Foreword

This document (EN 62657-2:2015) consists of the text of IEC 62657-2:2013 prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation", together with the common modifications prepared by CLC/TC 65X "Industrial-process measurement, control and automation".

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-03-16
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-03-16

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62657-2:2013 was approved by CENELEC as a European Standard with agreed common modifications.

CONTENTS

FOREWORD 7
INTRODUCTION 9
1 Scope 11
2 Normative references 11
3 Terms, definitions, abbreviated terms and conventions 11
3.1 Terms and definitions 11
3.2 Abbreviated terms 16
3.3 Conventions 17
4 Coexistence concept in industrial automation 17
4.1 Overview 17
4.1.1 General 17
4.1.2 Manual coexistence management 19
4.1.3 Automated non-collaborative metrics-based coexistence management 19
4.1.4 Automated collaborative metrics-based coexistence management 19
4.2 Objective 19
4.3 Necessity to implement a coexistence management 21
4.4 Interference potential 23
4.5 Ancillary conditions 25
4.6 Best practices to achieve coexistence 25
4.7 Coexistence conceptual model 28
4.8 Coexistence management and selection of a wireless communication solution 30
4.9 Coexistence management system 32
5 Coexistence management parameters 32
5.1 General 32
5.2 Explanation of coexistence parameters 32
5.2.1 Adjacent channel selectivity 32
5.2.2 Antenna gain 32
5.2.3 Antenna radiation pattern 33
5.2.4 Bandwidth 33
5.2.5 Bit rate of physical link 33
5.2.6 Centre frequency 33
5.2.7 Characteristic of the area of operation 33
5.2.8 Communication load 33
5.2.9 Cut-off frequency 34
5.2.10 Data throughput 35
5.2.11 Duty cycle 35
5.2.12 Effective radiated power (EIRP, ERP) 36
5.2.13 Frequency hopping procedure 37
5.2.14 Future expansion plan 37
5.2.15 Geographical dimension of the plant 37
5.2.16 Infrastructure components 37
5.2.17 Initiation of data transmission 37
5.2.18 Length of user data per transmission interval 37
5.2.19 Limitation from neighbors of the plant 37
5.2.20 Maximum dwell time 38

5.2.21 Maximum number of retransmissions 38
5.2.22 Maximum transmitter sequence 38
5.2.23 Mechanisms for adaptivity 39
5.2.24 Medium access control mechanism 40
5.2.25 Modulation 40
5.2.26 Natural environmental conditions 40
5.2.27 Device characterization parameters 40
5.2.28 Other frequency users 40
5.2.29 Packet loss rate (PLR) 40
5.2.30 Physical links 41
5.2.31 Positions of wireless devices and distances between them 41
5.2.32 Power spectral density (PSD) 41
5.2.33 Purpose of the automation application 42
5.2.34 Radio channel 42
5.2.35 Radio propagation conditions 42
5.2.36 Receiver blocking 43
5.2.37 Receiver maximum input level 43
5.2.38 Receiver sensitivity 43
5.2.39 Regional radio regulations 43
5.2.40 Relative movement 43
5.2.41 Reliability required 43
5.2.42 Response time 44
5.2.43 Security level required 44
5.2.44 Spatial coverage of the wireless communication network 44
5.2.45 Spurious response 44
5.2.46 Topology 45
5.2.47 Total radiated power (TRP) 45
5.2.48 Transmission gap 45
5.2.49 Transmission interval 46
5.2.50 Transmission time 46
5.2.51 Transmitter spectral mask 48
5.2.52 Type of antenna 49
5.2.53 Update time 49
5.2.54 Used frequency bands 50
5.2.55 Wireless devices 50
5.2.56 Wireless communication networks 50
5.2.57 Wireless technology or standard 51
6 Coexistence management information structures 51
6.1 General 51
6.2 General plant characteristic 52
6.3 Application communication requirements 53
6.3.1 Overview 53
6.3.2 Requirements influencing the characteristic of wireless solutions 53
6.3.3 Performance requirements 54
6.4 Characteristic of wireless system type and wireless device type 54
6.4.1 Overview 54
6.4.2 Characteristic of wireless system type 55
6.4.3 Characteristic of wireless devices type 56
6.5 Characteristic of wireless communication solution 58

