# REGIONAL PARAMETERS

V1.1

| Version | Modifications | Date |
|---|---|---|
| 1.0 | Initial version (included in LAN Protocol Specification v1.0) | 22/09/2017 |
| 1.1 | Separate document for regional parameters | 07/06/2019 |

## Summary

This document outlines the regional parameters of the physical layer of the Wize LAN protocol (i.e. those related to the frequency band). The LAN network designates the medium range radio network between the devices and the gateways.

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## Contributors

See document [R1]

# 1 Introduction

This document describes the Wize LAN Regional Parameters. For each region and frequency scheme in which Wize is used, this document provides characteristics description and specification of the physical layers, including frequency channels, physical link parameters, data encoding & preambles and specific parameters.

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# 2 Reference documents

## 2.1 Applicable standards

See document [R1]

## 2.2 Main specifications

| Reference | Document | Version |
|---|---|---|
| R[1] | Wize Alliance : LAN protocol Specification | V1.1 |
| R[2] | Common application Layers and Specific Application Layers index | V1.1 |

# 3 Wize regional parameters list

The following regional parameters have been defined for use of Wize, provided with their common reference name:

| Common reference name | Region(s) of use | Frequency bands and key characteristics |
|---|---|---|
| EU169 | Europe | 169MHz ISM band with modulations as defined by EN13757-4 mode N2 |

(others bands are under investigation and would be added on request, please contact the Wize alliance)

# 4 EU169 regional parameters

These regional parameters are used by Wize for the LAN interface in Europe is the 169 MHz band. It is a license-free ISM band at the European level, usable with duty cycles up to 10% for tracking and remote device reading applications as per recommendation REC/ERC/70-03 (annex 2)..

## 4.1 Physical layers

While using EU169 regional parameters, three different physical layers are supported on the LAN interface:

| Physical layer | Description | Specification |
|---|---|---|
| **PHY-WM2400** | Physical layer using mode EN13757-4 N2a-f at 2400bps | see 4.3.2 |
| **PHY-WM4800** | Physical layer using mode EN13757-4 N2a-f at 4800bps | see 4.3.3 |
| **PHY-HSPEED** | High speed specific physical layer for very densely populated zones, using a 12.5KHz channel similar to modes EN13757-3 N2a-f | see 4.3.4 |

*Table 1 : Physical layers*

## 4.2 Frequency channels

As per standard EN13757-4 (mode N2), this frequency band is divided into 6 channels, each 12.5 KHz wide.

**DISPENSATION** with respect to standard EN13757-4: standard EN13757-4 stipulates the use of physical layer PHY-WM2400 on some of the six channels of the 169MHz band, and the use of the physical layer PHY-WM4800 on the rest. To optimise engineering and network capacity, the Wize LAN protocol allows the free use of one or more of the various physical layers in each frequency channel. (*)

**DISPENSATION** with respect to standard EN13757-4: for two-way exchanges (N2 mode, COMMAND/RESPONSE flows), the modulation used in the downlink direction by Wize protocol may be different from that used in the uplink direction (*)

(*) Nota : It should be highlighted that, due to joint work of the Wize Alliance members and CEN standard working groups, the majority of these deviations and additions are now indeed part of EN13757-4:2018 standard version. The next version (V2.0) of Wize Standard specification will be aligned with this new version after a detailed analysis of any compatibility risks. For consistency and system compatibility, this V1.1 version stay aligned with EN13757-4:2013 as was V1.0.

| Mode | Channel | Central frequency (MHz) | Channel spacing (KHz) | Flow (kbps) and modulation | Central frequency tolerance | Max Tx Power | Duty cycle |
|---|---|---|---|---|---|---|---|
| N1a,N2a | 1a | 169.406250 | 12.5 | WM-2400 Or WM-4800 Or WM-HSPEED | 1.5 | 500 mW | 10% |
| N1b, N2b | 1b | 169.418750 | | | | | |
| N1c, N2c | 2a | 169.431250 | | | | | |
| N1d, N2b | 2b | 169.443750 | | | | | |
| N1e, N2e | 3a | 169.456250 | | | | | |
| N1f, N2f | 3b | 169.468750 | | | | | |

*Figure 1 : Physical layer/channel allocations*

The equipment hardware (device and LAN modem) must at least be compatible with the use of:

- the three physical modulations PHY_WM2400, PHY_WM4800 and PHY_HSPEED in the uplink direction;
- the two physical modulations PHY_WM2400 and PHY_WM4800 in the downlink direction

This applies to each of the 6 channels.

Note: as per regulations, this frequency band must be used according to a cyclical transmission ratio of 10% (duty cycle): all equipment transmitting on this band can transmit at most 6 minutes every hour. In reality, this only affects the download of software by the gateways, as this limit must be taken into account by the Head-End system for scheduling purposes.

