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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Industrial communication networks – Wireless communication networks – Part 1: Wireless communication requirements and spectrum considerations

Réseaux de communication industriels – Réseaux de communication sans fil – Partie 1: Exigences de communication sans fil et considérations relatives au spectre

IEC 62657-1:2017-06(en-fr)

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INDUSTRIAL COMMUNICATION NETWORKS – WIRELESS COMMUNICATION NETWORKS –

Part 1: Wireless communication requirements and spectrum considerations

FOREWORD

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International Standard IEC 62657-1 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition cancels and replaces the first edition of IEC TS 62657-1 published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TS 62657-1:2014:

a) update of requirements for wireless industrial applications;
b) addition of performance indicators and their measurement.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/874/FDIS	65C/878/RVD

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

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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INTRODUCTION

This document provides general requirements of industrial automation and spectrum considerations that are the basis for industrial communication solutions. This document is intended to facilitate harmonization of future adjustments to international, national, regional and local regulations.

IEC 62657-2 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.

INDUSTRIAL COMMUNICATION NETWORKS – WIRELESS COMMUNICATION NETWORKS –

Part 1: Wireless communication requirements and spectrum considerations

1 Scope

This part of IEC 62657 provides the wireless communication requirements dictated by the applications of wireless communication systems in industrial automation, and requirements of related context. The requirements are specified in a way that is independent of the wireless technology employed. The requirements are described in detail and in such a way as to be understood by a large audience, including readers who are not familiar with the industry applications.

Social aspects, environmental aspects, health aspects and market requirements for wireless communication systems in industrial automation are described to justify the wireless communication requirements.

This document also provides a rationale to successfully articulate the solutions of the wireless communication requirements proposed for the short-term and long-term. Coexistence management according to IEC 62657-2 is already applied in the short-term.

This document describes requirements of the industrial automation applications that can be used to ask for additional dedicated, worldwide unique spectrum. This additional spectrum is intended to be used for additional wireless applications while continuing using the current industrial, scientific and medical (ISM) bands.

This document provides useful information for the automation field professionals who are not familiar with the spectrum and wireless technologies.

Building automation is excluded from the scope because of the different usage constraints (for most non-industrial buildings it is normally difficult for the owner/operator to impose control over the presence and operation of radio equipment).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-10-2, *Explosive atmospheres – Part 10-2: Classification of areas – Explosive dust atmospheres*

IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 61784-3, *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

IEC 62657-2:—[1], *Industrial communication networks – Wireless communication networks – Part 2: Coexistence management*

ETSI TR 102 889-2 V.1.1.1 (2011), *Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Part 2: Technical characteristics for SRD equipment for wireless industrial applications using technologies different from Ultra-Wide Band (UWB)*

ETSI EN 300 328 V2.1.1 (2016), *Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU*

3 Terms, definitions abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62657-2:— and the following apply.

3.1.1
automation application
application of measurement and automatic control in the industrial automation domains

3.1.2
availability, <performance>
ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

Note 1 to entry This ability depends on the combined aspects of the reliability performance, the maintainability performance, and the maintenance support performance.

Note 2 to entry Required external resources, other than maintenance resources, do not affect the availability performance of the item.

[SOURCE: IEC 60050-191:1990, 191-02-05]

3.1.3
coexistence
wireless communication coexistence
state in which all wireless communication solutions of a plant using shared medium fulfil all their application communication requirements

Note 1 to entry: In IEEE 802.15.2-2003 [17][2] the coexistence is defined as a characteristic of a device.

[SOURCE: IEC 62657-2:—, 3.1.13]

3.1.4
coexistence management
process to establish and to maintain coexistence that includes technical and organizational measures

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1 Under preparation. Stage at the time of publication: IEC FDIS 62657-2:2017.

2 Numbers in square brackets refer to the Bibliography.

[SOURCE: IEC 62657-2: —, 3.1.15]

3.1.5
cognitive radio system
radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained

[SOURCE: ITU-R SM.2152:2009] [8]

3.1.6
conduit
logical grouping of communication assets that protects the security of the channels it contains

Note 1 to entry This is analogous to the way that a physical conduit protects cables from physical damage [see IEC 62443 (all parts)].

