

IEEE Standard for Low-Rate Wireless Networks

Amendment 3: Use of the 865 MHz to 867 MHz Band in India

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 802.15.4u™-2016
(Amendment to
IEEE Std 802.15.4™-2015)
as amended by IEEE Std 802.15.4n™-2016 and
IEEE Std 802.15.4q™-2016)

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Approved 22 September 2016

IEEE-SA Standards Board

Abstract: A physical (PHY) layer enabling the use of the 865 MHz to 867 MHz band in India is defined in this amendment. The supported data rate should be at least 40 kb/s and the typical line-of-sight range should be on the order of 5 km using an omnidirectional antenna. Included are any channel access and/or timing changes in the medium access control necessary to support this PHY layer.

Keywords: 865 MHz to 867 MHz band, amendment, IEEE 802.15.4™, IEEE 802.15.4u™, low data rate, low power, wireless personal area network, WPAN

The Institute of Electrical and Electronics Engineers, Inc.
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Print: ISBN 978-1-5044-2320-5 STD21110
PDF: ISBN 978-1-5044-2321-2 STDPD21110

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Introduction

This introduction is not part of IEEE Std 802.15.4u-2016, IEEE Standard for Low-Rate Wireless Networks—Amendment 3: Use of the 865 MHz to 867 MHz Band in India.

This amendment defines a physical (PHY) layer enabling the use of the 865 MHz to 867 MHz band in India. The supported data rate should be at least 40 kb/s and the typical line-of-sight range should be on the order of 5 km using an omnidirectional antenna. Included are any channel access and/or timing changes in the medium access control necessary to support this PHY layer.

The Ministry of Urban Development (MoUD) in India has released a concept note on Smart Cities. The Department of Telecommunications (DoT) has formulated a roadmap for deployment of machine-to-machine (M2M) communications. The Telecommunication Engineering Centre (TEC) has formed several M2M Working Groups to delve deeply into various aspects of M2M Communications. The Department of Electronics and Information Technology (DietY) has recently released a draft Internet of Things (IOT) Policy. The India Smart Grid Forum (ISGF) is in the process of preparing a standard framework for Smart Cities for submission to MoUD. Lastly, the Telecommunications Standards Development Society, India (TSDSI) is in the process of preparing technical reports containing use cases on various domains of M2M/IOT. Many of these activities are recommending the use of sub 1 GHz bands and in particular the 865 MHz to 867 MHz band in India, which has recently been opened for broader unlicensed use at power levels up to 4 W. This amendment enables that capability.

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Amendment 3: Use of the 865 MHz to 867 MHz Band in India

(This amendment is based on IEEE Std 802.15.4™-2015 as amended by IEEE Std 802.15.4n™-2016 and IEEE Std 802.15.4q™-2016.)

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard. The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strike through~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Deletions and insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.¹

¹Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

7. MAC frame formats

7.4 IEs

7.4.4 Nested IE

7.4.4.10 SUN Device Capabilities IE

Change the end of Table 7-19 as follows:

Table 7-19—Frequency band identifier values

Frequency band identifier	Band Designation
<u>14</u>	<u>866 MHz band</u>
14 –15	Reserved

Change the end of Table 7-22 as follows:

Table 7-22—FSK-B PHY mode encoding

PHY Mode ID	FSK PHY mode
<u>7</u>	<u>100 kb/s; 2-FSK; mod index = 0.5; channel spacing = 200 kHz</u>
<u>8</u>	<u>50 kb/s; 2-FSK; mod index = 0.5; channel spacing = 100 kHz</u>
<u>9</u>	<u>150 kb/s; 2-FSK; mod index = 0.5; channel spacing = 200 kHz</u>
7 –10	Reserved

10. General PHY requirements

10.1 General requirements and definitions

10.1.1 Operating frequency range

Insert new row (in numerical order) into Table 10-1 as follows:

Table 10-1—Frequency band designations

Band designation	Frequency band (MHz)
866 MHz	865–867

10.1.2 Channel assignments

10.1.2.8 Channel numbering for SUN and TVWS PHYs

Insert new row (in numerical order) into Table 10-10 as follows:

Table 10-10—Channel numbering for SUN PHYs

Frequency band (MHz)	Modulation	ChanSpacing (MHz)	TotalNumChan	ChanCenterFreq ₀ (MHz)
865–867	SUN FSK operating mode #1	0.1	19	865.1
	SUN FSK operating mode #2 & #3	0.2	10	865.1
	OFDM Option4	0.2	10	865.1
	O-QPSK	0.2	10	865.1

20. SUN FSK PHY

20.1 Introduction

Insert new row (in numerical order) into Table 20-1 as follows:

Table 20-1—SUN FSK symbol period used for MAC and PHY timing parameters

Frequency band (MHz)	symbol period used for MAC and PHY timing parameters (μs)
865–867	20

20.3 Modulation and coding for SUN FSK

Change the second paragraph of 20.3 as follows:

Table 20-6 shows the modulation and channel parameters for the standard-defined PHY operating modes for the 169 MHz, 450 MHz, 470 MHz, 863 MHz, 896 MHz, 901 MHz, 915 MHz, 928 MHz, 1427 MHz, and 2450 MHz bands. A device shall support operating mode #1 and may additionally support operating modes #2 and #3. For 866 MHz band, a device shall support operating modes #1 and #2 and may additionally support operating mode #3.

