELF) communication, and Magnetic Fusion Communication (MFC). This document also highlights:

– technical overview of different communication technologies;
– characteristics of different communication technologies;
– trends of different communication technologies;
– applications of each communication technology;
– benefits and challenges of each communication technology.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 Symbols and abbreviated terms

ACPG	a specific graph technique
AUV	autonomous underwater vehicle
ASK	amplitude shift keying
BER	bit error rate
BPSK	binary phase-shift keying
CBC-MAC	cipher block chaining-message authentication code
CCM-UW	counter with CBC-MAC for underwater
CRC	cyclic redundancy code
DTN	delay/disruption tolerant network
ELF	Extremely Low Frequency
FSK	frequency-shift keying
FSO	free space optics
HF	high frequency
IM	intensity modulation