**IEEE P802.15**

**Wireless Personal Area Networks**

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| Abstract | Analysis on coexistence of 802.15.4aa with other 802 systems within the same spectrum bands. | |
| Purpose | To address the coexistence capability of 802.15.4aa. | |
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# Introduction

TG4aa introduces operating modes to 802.15.4 supporting higher data rates in the 920MHz band. These new operating modes use GFSK modulation, which is one of the existing modulation methods. The higher data rates have the effect of increasing the signal bandwidth from the GFSK operating modes specified in 802.15.4 for the 920MHz band. The regulation governing the 920MHz band[B1] specify stringent requirements on devices to ensure efficient and equitable shared usage of the band. The regulation specifies a channel plan which also allows aggregation of channels, hence permitting varying signal bandwidths. It additionally specifies parameters for listen before talk, maximum transmit power levels and transmit duty cycle limits. The TG4g coexistence assurance document[B2], and P802.19 draft[B3] already provide a comprehensive analysis for coexistence in all bands, including 920MHz band. TG4aa adds no functionality, channel access requirements, or modulations beyond those used in 802.15.4.

# Bibliography

[B1] ARIB STD-T108, 920MHz-BAND TELEMETER, TELECONTROL AND DATA TRANSMISSION RADIO EQUIPMENT, (<http://www.arib.or.jp/english/html/overview/doc/5-STD-T108v1_3-E1.pdf>).

[B2] P802.15.4aa PAR, DCN 15-20-0202-04,2020

[B3] P802.19/D0.07,Draft Recommended Practice for Local and Metropolitan Area Networks – Part 19:Coexistence Methods for 802.11 and 802.15.4 based systems operating in the Sub-1GHz Frequency Bands

[B4] T. Kuramochi, IEEE 802.15 document 15-21-0081-02-04aa, 2021.

[B5] TG4g coexistence assurance document, (<https://mentor.ieee.org/802.15/dcn/10/15-10-0668-05-004g-tg4g-coexistence-assurance-document-first-draft.pdf>).

# Overview

This clause gives on overview on IEEE 802.15.4aa which covers used frequency band and the changes compared to the existing IEEE Std 802.15.4 SUN FSK system. Finally, it introduces the coexistence mechanisms for improved performance and coexistence in license-exempt frequency bands.

## Overview of IEEE802.15.4aa

The IEEE 802.15 Task Group 4aa defines data rate extension of SUN FSK PHY to IEEE Std 802.15.4-2020. According to the 802.15.4aa PAR[B2], the requirements for higher data rates have come from Japanese utilities to allow the number of nodes to be increased per Personal Area Network (PAN), permitting the communication of various utility data for not only electricity but also gas and water, along with Over-the-Air (OTA) updates without an increase of the meter's energy consumption.

PHY amendments in 802.15.4aa are shown in Table 1.Operating modes #5,#6,#7, and #8 are added to IEEE Std802.15.4-2020 in 802.15.4aa. Compare to former operating modes, these new operating modes have 1MHz bandwidth, and utilize overlapping channel assignments[B4] in order to increase the number of available channels; the channel separation, which is narrower than the channel bandwidth, is permitted by Japanese regulation[B1].

Table 1 PHY amendments in 802.15.4aa

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Frequency band  (MHz) | Parameter | Operating mode | | | | | | | |
| #1 | #2 | #3 | #4 | **#5** | **#6** | **#7** | **#8** |
| 920-928  MHz | Data rate  (kb/s) | 50 | 100 | 200 | 400 | **400** | **600** | **600** | **800** |
| Modulation | 2-FSK | 2-FSK | 2-FSK | 4-FSK | **2-FSK** | **2-FSK** | **4-FSK** | **4-FSK** |
| Modulation index | 1.0 | 1.0 | 1.0 | 0.33 | **0.5** | **0.4** | **0.5** | **0.33** |
| Channel  bandwidth  (kHz) | 200 | 400 | 600 | 600 | **1000** | **1000** | **1000** | **1000** |
| Channel separation  (kHz) | 200 | 400 | 600 | 600 | **200 \* N**  **1≦N≦5** | **200 \* N**  **1≦N≦5** | **200 \* N**  **1≦N≦5** | **200 \* N**  **1≦N≦5** |
| Standard | SUN FSK PHY of IEEE Std 802.15.4-2020 | | | | **TG4aa amendment** | | | |

## Regulatory Information

The allocated frequency band for 802.15.4aa is given in 920.5-928.1MHz(Japan).[B1]

## Overview of Coexistence Mechanism in 802.15.4aa

The developed amendment follows the coexistence mechanisms defined in 802.15.4g[B5].

# Dissimilar IEEE802 Systems Sharaing the Same Frequency Bands with 802.15.4aa

This clause presents an overview on other 802 systems which are specified to operate in the same frequency bands that are also specified for the 802.15.4aa. The table in the following section list the latest standard (or amendment) and the corresponding PHY specifications that share the same frequency band as 802.15.4aa.

## Coexisting Systems in 920MHz Band

Table 2: Dissimilar systems co-existing with the 802.15.4aa PHY within the 920.5-928.1MHz band.

|  |  |
| --- | --- |
| **System** | **PHY Specification** |
| 802.15.4-2020 | SUN FSK |
| SUN OFDM |
| LECIM DSSS |
| LECIM FSK |
| 802.11ah | S1G OFDM |

# Coexsistence Scenarios and Analysis

## PHY Modes in the 802.15.4aa PHY Modes

## Performance of the 802.15.4aa PHY Modes

### AWGN Channel

### Erasure Channel

## Interference Modeling for Dissimilar System Analysis

## 802.15.4 Coexistence Performance

## 802.11ah Coexistence Performance

### Victim 802.11ah

### Victim 802.15.4aa

# Interference Mitigation and Avoidance Techniques

# Conclusions