## 4.3 Detailed specification of the physical layers

### 4.3.1 Specification of the frequency channels

Communications via the LAN interface take place on six separate frequency channels. Each physical layer can use each of these channels for a specific communication.

The frequency band used is the harmonised band 169.4 MHz to 169.475 MHz. Each of the 6 $N_i$ channels ($1 \leq i \leq 6$) has a width of 12.5KHz and a central frequency equal to:

$$\mathbf{F_i = 169.39375 + i*0.0125\ MHz}$$

Each of the six channels is identified by the following frequency channel number:

| Frequency channel number | Central frequency |
|---|---|
| **100** | 169.406250 MHz |
| **110** | 169.418750 MHz |
| **120** | 169.431250 MHz |
| **130** | 169.443750 MHz |
| **140** | 169.456250 MHz |
| **150** | 169.468750 MHz |

*Table 2 : Channel frequencies*

*Note: The other frequency channel number values are reserved for future extensions.*

Central frequency accuracy must be guaranteed by design for the gateway + device assembly according to the specified tolerance of +/-1.5KHz required for the WM-4800 mode, which is the most restrictive (see 4.2), i.e. +/-8.8ppm.

To reduce the cost of the devices, the readjustment of the central frequency via a downlink command is possible in order to compensate oscillator long-term drifts (quartz ageing) and to allievate long-term stability requirements for central frequency.

### 4.3.2 PHY-WM2400 physical layer

The PHY-WM2400 physical layer is strictly identical to the physical layer specified in standard EN13757-4 (EN13757-4) for modes N2c and N2d, with the two specific adaptations below:

- In mode PHY-WM2400, the frequency channel can be freely chosen, according to LAN layer configuration, out of all the available frequency channels (see 4.3.1), and is not limited to the two channels N2c and N2d (see 4.2)

- **DISPENSATION** with respect to standard EN13757-4: the frequency deviation tolerance is +/-0.2% (static) instead of the +/-10% specified in EN13757-4, and the GFSK modulation must be of the continuous phase type, so as to optimise the receiver's achievable performances (modulation index exactly 2.0). (*)

(*) Nota : It should be highlighted that, due to joint work of the Wize Alliance members and CEN standard working groups, the majority of these deviations and additions are now indeed part of EN13757-4:2018 standard version. The next version (V2.0) of Wize Standard specification will be aligned with this new version after a detailed analysis of any compatibility risks. For consistency and system compatibility, this V1.1 version stay aligned with EN13757-4:2013 as was V1.0.

The main characteristics of this modulation are thus as follows:

| Parameter | Min | Nominal | Max | Comments |
|---|---|---|---|---|
| **Channel width** | | 12.5KHz | | |
| **Central frequency** | Cf. paragraph 4.1 | | | Channels 100 to 150 |
| **Central freq tolerance** | -2KHz | | +2KHz | |
| **Modulation** | | GFSK | | Continuous phase |
| **Deviation** | -0.2% (*) | +/-2.4KHz | +0.2% (*) | -2.4KHz=0, +2.4KHz=1 |
| **Modulation index** | | 2.0 | | |
| **Filtering index** | | 0.5BT | | |
| **Bit rate** | -100ppm | 2400bps | +100ppm | |
| **Binary encoding** | | NRZ | | MSBs first |

*Table 3 : Characteristics of the PHY-WM2400 layer*

*(* ) The tolerances indicated are tolerances on static deviations, i.e. for set binary levels, and thus do not affect hardware cost as all current integrated transceivers have numerical modulators. On transitions between two logical states, a difference of 10% maximum with the theoretical GFSK deviation is tolerated.*

As per standard EN13757-4, the physical frame in mode PHY-WM2400 thus consists of a preamble of 16 bits and a synchronisation sequence of 16 bits, followed by an L2 level frame of variable length. The frame format chosen for the LAN protocol is the format B of standard EN13757-4 (only one CRC per frame). The frame header format is thus as follows:


*Figure 2 : Format of PHY-WM2400 frames*

### 4.3.3 PHY-WM4800 physical layer

The PHY-WM4800 physical layer is strictly identical to the physical layer specified in standard EN13757-4 for modes N2a, N2b, N2e and N2f, with the two specific adaptations below:

- The frequency channel can be freely chosen, according to LAN layer configuration, out of all the available frequency channels (see 4.3.1), and is not limited to the two channels N2c and N2d (see 4.2)

- **DISPENSATION** with respect to standard EN13757-4: the frequency deviation tolerance is +/-0.2% (static) instead of the +/-10% as specified in EN13757-4, and the GFSK modulation must be of the continuous phase type, so as to optimise the receiver's achievable

performances (modulation index exactly 1.0). (*)

(*) Nota : It should be highlighted that, due to joint work of the Wize Alliance members and CEN standard working groups, the majority of these deviations and additions are now indeed part of EN13757-4:2018 standard version. The next version (V2.0) of Wize Standard specification will be aligned with this new version after a detailed analysis of any compatibility risks. For consistency and system compatibility, this V1.1 version stay aligned with EN13757-4:2013 as was V1.0.