6.5.1 Overview 58
6.5.2 Characteristic of a wireless network solution 59
6.5.3 Characteristic of wireless devices solution 59
7 Coexistence management process 60
7.1 General 60
7.1.1 Overview 60
7.1.2 Documentation 61
7.1.3 Suitable documentation method 63
7.1.4 Application of tools 64
7.2 Establishment of a coexistence management system 64
7.2.1 Nomination of a coexistence manager 64
7.2.2 Responsibility of a coexistence manager 65
7.2.3 Support by radio experts 65
7.2.4 Training 65
7.3 Maintaining coexistence management system 66
7.4 Phases of a coexistence management process 66
7.4.1 Investigation phase 66
7.4.2 Planning phase 69
7.4.3 Implementation phase 71
7.4.4 Operation phase 72
8 Coexistence parameter templates 74
Bibliography 78

Figure 1 – Area of consideration 21
Figure 2 – Examples of wireless equipment in industrial environments 22
Figure 3 – Progression of expense to achieve coexistence corresponding to the application classes 25
Figure 4 – Separation of wireless communication systems according to frequency and time 26
Figure 5 – Coexistence conceptual model 29
Figure 6 – Flow chart of the coexistence conceptual model 30
Figure 7 – Selection of a wireless communication system in the coexistence management process 31
Figure 8 – Communication load in case of two wireless devices 34
Figure 9 – Communication load in the case of several wireless devices 34
Figure 10 – Cut-off frequencies derived from maximum power level 35
Figure 11 – Duty cycle 36
Figure 12 – Maximum dwell time 38
Figure 13 – Maximum transmitter sequence 39
Figure 14 – Distance of the radio components 41
Figure 15 – Power spectral density of an IEEE 802.15.4 system 42
Figure 16 – Minimum transmission gap 45
Figure 17 – Communication cycle, application event interval and machine cycle 46
Figure 18 – Example of the density functions of transmission time 47
Figure 19 – Example of the distribution functions of transmission time 48
Figure 20 – Transmitter spectral mask of an IEEE 802.15.4 system 49

Figure 21 – Example of distribution functions of the update time 50
Figure 22 – Principle for use of coexistence parameters 51
Figure 23 – Parameters to describe the general plant characteristic 52
Figure 24 – Parameters to describe application communication requirements 53
Figure 25 – Parameters to describe wireless network type and device type 55
Figure 26 – Power spectral density and transmitter spectral mask of a DECT system 57
Figure 27 – Medium utilization in time and frequency of a DECT system 57
Figure 28 – Parameters to describe a wireless communication solution 59
Figure 29 – Relations of the documents in a coexistence management system specification 63
Figure 30 – Planning of a wireless communication system in the coexistence management process 70
Figure 31 – Implementation and operation of a wireless communication system in the coexistence management process 73

Table 1 – Classification of application communication requirements 20
Table 2 – Application profile dependent observation time values 36
Table 3 – List of parameters used to describe the general plant characteristic 52
Table 4 – List of parameters used to describe the requirements influencing the characteristic of wireless solutions 54
Table 5 – List of parameters used to describe performance requirements 54
Table 6 – List of parameters used to describe the wireless system type 56
Table 7 – List of parameters used to describe the transmitter of a wireless device type 58
Table 8 – List of parameters used to describe the receiver of a wireless device type 58
Table 9 – List of parameters used to describe a wireless network solution 59
Table 10 – List of parameters used to describe the transmitter of a wireless device solution 60
Table 11 – List of parameters used to describe the receiver of a wireless device solution 60
Table 12 – Template used to describe the general plant characteristic 74
Table 13 – Template used to describe the application communication requirements 75
Table 14 – Template used to describe the wireless system type 75
Table 15 – Template used to describe a wireless device type 76
Table 16 – Template used to describe the wireless network solution 76
Table 17 – Template used to describe a wireless device solution 77

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – WIRELESS COMMUNICATION NETWORKS –

Part 2: Coexistence management

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62657-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/736/FDIS	65C/740/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This first edition cancels and replaces IEC/TS 62657-2, published in 2011.

