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Information technology — Telecommunications and information exchange between systems — Magnetic field area network (MFAN) —

Part 3: Relay Protocol for Extended Range

Technologies de l'information — Téléinformatique — Réseau de zone de champ magnétique (MFAN)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This first edition of ISO/IEC 15149-3, together with ISO/IEC 15149-1, ISO/IEC 15149-2, and ISO/IEC 15149-4, cancels and replaces ISO/IEC 15149:2011, which has been technically revised.

ISO/IEC 15149 consists of the following parts, under the general title *Information technology — Telecommunications and information exchange between systems*:

— *Part 1: Air Interface*

— *Part 2: In-Band Control Protocol for Wireless Power Transfer*

— *Part 3: Relay Protocol for Extended Range*

— *Part 4: Security Protocol for Authentication*

Introduction

This part of ISO/IEC 15149 provides protocols for magnetic field area networks (MFAN). MFAN can support the service based on wireless communication and wireless power transfer in harsh environments. MFAN is composed of four protocols; air interface, in-band control protocol, relay protocol and security protocol.

ISO/IEC 15149-1 specifies the physical layer and media access control layer protocols of wireless network over a magnetic field.

ISO/IEC 15149-2 specifies the control protocol for wireless power transfer based on magnetic field area network.

ISO/IEC 15149-3 specifies the relay protocol to extend effective network coverage of magnetic field area network.

ISO/IEC 15149-4 specifies the security protocol to authenticate nodes to communicate in magnetic field area network.

Information technology — Telecommunications and information exchange between systems — Magnetic field area network (MFAN) —

Part 3:
Relay Protocol for Extended Range

1 Scope

This part of ISO/IEC 15149 specifies relay protocol to extend effective network coverage of magnetic field area networks. The addressing, request and response codes are defined.

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 15149-1:2014, *Information technology — Telecommunications and information exchange between systems — Magnetic field area network (MFAN) — Part 1: Air Interface*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 15149-1:2014 and the following apply.

3.1
wireless power transfer
WPT
mechanism in which a unit having enough power wirelessly transfer it to other units

3.2
Magnetic Field Area Network
MFAN
wireless network that provides reliable communication in harsh environments using magnetic field

3.3
Magnetic Field Area Network - Coordinator
MFAN-C
device that manages the connection and release of nodes within the communication area and the sending and receiving time of data in an MFAN

3.4
Magnetic Field Area Network – Node
MFAN-N
device except the coordinator that forms a network in an MFAN

3.5
Magnetic Field Area Network – Repeater
MFAN-R
device among MFAN-Ns that performs partial functions of coordinator

4 Symbols and abbreviated terms

The following acronyms are used in this document:

RSRq Repeater Set-up Request

RSRs Repeater Set-up Response

RSRA Repeater Set-up Response Acknowledgement

5 Overview

MFAN is a wireless communication network that can transmit and receive data over a magnetic field in a low frequency band (30kHz~300kHz.) Wireless communication over a magnetic field enables reliable communication and extends the communication system coverage around metal, soil, and water. It is designed using those characteristics of the magnetic field communication. It uses a low carrier frequency for reliable communication and large magnetic field area in harsh environments, a simple and robust modulation like BPSK for a low implementation cost and error probability, and a dynamic coding technique like Manchester or NRZ-L coding for noise robustness. In essence, it provides several kbps data transmission within a distance of several meters.

There are three types of devices associated to MFAN: MFAN-C, MFAN-N, and MFAN-R. Only a single MFAN-C is to exist per a single MFAN, while together with several associated MFAN-Ns consist MFAN. MFAN-R, capable of creating a relay network, connects out-of-boundary MFAN-Ns to MFAN.

Within MFAN, the primary and the first device to be settled is MFAN-C. Once the coordinator is ready to broadcast request packets, MFAN superframe is initiated. MFAN-C is in charge of association, disassociation, and management of data transmission with MFAN-Ns and MFAN-Rs. There is only a single channel within MFAN communication range, which means there will be no more than a single network in MFAN. Therefore, except for a single MFAN-C, the rest devices are to be either MFAN-N or MFAN-R. All the devices of MFAN are classified as MFAN-C, MFAN-N, and MFAN-R, but any device can take the role of MFAN-C, MFAN-N, or MFAN-R. MFAN-C and each MFAN-N are connected on 1:1 basis.

6 Network elements

6.1 General

The network elements of MFAN relay network consist of time and physical elements.

6.2 Time element

MFAN relay network is capable of utilizing TDMA management. MFAN-C manages a group of MFAN-Ns and MFAN-Rs by allocating appropriate request time slot. Depending on the status of MFAN-Ns and MFAN-Rs, response period is adjusted.

