ISO/IEC 14543-3-10

Edition 1.0 2012-03

INTERNATIONAL STANDARD

colour inside

Information technology – Home electronic system (HES) architecture – Part 3-10: Wireless short-packet (WSP) protocol optimised for energy harvesting – Architecture and lower layer protocols

ISO/IEC 14543-3-10:2012(E)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,…).
It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

ISO/IEC 14543-3-10

Edition 1.0 2012-03

INTERNATIONAL STANDARD

colour inside

Information technology – Home electronic system (HES) architecture – Part 3-10: Wireless short-packet (WSP) protocol optimised for energy harvesting – Architecture and lower layer protocols

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE **N**

ICS 35.200

ISBN 978-2-88912-970-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-10: Wireless short-packet (WSP) protocol optimised for energy harvesting – Architecture and lower layer protocols

FOREWORD

1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards. Their preparation is entrusted to technical committees; any ISO and IEC member body interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with ISO and IEC also participate in this preparation.

2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

3) The formal decisions or agreements of IEC and ISO 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 and ISO member bodies.

4) IEC, ISO and ISO/IEC publications have the form of recommendations for international use and are accepted by IEC and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

5) In order to promote international uniformity, IEC and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.

6) ISO and IEC provide no marking procedure to indicate their approval and cannot be rendered responsible for any equipment declared to be in conformity with an ISO/IEC publication.

7) All users should ensure that they have the latest edition of this publication.

8) No liability shall attach to IEC or ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC or ISO member bodies 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 of, use of, or reliance upon, this ISO/IEC publication or any other IEC, ISO or ISO/IEC publications.

9) 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.

10) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

The International Standard ISO/IEC 14543-3-10 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 14543 series, under the general title *Information technology – Home electronic system (HES) architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the title page.

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

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

Various electrically controlled sensors and switches are used in homes and similar environments for many different applications. Examples of such applications are lighting, heating, energy management, blinds control, different forms of security control and entertainment (audio and video).

In most cases the device, e.g. a switch initiating an action, and the device, e.g., a lamp, are installed at different places. The distance can be bridged by wires, infrared or radio transmission. Presently equipment at both ends of a wireless transmission link needs to be powered by line or battery.

While wireless transmissions are especially attractive to retrofit homes, power maintenance of battery-driven devices is a burden. In addition, these batteries require scarce materials. Since the command and control messages sent by control and sensor devices in homes are very short, they can be powered using new techniques for energy harvesting, provided they use a wireless protocol that operates on relatively low power. Energy available in the environment of a device is captured and stored (harvested) to power operation of the device. Examples of energy sources are mechanical actuation, solar radiation, temperature differences, etc. If this is executed at least one device in the link neither needs a battery nor a wire. Energy harvesting devices need very limited power and use an energy efficient radio protocol to send data to other conventionally powered devices in the home. In order to ensure interoperability of such devices from different sources within a home, an international standard for a protocol is required that uses the little power that energy harvested devices can provide and at the same time spans distances to be bridged within a home environment.

Several such devices used within a home may come from different sources. They are required to interwork with each other using a common internal network (in this standard called a home network) and supporting a home automation system. When a home automation system meets ISO/IEC HES Standards, it is called a Home Electronic System (HES).

ISO/IEC 14543-3-10 specifies the Wireless Short-Packet protocol. The protocol is efficient enough to

- support energy harvested products for sensors and switches that do not require wires and batteries, and
- extend the life of battery-operated devices.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 3-10: Wireless short-packet (WSP) protocol optimised for energy harvesting – Architecture and lower layer protocols

1 Scope

This part of ISO/IEC 14543 specifies a wireless protocol for low-powered devices such as energy harvested devices in a home environment. This wireless protocol is specifically designed to keep the energy consumption of such sensors and switches extremely low.

The design is characterised by

- keeping the communications very short, infrequent and mostly unidirectional, and
- using communication frequencies that provide a good range even at low transmit power and avoid collisions from disturbers.

This allows the use of small and low cost energy harvesters that can compete with similar batteries-powered devices. The messages sent by energy harvested devices are received and processed mainly by line-powered devices such as relay switch actuators, repeaters or gateways. Together these form part of a home automation system, which, when conforming to the ISO/IEC 14543 series of standards, is defined as a home electronic system.