The main changes with respect to the TS are:

a) updated the normative references, terms, definitions, symbols, abbreviations;

b) corrected spelling;

c) changed figures to make them consistent with the text and vice versa;

d) added and modified text to make the text more readable.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62657 series, under the general title *Industrial communication networks – Wireless communication networks,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The market is in need of network solutions, each with different performance characteristics and functional capabilities, matching diverse application requirements. Industrial automation applications cover different industrial application domains like:

– process automation, covering for example the following industry branches
  - oil & gas, refining,
  - chemical,
  - pharmaceutical,
  - mining,
  - pulp & paper,
  - water & wastewater,
  - steel
– electric power like
  - power generation (for example wind turbine),
  - power distribution (grid),
– factory automation, covering for example the following industry branches
  - food & beverage,
  - automotive,
  - machinery,
  - semiconductor.

Industrial automation applications require behaviors of wireless communication networks that are different from those that are used for example in telecommunications or for commercial like a remote control or toy. These industrial automation requirements are identified and provided in IEC/TS 62657-1.

In industrial automation, many different wireless communication networks may operate in the same premises. Examples of these networks are IEC 62591 [6] [1] (WirelessHART®[2]), IEC 62601 [7] (WIA-PA) and IEC/PAS 62734 [9] (ISA100.11a); all these networks use IEEE 802.15.4 [18] for the process automation applications. Other examples of wireless networks are specified in IEC 61784-1 [3] and IEC 61784-2 [4] CPs that use IEEE 802.11 [14] and IEEE 802.15.1 [16] for factory automation applications. Different to wired fieldbuses, the wireless communication interfaces can interfere with others on the same premises or environment, disturbing each other. Therefore, without a predictable assuredness of coexistence, it could be problematic to have multiple wireless communication networks in the same facility or environment, especially because the time-criticality, the safety and the security of the operation may not be ensured in such an environment.

This part of the IEC 62657 addresses the coexistence management for a predictable assuredness of coexistence.

---

1 Figures in square brackets refer to the Bibliography.

2 WirelessHART is the registered trade name of the HART Communication Foundation. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

The IEC 62657 series has two parts:

- Part 1: Wireless communication requirements and spectrum considerations
- Part 2: Coexistence management

IEC/TS 62657-1 [8] provides general requirements of industrial automation and spectrum considerations that are the basis for industrial communication solutions. This second part of IEC 62657 specifies the coexistence management with a predictable assuredness of coexistence. It is intended to facilitate harmonization of future adjustments to international, national, and local regulations.

This Part 2 of IEC 62657 provides the coexistence management concept and process. Based on the coexistence management process, a predictable assuredness of coexistence can be achieved for a given spectrum with certain application requirements.

This Part 2 of IEC 62657 provides guidance to the users of wireless communication networks on selection and proper use of wireless communication networks. To provide suitable wireless devices to the market, it also serves vendors in describing the behaviors of wireless devices to build wireless communication networks matching the application requirements.

This Part 2 of IEC 62657 is based on analyses of a number of International Standards, which focus on specific technologies. The intention of this standard is not to invent new parameters but to use already defined ones and to be technology independent.

INDUSTRIAL COMMUNICATION NETWORKS – WIRELESS COMMUNICATION NETWORKS –

Part 2: Coexistence management

1 Scope

This Part 2 of IEC 62657

- specifies the fundamental assumptions, concepts, parameters, and procedure for wireless communication coexistence;
- specifies coexistence parameters and how they are used in an application requiring wireless coexistence;
- provides guidelines, requirements, and best practices for wireless communication's availability and performance in an industrial automation plant; it covers the life cycle of wireless communication coexistence;
- helps the work of all persons involved with the relevant responsibilities to cope with the critical aspects at each phase of life cycle of the wireless communication coexistence management in an industrial automation plant. Life cycle aspects include: planning, design, installation implementation, operation, maintenance, administration and training;
- provides a common point of reference for wireless communication coexistence for industrial automation sites as a homogeneous guideline to help the users assess and gauge their plant efforts;
- deals with the operational aspects of wireless communication coexistence regarding both the static human/tool-organization and the dynamic network self-organization.

This Part 2 of IEC 62657 will provide a major contribution to national and regional regulations. It does not exempt devices to conform to all requirements of national and regional regulations.

〖C〉 *Text deleted* 〈C〗

2 Normative references

None

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

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

3.1.1
adjacent channel interference
interference that occurs when two or more wireless applications use adjacent frequency channels