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Information technology — Home electronic system (HES) architecture

Part 3-11: Frequency modulated wireless short-packet (FMWSP) protocol optimised for energy harvesting — Architecture and lower layer protocols

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This British Standard is the UK implementation of ISO/IEC 14543-3-11:2016.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Part 3-11: Frequency modulated wireless short-packet (FMWSP) protocol optimised for energy harvesting – Architecture and lower layer protocols

FOREWORD

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International Standard ISO/IEC 14543-3-11 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 and ISO 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.

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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).

Two alternative technologies are supported by the ISO/IEC 14543 series of standards. The two standards, ISO/IEC 14543-3-10 and ISO/IEC 14543-3-11, are optimised for energy harvesting based on similar techniques, but with different modulation schemes. ISO/IEC 14543-3-10 and ISO/IEC 14543-3-11 specify two lower layer wireless short-packet protocols, where the former uses an amplitude modulated signal and ISO/IEC 14543-3-11 a frequency modulated signal.

Amplitude modulated wireless communications are more energy efficient but less adapted to mobile devices. This is due to the fact that the impedance of a mobile antenna is affected by the environment of the mobile device, e.g., when the device is held in the hand or moved to metal surface. Changes in impedance affect the amplitude linearity of the radio frequency output amplifier, but have no impact on the frequency itself. Thus, an AM wireless system is more sensitive to changes in environment than a FM wireless system. Also frequencies above 800 MHz are better suited for mobile devices, since they require smaller antennas. Thus, the frequency 315 MHz is not used in this standard, which together makes the FM wireless system more efficient for mobile devices.

Compared to the AM wireless system, the FM wireless system provides more flexibility in the size of various pieces of information that can be transmitted. This includes the possibility to have larger payloads, different lengths of the identifiers of originators and destinations, and greater variability of structures and lengths of the telegram types. In addition, the number of steps a telegram can be repeated is increased from 2 to 15.

AM and FM wireless system are efficient enough to

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

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Both an AM and a FM system can be active at the same time, since each system is so constructed that only permitted messages are accepted. Collisions can be avoided by listen-before-talk (LBT) technology or overcome by redundant transmissions.

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1 Scope

This part of ISO/IEC 14543 specifies a frequency modulated 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 Frequency Modulated Wireless Short-Packet (FMWSP) protocol. It makes use of a frequency modulated signal well adapted to mobile devices and also supports high frequency wireless communications.

The FMWSP 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 such that no good direct communication between them can be established. By direct communications the functional distance of the system is up to 300 m line-of-sight including the Fresnel zone and up to 30 m in buildings.

Since wireless communications may be overheard by receivers outside the intended environment, users should be aware of the risks this might cause before installing any wireless system. In contrast to listening devices, however, protection against malicious attacks for the technology in this standard can partly be handled in the upper layers, and is thus not treated here.

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*

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