

ISO/IEC 30140-1:2018-02 (E)

Information technology - Underwater acoustic sensor network (UWASN) - Part 1: Overview and requirements

Contents

Page

FOREWORD	5
INTRODUCTION	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	7
4 Abbreviated terms	9
5 UWASN overview and applications	9
5.1 Overview	9
5.2 Application domain of UWASN	11
6 Characteristics of UWASN in terms of the effects of propagation variability	12
6.1 Underwater acoustic communication	12
6.2 Acoustic signal strength attenuation	12
6.3 High propagation delay	12
6.4 Multipath	13
6.5 Propagation loss	13
6.6 Noise	14
7 Differences between UWASN and terrestrial sensor network	14
7.1 Types of underwater communication technologies	14
7.2 Housing case	16
7.3 Costs associated with sensor nodes	16
7.4 Omni-directional and directional transducers for data transmission and reception	16
7.5 Underwater object and event localization and 3D relay node	17
7.6 Energy harvesting technology for UWASN	18
8 Specificities of UWASN and related requirements	18
8.1 Three structural scales of UWASN network	18
8.2 Deployments of 2D and 3D topology	21
8.2.1 General	21
8.2.2 Two-dimensional UWASN architecture	21
8.2.3 Three-dimensional UWASN architecture	22
8.3 Cross layering	24
8.4 Underwater acoustic modem	25
8.5 Doppler spread	25
8.6 Deployment considering water depths	26
8.7 Underwater wired and wireless communication	26
8.8 Time synchronization	27
8.9 Data transmission period for energy saving	28
8.10 Routing	29
8.11 Network coding	31
8.12 Data compression	31
8.13 Delay and disruption tolerant network (DTN)	31

9	UWASN further general requirements	32
9.1	General.....	32
9.2	General requirements for UWASN – Cross layering	32
9.3	General requirements for the UWASN – Communication technology	32
9.4	General requirements for the UWASN – Other system requirements	33
	Annex A (informative) Selected applications of UWASN.....	34
A.1	Environmental monitoring – Chemical and biological changes.....	34
A.1.1	Description	34
A.1.2	Physical entities	35
A.1.3	Normal flow	35
A.1.4	Conditions	35
A.2	Detection of pipeline leakages	35
A.2.1	Description	35
A.2.2	Physical entities	36
A.2.3	Normal flow	36
A.2.4	Conditions	37
A.3	Exploration of natural resources.....	37
A.3.1	Description	37
A.3.2	Physical entities	38
A.3.3	Normal flow	38
A.3.4	Conditions	39
A.4	Fish farming.....	39
A.4.1	Description	39
A.4.2	Physical entities	40
A.4.3	Normal flow	40
A.4.4	Conditions	40
A.5	Harbour security	40
A.5.1	Description	40
A.5.2	Physical entities	41
A.5.3	Normal flow	41
A.5.4	Conditions	42
	Bibliography.....	43
	Figure 1 – Overview of a UWASN	10
	Figure 2 – Omni-directional and directional transducers for data transmission and reception	17
	Figure 3 – Underwater cluster network.....	18
	Figure 4 – Underwater ad-hoc network.....	19
	Figure 5 – UWA-UN communication network.....	19
	Figure 6 – UWA-UN communication network using fixed gateway	20
	Figure 7 – UWA-EUN communication network	21
	Figure 8 – Two-dimensional UWASN architecture	22
	Figure 9 – Three-dimensional UWASN architecture	23
	Figure 10 – UWA-cross layer protocol stack.....	25
	Figure 11 – Underwater wired and wireless communication	27
	Figure 12 – Time synchronization for data transmission	28
	Figure 13 – Using active and sleep modes for energy saving	29
	Figure 14 – UWASN routing	30
	Figure A.1 – Illustration of the environmental monitoring use case	34
	Figure A.2 – Oil and gas pipeline leakage monitoring use case.....	36
	Figure A.3 – Flow – Oil and gas pipeline leakage monitoring	37

Figure A.4 – Underwater resource exploration use case	38
Figure A.5 – Fish farming and monitoring use case.....	39
Figure A.6 – Harbour security monitoring use case	41
Table 1 – UWASN market segments and their current and future applications list	11
Table 2 – Summary of the features of acoustic, radio, and optical waves in seawater environments	15
Table 3 – Differences between underwater communication technologies [10][12].....	15
Table 4 – Comparison between 2D and 3D UWASNs.	24