The main characteristics of this modulation are thus as follows:

| Parameter | Min | Nominal | Max | Comments |
|---|---|---|---|---|
| **Channel width** | | 12.5KHz | | |
| **Central frequency** | Cf. paragraph 4.1 | | | Channels 100 to 150 |
| **Central freq tolerance** | -1.5KHz | | +1.5KHz | |
| **Modulation** | | GFSK | | Continuous phase |
| **Deviation** | -0.2% (*) | +/-2.4KHz | +0.2% (*) | -2.4KHz=0, +2.4KHz=1 |
| **Modulation index** | | 1.0 | | |
| **Filtering index** | | 0.5BT | | |
| **Bit rate** | -100ppm | 4800bps | +100ppm | |
| **Binary encoding** | | NRZ | | MSBs first |

*Table 4 : Characteristics of the PHY-WM4800 layer*

*(* ) The tolerances indicated are tolerances on static deviations, i.e. for set binary levels, and thus do not affect hardware cost as all current integrated transceivers have numerical modulators. On transitions between two logical states, a difference of 10% maximum with the theoretical GFSK deviation is tolerated.*

The format of the physical frame in PHY-WM4800 mode is strictly identical to that used for mode PHY_WM2400:


*Figure 3 : Format of the PHY-WM4800 frame*

### 4.3.4 PHY-HSPEED physical layer

The PHY-HSPEED physical layer is a variant used to increase channel capacity using a specific bitrate and a 4GFSK modulation specified in standard EN13757-4. (*)

(*) Nota : It should be highlighted that, due to joint work of the Wize Alliance members and CEN standard working groups, this addition is now indeed part of EN13757-4:2018 standard version. The next version (V2.0) of Wize Standard specification will be aligned with this new version after a detailed analysis of any compatibility risks. For consistency and system compatibility, this V1.1 version stay aligned with EN13757-4:2013 as was V1.0.

The main characteristics for this physical mode are as follows:

| Parameter | Min | Nominal | Max | Comments |
|---|---|---|---|---|
| **Channel width** | | 12.5KHz | | |
| **Central frequency** | Cf. paragraph 4.1 | | | Channels 100 to 150 |

| | | | | |
|---|---|---|---|---|
| **Central freq tolerance** | -1.5KHz | | +1.5KHz | |
| **Modulation** | | 4GFSK | | Continuous phase |
| **Deviation** | -1% (*) | -3.2KHz<br>-1.066KHz<br>+1.066KHz<br>+3.2KHz | +1% (*) | -3.2KHz=01 (code A)<br>-1.066KHz=00 (code B)<br>+1.066KHz=10 (code C)<br>+3.2KHz=11 (code D) |
| **Modulation index** | | 1 | | |
| **Filtering index** | | 0.5BT | | |
| **Bit rate** | -100ppm | 6400bps | +100ppm | |
| **Binary encoding** | | NRZ | | MSBs first |

*Table 5 : Characteristics of the PHY-HSPEED layer*

*(*) The tolerances indicated are tolerances on static deviations, i.e. for set binary levels. On transitions between two statuses, a difference of 10% maximum with the theoretical GFSK deviation is tolerated*

The physical frame in PHY-HSPEED mode consists of a preamble of 16 symbols and a synchronisation sequence of 16 symbols, followed by an L2 level frame of variable length:


*Figure 4: Format of PHY-HSPEED frames*

## 4.4 Physical link parameters

The physical link parameters for EU169 are specified in European norm EN13757-4 section 10.2, which is the reference. For easy reference, here is an extract from this standard (please refer to the official standard for consistency) :

