

# 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