Note 2 to entry A USB port is considered a conduit, but a USB device (e.g. memory stick) is considered an asset.

3.1.7
Ethernet
communication system according to ISO/IEC/IEEE 8802-3 and IEEE 802.1D

3.1.8
factory automation
automation application in industrial automation branches typically with discrete characteristics of the application to be automated with specific requirements for determinism, low latency, reliability, redundancy, cyber security, and functional safety

Note 1 to entry Low latency typically means below 10 ms delivery time.

3.1.9
plant
managed facility, typically with a physically protected perimeter, hosting the physical process, operation, personnel, equipment

[SOURCE: IEC 62657-2:—, 3.1.58]

3.1.10
process automation
automation application in industrial automation branches typically with continuous characteristics of the application to be automated with specific requirements for determinism, reliability, redundancy, cyber security, and functional safety

3.1.11
reconfigurable radio system
RRS
radio system encompassing software defined radio and/or cognitive radio system

[SOURCE: ETSI TR 102 945 V1.1.1 (2013-06)]

3.1.12
reliability
ability of an item to perform a required function under given conditions for a given time interval

Note 1 to entry It is generally assumed that the item is in a state to perform this required function at the beginning of the time interval.

Note 2 to entry The term “reliability” is also used as a measure of reliability performance (see IEC 60050-191:1990, 191-12-01).

[SOURCE: IEC 60050-191:1990, 191-02-06, modified – Note 2 to entry has been modified.]

3.1.13
shared medium
resource of frequency band in particular area shared by several wireless applications

Note 1 to entry In the industrial, scientific and medical (ISM)-bands many wireless applications are used. Due to this joint use, the term shared medium is used in this document. The frequency bands are used by diverse ISM and wireless applications.

[SOURCE: IEC 62657-2:—, 3.1.77]

3.1.14
software defined radio
radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard

[SOURCE: ITU-R SM.2152:2009] [8]

3.1.15
telecommunication
any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems

[SOURCE: Radio Regulations (2012) – Art. 1 § 1.3]

3.1.16
victim
device interfered by emissions of radio frequencies by other devices or equipment

3.1.17
wireless application
any use of electromagnetic waves with devices or equipment for the generation and use of radio frequency energy

Note 1 to entry The definition includes radio determination equipment.

[SOURCE: IEC 62657-2:—, 3.1.93]

3.1.18
wireless communication
communication in which electromagnetic radiations are used to transfer information without the use of wires or optical fibers

[SOURCE: IEC 62657-2:—, 3.1.94]

3.1.19
wireless solution
wireless communication solution
specific implementation or instance of a wireless communication system

Note 1 to entry A wireless solution may be composed of products of one or more producers.

[SOURCE: IEC 62657-2:—, 3.1.100]

3.1.20
wireless system
wireless communication system
set of interrelated elements providing wireless communication

Note 1 to entry A wireless system is a high level representation of a system, while a wireless solution is a practical instance of a system. A wireless system can comprise one or more wireless networks.

[SOURCE: IEC 62657-2:—, 3.1.101]

3.2 Abbreviated terms and acronyms

AGV	Automated guided vehicle
BPCS	Basic process control system
CCP	Central coordination point
CO_2	Carbon dioxide
DAA	Detect and avoid
DCS	Distributed control system
DECT	Digital enhanced cordless telecommunications
DSL	Digital subscriber line
EC	European Commission
EDGE	Enhanced data GSM environment
EIRP	Equivalent isotropic radiated power
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMS	Electromagnetic susceptibility
FIFO	First in first out memory
GPRS	General packet radio service
GPS	Global positioning system
GSM	Global system for mobile communications
ID	Identification
IEA	International energy agency
IP	Internet protocol
ISDN	Integrated services digital network
ISM	Industrial, scientific and medical
LAN	Local area network
LBT	Listen before talk
LOS	Line of sight
LTE	Long term evolution
NLOS	Non line of sight
OLOS	Obstructed line of sight
PC	Personal computer
PPE	Personal protective equipment
RF	Radio frequency
RRS	Reconfigurable radio system
SDR	Software defined radio
SIL	Safety integrity level

