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IEEE Standard for
Local and metropolitan area networks—

Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
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USA

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IEEE Std 802.15.4™-2011
(Revision of
IEEE Std 802.15.4-2006)

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Abstract: The protocol and compatible interconnection for data communication devices using low-data-rate, low-power, and low-complexity short-range radio frequency (RF) transmissions in a wireless personal area network (WPAN) were defined in IEEE Std 802.15.4-2006. In this revision, the market applicability of IEEE Std 802.15.4 is extended, the ambiguities in the standard are removed, and the improvements learned from implementations of IEEE Std 802.15.4-2006 are included.

Keywords: ad hoc network, IEEE 802.15.4, low data rate, low power, LR-WPAN, mobility, PAN, personal area network, radio frequency, RF, short range, wireless, wireless personal area network, WPAN

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Introduction

This introduction is not part of IEEE Std 802.15.4-2011, IEEE Standard for Local and metropolitan area networks—Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs).

This is the second revision of IEEE Std 802.15.4. From the beginning, the goal of 802.15.4 was to produce a standard that enabled very low-cost, low-power communications. The initial standard, IEEE Std 802.15.4-2003, defined two optional PHYs, operating in different frequency bands with a very simple, but effective, MAC.

In 2006, the standard was revised, adding two more PHY options. The MAC was backward-compatible, but it added MAC frames with an increased version number, new security features, and a variety of MAC enhancements, including:

— Support for a shared time base with a data time stamping mechanism
— Support for beacon scheduling
— Synchronization of broadcast messages in beacon-enabled PANs

In 2007, two new PHYs were added as an amendment, one of which supported accurate ranging. As a part of this amendment, MAC capability to support ranging was added.

In 2009, two new PHY amendments were approved, one to provide operation in frequency bands specific in China and the other for operation in frequency bands specific to Japan.

The current revision of the standard was created to roll in the previous three amendments into a single document. However, IEEE Std 802.15.4 had become very popular, and there were three additional amendments, 2 PHY and 1 MAC, in process at that time. It was clear that the original organization of the standard was inadequate for the variety of applications, optional PHYs and optional MAC features to which the 802.15.4 base standard would be applied.

Thus, the major changes in the current revision are not technical but editorial. The organization of the standard was changed so that each PHY now has a separate clause. The MAC clause was split into functional description, interface specification, and security specification. In additon, a great deal of informative text, including the coexisting annex and regulatory annex, were deleted so that the document would focus on only those technical requirements needed for interoperability. The revised organization is the consensus decision of a broad group of 802.15 members, including people who were part of the original standard as well as individuals developing amendments to the standard for new applications.

The PAR for IEEE Std 802.15.4-2011 was first proposed in July 2010 and was approved in September 2010 by NesCom. After a total of 10 drafts, 3 working group ballots ,and 4 sponsor ballots, the final standard was approved in June 2011, less than one year from start to finish.

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IEEE Standard for
Local and metropolitan area networks—

Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)

1. Overview

1.1 General

Wireless personal area networks (WPANs) are used to convey information over relatively short distances. Unlike wireless local area networks (WLANs), connections effected via WPANs involve little or no infrastructure. This feature allows small, power-efficient, inexpensive solutions to be implemented for a wide range of devices.

1.2 Scope

This standard defines the physical layer (PHY) and medium access control (MAC) sublayer specifications for low-data-rate wireless connectivity with fixed, portable, and moving devices with no battery or very limited battery consumption requirements typically operating in the personal operating space (POS) of 10 m.

Physical layers (PHYs) are defined for

- — Devices operating in the license-free 868–868.6 MHz, 902–928 MHz, and 2400–2483.5 MHz bands
- — Devices with precision ranging, extended range, and enhanced robustness and mobility
- — Devices operating according the Chinese regulations, Radio Management of P. R. of China doc. #6326360786867187500 or current document, for one or more of the 314–316 MHz, 430–434 MHz, and 779–787 MHz frequency bands
- — Devices operating in the 950–956 MHz allocation in Japan and coexisting with passive tag systems in the band