This part of ISO/IEC 14543 specifies OSI Layers 1 to 3 of the Wireless Short-Packet (WSP) protocol.

The WSP protocol system consists of two and optionally three types of components that are specified in this standard. These are the transmitter, the receiver and optionally the repeater. Repeaters are needed when the transmitter and the receiver are located in such a way that no good direct communication between them can be established.

Protection against malicious attacks is handled in the upper layers and thus not treated in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 7498-1, *Information technology – Open systems interconnection – Basic reference model – Part 1: The basic model*

EN 300 220-1, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW – Part 1: Technical characteristics and test methods*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
amplitude shift keying envelope
ASK envelope
envelope of the modulated signal

3.1.2
bit duration
time between transitions of the mesial power level of an ASK envelope in an alternating sequence

Note 1 to entry: Figure 2 shows this in detail.

3.1.3
bit duration error
deviation of bit duration from specified bit duration

3.1.4
byte
represented by 8 bits

3.1.5
collision
two wireless transmitters using the same wireless channel and transmitting data at the same time

3.1.6
cyclic redundancy check
CRC
integrity hash algorithm based on a polynomial division

3.1.7
DATA
application payload data transmitted in the telegram

3.1.8
energy harvesting
energy available in the environment of a device that is captured and stored (harvested) to power operation of the device

Note 1 to entry: Examples of energy sources are mechanical actuation, solar radiation, temperature differences, etc.

3.1.9
frame
set of data to be transmitted as a complete unit on the physical layer

Note 1 to entry: A frame contains the necessary protocol control and synchronisation data for transmission between network nodes.

3.1.10
HASH
field in which the hash value for the data integrity control of each transmitted telegram and subtelegram is specified

3.1.11
high nibble
upper 4 bits of the byte

Note 1 to entry: The *N* value from the byte 0xNM.

3.1.12
high state amplitude
power level of the high state level

3.1.13
high state level
level of the ASK envelope that represents the high state amplitude

Note 1 to entry: The definition aligns with IEEE 194-1977, 5.2.2.5, static levels. Figure 2 gives an illustration.

3.1.14
identity of the destination device
DESTID
unique identity of the destination device of a WSP telegram consisting of four bytes

3.1.15
identity of the transmitting device
TXID
unique identity of the WSP protocol transmitting device consisting of four bytes

3.1.16
inverse bits
INV
added by the encoding procedure into a subframe behind the 3rd and the 6th bit to reduce the DC content of the data

3.1.17
listen before talk
LBT
technique of checking the occupancy of the wireless channel before transmitting any frames

3.1.18
low nibble
lower 4 bits of the byte

Note 1 to entry: The *M* value from the byte 0xNM.

3.1.19
low state amplitude
power level of the low state level.

3.1.20
low state level
level of the ASK envelope that represents the low state amplitude

Note 1 to entry: The definition aligns with IEEE 194-1977, 5.2.2.5, static levels. Figure 2 gives an illustration.

3.1.21
mesial power level
median between high state level and low state level of an ASK envelope

Note 1 to entry: Figure 2 gives an illustration.

3.1.22
negative overshoot
difference between minimum peak level and low state level of an ASK envelope after a transition from a high state to a low state has occurred

Note 1 to entry: Figure 2 gives an illustration.

3.1.23
negative undershoot
difference between maximum peak level and low state level of an ASK envelope after a transition from a high state to a low state has occurred

Note 1 to entry: Figure 2 gives an illustration.

3.1.24
nibble
four-bit aggregation or half a byte

3.1.25
positive overshoot
difference between maximum peak level and high state level of ASK envelope after a transition from a low state to a high state has occurred

Note 1 to entry: Figure 2 gives an illustration.

3.1.26
positive undershoot
difference between minimum peak level and high state level of ASK envelope after a transition from a low state to a high state has occurred

Note 1 to entry: Figure 2 gives an illustration.

3.1.27
receiving device maturity time
determines at the receiving device the maximum time between the end of the first subtelegram and the end of the last subtelegram belonging to the same telegram

3.1.28
repeated telegrams
telegrams transmitted by a repeater

3.1.29
repeater
receives telegrams and sends refreshed signals to any WSP receiver

3.1.30
subframe
subtelegram byte expanded by protocol control and synchronisation information