Insert new row (in numerical order) into Table 20-6 as follows:

Table 20-6—SUN FSK modulation and channel parameters^a

Frequency band (MHz)	Parameter	Operating mode #1	Operating mode #2	Operating mode #3
865–867	Data rate (kb/s)	50	100	150
	Modulation	2-FSK	2-FSK	2-FSK
	Modulation index	0.5	0.5	0.5
	Channel spacing (kHz)	100	200	200

^aData rates shown are over-the-air data rates (the data rate transmitted over the air regardless of whether the FEC is enabled).

21. SUN OFDM PHY

21.5 SUN OFDM PHY RF requirements

21.5.1 Operating frequency range

Insert the following into the list of operating bands:

— 865–867 MHz

22. SUN O-QPSK PHY

22.2 PPDU format for SUN O-QPSK

22.2.1 SHR field format

22.2.1.1 Preamble field format

Change the first paragraph of 22.2.1.1 as shown:

The Preamble field shall contain a sequence of 56 bits, all zero, for the 780 MHz, 915 MHz, 917 MHz, and 2450 MHz frequency bands. It shall contain a sequence of 32 bits, all zero, for the 470 MHz, 866 MHz, 868 MHz, and 920 MHz frequency bands.

22.2.2 PHR field format

Change the second paragraph of 22.2.2 as shown:

For the 780 MHz, 915 MHz, 917 MHz, and 2450 MHz frequency bands, the Spreading Mode field shall be set to one if MDSSS is used for PSDU spreading, as described in 22.3.5. Otherwise, the Spreading Mode field shall be set to zero if DSSS is used for PSDU spreading, as described in 22.3.4. For the 470 MHz, 866 MHz, 868 MHz, and 920 MHz, frequency bands, the Spreading Mode field shall be set to zero, i.e., MDSSS is not supported.

22.3 Modulation and coding for SUN O-QPSK

22.3.2 SHR coding and spreading

Insert new row (in numerical order) into Table 22.2 as follows:

Table 22-2—SHR coding and spreading parameters

Frequency band (MHz)	Chip rate (kchip/s)	BDE	Spreading mode
865–867	100	yes	(32,1) ₀ -DSSS

22.3.3 PHR coding and spreading

Insert new row (in numerical order) into Table 22.3 as follows:

Table 22-3—PHR coding and spreading parameters

Frequency band (MHz)	Chip rate (kchip/s)	BDE	rate ½ FEC + interleaver	Spreading mode
865–867	100	yes	yes	(8,1) ₀ -DSSS

22.3.4 PSDU coding and spreading for DSSS

Insert new row (in numerical order) into Table 22.4 as follows:

Table 22-4—PSDU parameters for spreading mode DSSS

Frequency band (MHz)	Chip rate (kchip/s)	Rate mode	BDE	Spreading mode	rate ½ FEC + interleaver	Data rate (kb/s)
865–867	100	0	yes	(8,1) _{0/1} -DSSS	yes	6.25
		1	yes	(4,1)-DSSS	yes	12.5
		2	yes	(2,1)-DSSS	yes	25
		3	no	none	yes	50

22.3.5 PSDU coding and spreading MDSSS

Insert new row (in numerical order) into Table 22-5 as follows:

Table 22-5—PSDU parameters for spreading mode MDSSS

Frequency band (MHz)	Chip rate (kchip/s)	Rate mode	BDE	Spreading mode	rate $\frac{1}{2}$ FEC + interleaver	Data rate (kb/s)
865–867	not supported					

22.3.11 Chip whitening

Insert new row in (numerical order) into Table 22-19 as follows:

Table 22-19—Chip whitening for DSSS

Frequency band (MHz)	Rate mode
865–867	1 and 2 and 3

22.3.12 Pilot insertion

Insert new row (in numerical order) into Table 22-20 as follows:

Table 22-20—Pilot length, spacing and chip sequences

Frequency band (MHz)	Length N_p (# of chips)	Spacing M_p (# of chips)	Chip sequence $p = (p_0, p_1, \dots, p_{N_p-1})$
865–867	32	512	1101 1110 1010 0010 0111 0000 0110 0101

22.3.13 Modulation parameters for O-QPSK

Change the fourth paragraph of 22.3.13 as shown:

In the 470 MHz, 866 MHz, 868 MHz, 780 MHz, 917 MHz, and 920 MHz bands, a raised cosine pulse shape with roll-off factor of $r = 0.8$ is used to represent each baseband symbol and is described as follows:

22.5 SUN O-QPSK PHY RF requirements

22.5.1 Operating frequency range

Insert the following (in numerical order) into the list of operating bands as follows:

— 865–867 MHz

22.5.3 Receiver sensitivity

Insert new row (in numerical order) into Table 22-21 as follows:

Table 22-21—Required receiver sensitivity for spreading mode DSSS [dBm]

Frequency band (MHz)	Rate mode			
	0	1	2	3
865–867	–110	–105	–100	–95

Insert new row (numerically) into Table 22-22 as follows:

Table 22-22—Required receiver sensitivity for spreading mode MDSSS [dBm]

Frequency band (MHz)	Rate mode			
	0	1	2	3
865–867	not supported			

22.5.4 Adjacent channel rejection

Insert new row (numerically) into Table 22-23 as follows:

**Table 22-23—Minimum interference-to-signal ratio (ISR)
requirements depending on $|\Delta f|$**

Frequency band (MHz) 865–867	$ \Delta f $ (MHz)	0.2	0.4
	ISR (dB)	10	30

22.5.13 CCA

Insert new row (numerically) into Table 22-24 as follows:

Table 22-24—CCA duration for SUN O-QPSK PHY

Frequency band (MHz)	<i>aCcaTime</i> (# of symbols)
865–867	4

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