**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | Coexistence Document for IEEE 802.15.4z |
| Date Submitted | November 2018 |
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| Re: | Analyze the coexistence of 802.15.4z and other 802 wireless systems  |
| Abstract | IEEE 802.15.4 Coexistence Document |
| Purpose | Document coexistence analysis |
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# Introduction

## Bibliography

(B1) IEEE Std. 802.15.2-2003, IEEE Recommended Practice for Information Technology – Telecommunications and Information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 15.2: Coexistence of Wireless Personal Area Networks with Other Wireless Devices Operating in Unlicensed Frequency Bands.

(B2) IEEE Std. 802.15.4-2015, IEEE Standard for Information Technology – Telecommunications and Information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs).

(B3) P802.15.4z/D[xx] IEEE Draft Standard for Information Technology –

(B4) IEEE Std. 802.11-2016 IEEE Standard for Information Technology – Telecommunications and Information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.

(B5) P802.11ax/Dxx

(B6) Doc. SE45(18)112R5 Monte Carlo studies for the UWB section of the report.

(B7) [additional ECC reference]

## Acronyms

The acronyms used are taken from [B1], [B2], and [B3]. Definitions of the terms can be found in the same documents.

# Overview

Description of 802.15.4 UWB and Amendment 4z. Summary of regions with UWB regulations and typical applications.

## Overview of 802.15.4z UWB

### Frequency bands of interest

[insert the channel plan graphic and channel definitions – 4z only concerned with high band]

### LRP

Reference to standard.

* New PHY packet formats
	+ Frame duration likely to be shorter– less impact and smaller exposure
		- Fewer pulses and shorter packet duration.
		- More robust in presence of interference
		- PSD and peak same as legacy UWB
		- Energy levels haven’t changed
		- More likely to have duration in time and less energy per packet
* New modulation and PRF
	+ Net no change in impact
	+ May be more robust to interference

### HRP

Reference to standard

* New modulation and PRFs
	+ Doesn’t use BPM
	+ Peak PRF hasn’t changed
	+ Mean PRF may change but averages to the same energy (reg limits)
	+ New codes – take advantage of higher mean PRF enable higher data rate,, less frame overhead, may result in reduced duration frame transmission
	+ Higher data rates added lower overhead etc good both ways
* Adding additional preamble codes – enables more spectral reuse, etc.
* Impacts on legacy HRP:
	+ new codes ignored by legacy devices without harm;
	+ Compatible PHY modes to interoperate with legacy devices;
* More reliable transmission
	+ Instantaneous peak power better controlled
	+ Reduce retransmissions required

### Common MAC stuff added in 4z

* Exiting features of the MAC assure legacy devices aren’t broken
* Broadcast / multicast options
	+ Many to many, scheduled multicast ??
* New information elements – no impact, s/b ignored by legacy devices
* New scheduling options are equivalent to existing mechanisms wrt channel loading, effective duty cycle, etc. My have increased overhead.
* Channel access still Aloha (CSMA with CCA mode 4).

## Overview of Coexistence Mechanisms in 802.15.4

Ref to another CAD.

## Coexistence Analysis Methodology

Ref to another CAD.

Add description of the methodology used by SE45 references.

# Dissimilar Systems Sharing the Same Frequency Bands

This clause presents an overview on other 802 systems which are specified to operate in some of the same frequency bands.

802.15.4z and 801.11

## Coexisting Systems in 4940 - 4990 MHz Band

At this time, there are approved standards which specify operation in this band: IEEE 802.15.11-2016 and 802.15.4-2016. Specifically the following PHYs may be operating in the band:

In the 4940 – 4990 MHz band, IEEE 802.11-2011 is the only other 802 system sharing this band with the proposed 802.15.4 UWB PHYs.

Table 1: Dissimilar Systems coexisting with 802.15.4z within 5250 - 5350 MHz band

|  |  |  |
| --- | --- | --- |
| Standard | Standard PHY | Involved 802.15.4z PHY |
| HRP | LRP |  |
| 802.11a | OFDM |  |  |  |
| 802.11n | OFDM |  |  |  |
| 802.15.4 | LMR DSSS |  |  |  |
|  |  |  |  |  |

## Coexisting Systems in 5250 - 5850 MHz Band

In the 5250 - 5350 MHz band, IEEE 802.11-2011 is the only other 802 system sharing this band with the proposed 802.15.4 UWB PHYs.

Table 2: Dissimilar Systems coexisting with 802.15.4z within 5250 - 5350 MHz band

|  |  |  |
| --- | --- | --- |
| Standard | Standard PHY | Involved 802.15.4z PHY |
| HRP | LRP |  |
| 802.11a | OFDM |  |  |  |
| 802.11n | OFDM |  |  |  |
| 802.15.4 | LMR DSSS |  |  |  |
|  |  |  |  |  |

## Coexisting Systems in xxx – xxx MHz Band

**Error! Reference source not found.** shows other 802 systems that share

Table 3: Dissimilar Systems coexisting with 802.15.4z within 5725 - 5850 MHz band

|  |  |  |
| --- | --- | --- |
| Standard | Standard PHY | Involved 802.15.4p PHY |
|  |  |  |
| 802.11a | OFDM |  |  |  |
| 802.11n | OFDM |  |  |  |

# Coexistence Scenario and Analysis

## Methodology

Describe the methodology {e.g. based on prior CADs with deltas}

## PHY Modes in the 802.15.4 UWB and 802.15.4z System

What is added by the amendment not covered in prior CAD work.

## Dissimilar systems

### 802.11 as victim

### 802.15 as victim

## Other 802.15.4 systems

## xxx – xxxx MHz Band Coexistence Performance

This sub-clause presents the coexistence performance of the systems coexisting in the [whatever] MHz frequency band. Parameters for Coexistence Quantification

Present conclusions w/references.

# Summary conclusions

# Interference Avoidance and Mitigation Techniques

# Conclusions

As a victim, 802.15.4p FSK has comparable BER performance with the other 802 FSK systems; 802.15.4p DSSS has much better BER performance than the other 802 DSSS systems due to option of the high spreading factor values.

As an interferer, either 802.15.4p FSK or 802.15.4p DSSS has similar performance impact to the other 802 systems at the same transmitting power level. However the performance degradation to the other systems can become significant as the transmitting power is increased up to the possible maximum 30dBm. This requires more physical distance from other 802 systems if an 802.15.4p system is designed to operate at a high transmitting power level.