SIS	Safety instrumented system
SOP	Standard operating procedures
SRD	Short range devices
TDMA	Time division multiple access
UMTS	Universal mobile telecommunications system
USB	Universal serial bus
WIA-PA	Wireless network for industrial automation – process automation
WLAN	Wireless local area network
WRT	Wireless real-time

4 Wireless communication requirements of industrial automation – considerations for regulators

4.1 Worldwide harmonized frequency use

One of the reasons to enable worldwide harmonized frequency use of wireless devices is that they will go through several steps of successive integration before being actually used (into a product, then a machine, then a factory), so the final geographical location of the wireless device is not necessarily known. Regulation of the utilization of frequency bands is a matter of national sovereignty and has not yet been harmonized worldwide. Even when using the 2,4 GHz ISM band, national device approvals or licenses could be required. Furthermore, it could be necessary in some countries to gain approval for the operation of a wireless network, or to publish details of such a network in advance. Occasionally there are local usage restrictions related to the maximum transmission power that exceed international or regional norms, or a limitation of operation for indoor or outdoor areas. It is therefore important when exporting wireless systems to clarify in advance whether and under what circumstances the devices in question are permitted to be operated in the respective country.

NOTE Normally, manufacturers include such information in their documentation.

4.2 Coexistence management process (see IEC 62657-2)

Standard network solutions with specific performance characteristics (such as time criticality, safety and security) are used in industrial automation applications. The specific performance characteristics needed for industrial automation are identified and provided in Clause 5.

The overall market for wireless network solutions spans a range of diverse applications, with differing performance and functional requirements. Within this overall market, the industrial automation domain could include:

- 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 transmission and distribution (grid);
- factory automation, covering for example the following industry branches:

- food & beverage,
- automotive,
- machinery,
- semiconductor.

In industrial automation nowadays there are both wired networks and wireless networks. Examples of these wireless networks are IEC 62591 (*Wireless*HART®[3]), IEC 62601 (WIA-PA) and IEC 62734 (ISA100.11a); all these networks use IEEE 802.15.4 for the process applications. Other examples of wireless networks are specified in IEC 61784-1 and IEC 61784-2 communication profiles that use IEEE 802.11 and IEEE 802.15.1 for factory automation applications. Unlike separately wired networks, wireless networks share the same medium and thus may interfere with each other. Therefore, unless predicable coexistence is assured, operation of multiple wireless networks within the same facility could be problematic, resulting in unacceptable interference and consequently in the failure to meet time critical, safety and security requirements.

Typically, an industrial plant is in a fenced area and all the plant equipment is under the supervision of the plant management who can fully implement a coexistence management process for all the wireless networks of the plant.

Automation applications can also reside in industrial facilities with higher ambient electromagnetic interference (EMI) levels than those of non-industrial domains. One more influence is radiated EMI. Regional regulations can allow significant radiated power for specific radio applications in unlicensed spectrum, potentially generating a high field strength in the proximity of a wireless system.

In some cases the owner/operator may not be able to control, or may not choose to control, the equipment present. IEC 62657-2 can also be used to assist in the identification of the resulting performance limitations.

The coexistence management process represents the activities of the coexistence management system. The coexistence management process includes technical and organizational activities in order to establish and to maintain the coexistence state of all wireless solutions in a plant. The coexistence parameters specified in IEC 62657-2:—, Clause 5, and provided as described in IEC 62657-2:—, Clause 6, are used in different phases of the coexistence management process. The coexistence management process consists of the following phases:

- investigation phase (see IEC 62657-2:—, 7.4.1);
- planning phase (see IEC 62657-2:—, 7.4.2);
- implementation phase (see IEC 62657-2:—, 7.4.3);
- operation phase (see IEC 62657-2:—, 7.4.4).

4.3 Concepts for using spectrum in wireless industrial applications

4.3.1 General

This document discusses the following concepts and the resulting requirements for using spectrum in wireless industrial applications:

- use of suitable available spectrum for wireless industrial applications, see 4.3.2;
- dedicated spectrum for wireless industrial applications, see 4.3.3;

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