The structure of MFAN relay network superframe is described in Figure 1. The superframe is divided into three stages: request period, response period, and spontaneous period. The length of each stage is variable. The superframe is initiated when MFAN-C transfer response request packet during the request period. The response request packet contains information for MFAN-Ns and MFAN-Rs to return relevant response back to MFAN-C during the response period. MFAN-Ns may be approved to participate as MFAN-Rs upon the request of MFAN-C.

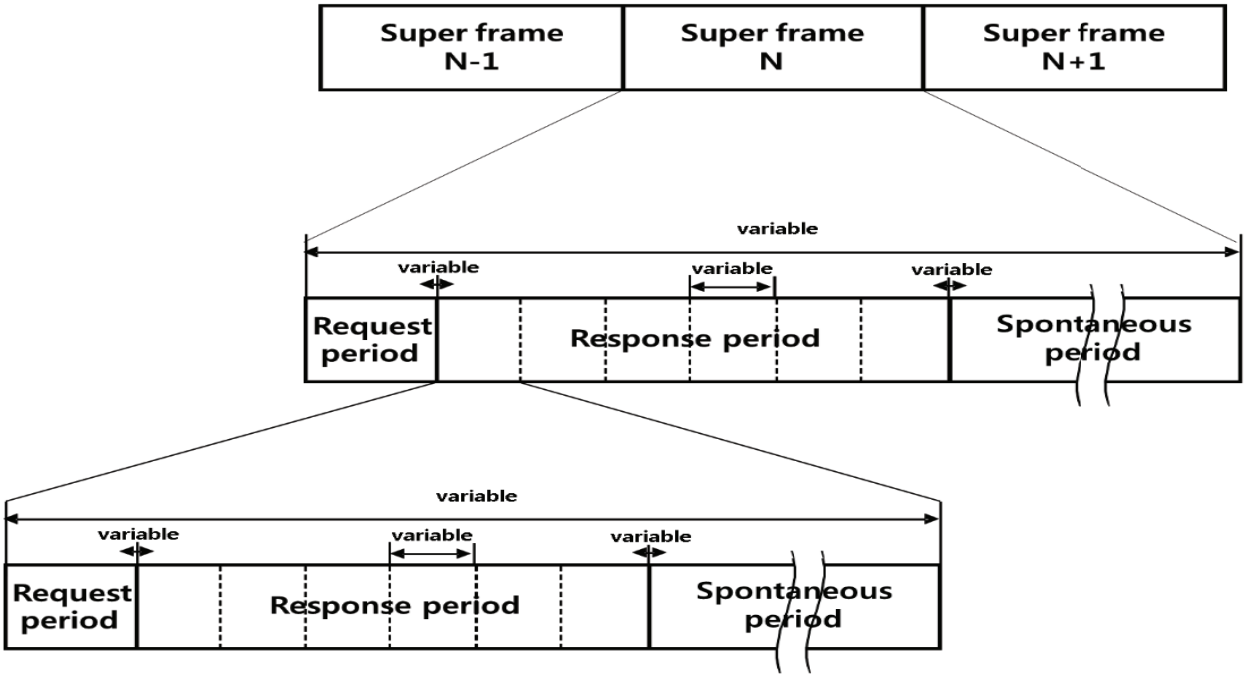

Figure 1 — Superframe structure of relay network

If approved, MFAN-R shall be allocated of time slot, just like other MFAN-Ns. However, within the time slot, MFAN-R shall sub-divide again its time slot to create superframe within its time slot. In this case, MFAN-R creates a relay network with MFAN-Ns unreachable from the MFAN-C.

6.2.1 Request period

In the request period of MFAN relay network, MFAN-R shall delivers response request packet to MFAN-Ns so they can return relevant response packet during response period.

6.2.2 Response period

In the response period of MFAN relay network, MFAN-Ns which are joined to MFAN relay network by MFAN-R return response packet back to MFAN-R based on the response request packet. Response period is divided into a number of time slots by the number of devices in MFAN relay network. The length of each time slot is variable depending on the length of response packet and acknowledgement packet. The time slots are numbered in periodical order to be allocated to appropriate MFAN-N. MFAN-R manages the allocation of time slots for data and packet transmission.

6.2.3 Spontaneous period

The spontaneous period of MFAN relay network begins when there is not a device returning response packet for a certain length of time. In this period, MFAN-Ns which are joined to MFAN relay network by MFAN-R can transfer data without the request of MFAN-R. The period lasts during the time which is allocated for MFAN-R by MFAN-C.

6.3 Physical element

The physical element of MFAN relay network consists of devices that are MFAN-C, MFAN-N, and MFAN-R. MFAN relay network is a network that enables communication between a MFAN-C and individual MFAN-Ns and MFAN-Rs; its basic element is device. Depending on its role, a device is categorized as MFAN-C, MFAN-N or MFAN-R. MFAN-C manages the entire MFAN relay network, and there will only be a single MFAN-C within a relay network. MFAN-C manages MFAN-Ns and MFAN-Rs by broadcasting