| Characteristic | Data rate | Symbol | mín. | typ. | max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| GFSK, deviation (mod. index 2,0) | 2,4 kbps | | ±1,68 | ±2,4 | ±3,12 | kHz | 70–130 % of nominal deviation |
| GFSK, deviation (mod. index 1,0) | 4,8 kbps | | ±1,68 | ±2,4 | ±3,12 | kHz | 70–130 % of nominal deviation |
| 4GFSK, deviation (mod. index 1,0) | 6,4 kbps | | ±2,24 | –3,2, –1,06, +1,06, +3,2 | ±4,16 | kHz | 70–130 % of nominal deviation |
| GFSK/4GFSK relative bandwidth | All | BT | | 0,5 | | | |
| Bit/symbol rate tolerance | All | | | | ±100 | ppm | |
| Preamble length | All | PL | 16 | | 16 | bits or symbols | |
| Synchronization length | All | SL | 16 | | 16 | bits or symbols | |
| Postamble (trailer) length | All | | | 0 | | bits or symbols | |
| Default response delay | All | $t_{RO}$ | 4 997,5 | 5 000 | 5 002,5 | ms | |
| Fast response delay (O-2-M) | All | $t_{RO}$ | 99,5 | 100 | 100,5 | ms | |
| Slow response delay (O-2-M) | 4,8 kbps<br>6,4 kbps<br>19,2 kbps | $t_{RO\_slow}$ | 1 099,5<br>1 099,5<br>1 099,5 | 1 100<br>1 100<br>1 100 | 1 100,5<br>1 100,5<br>1 100,5 | ms | |
| Slow response delay (O-2-M) | 2,4 kbps | $t_{RO\_slow}$ | 2 099,5 | 2 100 | 2 100,5 | ms | |
| Extended response delay (O-2-M) | All | $t_{RO\_slow}$ | 4 997,5 | 5 000 | 5 002,5 | ms | |
| FAC transmission delay | | $t_{TxD}$ | N × 1 000 –0,5 | N × 1 000 | N × 1 000 +0,5 | ms | $N$ = 5,7 or 13 |
| FAC time out | All | $t_{TO}$ | 25 | | 30 | s | |

*Table 10 : EN13757 Mode N, Modulation and timing*

## 4.5 Data encoding & preamble

The data encoding and preamble specifications for EU169 are specified in European norm EN13757-4 section 10.2, which is the reference. For easy reference, here is an extract from this standard (please refer to the official standard for consistency) :

### 4.5.1 Encoding

Data transmitted using GFSK modulation shall be NRZ encoded, with the low frequency corresponding to a binary “0”.

Data transmitted using 4GFSK modulation shall be NRZ encoded, with the lowest frequency corresponding to binary “01” (symbol A), the second frequency corresponding to binary “00” (B), the third frequency corresponding to binary “10” (C) and the highest frequency corresponding to binary “11” (D).

Each data byte shall be transmitted with the most significant bit first.

### 4.5.2 Preamble and synchronization pattern

All transmissions using GFSK shall, where n = 8, be preceded by either;
- n × (01) 11110110 10001101 (frame format A) or,
- n × (01) 11110110 01110010, (frame format B).

All transmissions using 4GFSK shall, where n = 8, be preceded by either;
- n × (AD) DDDDADDA DAAADDAD (frame format A) or,
- n × (AD) DDDDADDA ADDDAADA (frame format B).

NOTE: The first pattern is equivalent to, the bit pattern n × (0111) 1111111101111101 1101010111110111 and the second pattern is equivalent to the bit pattern n × (0111) 1111111101111101 0111111101011101.

All chips of each frame, including pre- and postamble, shall form an uninterrupted sequence.

The decoder may optionally detect that the receiver has captured another transmission, by detecting a new preamble and synchronization pattern in conjunction with an abrupt increase in the received signal strength. In that case, the receiver shall stop the analysis of the current frame and start detecting a new frame. This “capture detect” feature increases the communication capacity of the system in presence of many devices.

## 4.6 DATA LAN parameter dictionary

### 4.6.1 LAN Parameters

The parameters ID from $08 to $10 included are reserved for PHY layer managements and are then dependant of the regional parameter set. For EU169 regional parameters, the respective coding of PHY layer parameters are the following :

| Id | Parameter name | Description | Size (bytes) | Mode | L/R | Coding | Default value |
|---|---|---|---|---|---|---|---|
| Specified in Common Application Layers & Specific Application Layers index document ( [R2]) | | | | | | Specific to EU169 regional parameters | |
| 08 | **RF_UPLINK_CHANNEL** | Frequency channel to be used for all uplink message transmissions | 1 | R/W | L/R | 100,110,120,130,140,150. other : reserved | Cf. WIZE Alliance for allocation (channel 120 preferred as the downlink channel only) |
| 09 | **RF_DOWNLINK_CHANNEL** | Frequency channel to be used for all message receptions (except firmware download) | 1 | R/W | L/R | 100,110,120,130,140,150. Other : reserved | 120 |
| 0A | **RF_UPLINK_MOD** | Modulation to be used for all uplink message transmissions | 1 | R/W | L/R | 00 : WM-2400, 01 : WM-4800, 02 : WM-HSPEED, Other : reserved | 0 |
| 0B | **RF_DOWNLINK_MOD** | Modulation to be used for all message receptions (except | 1 | R/W | L/R | 00 : WM-2400, 01 : WM-4800, 02 : WM-HSPEED, Other : reserved | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | firmware download) | | | | | |
| 10 | **TX_POWER** | Transceiver nominal transmission power | 1 | R/W | L/R | 00 : Pmax, 01 : PMax – 6dB, 02 : PMax-12dB, Other : reserved | 0 |

*Table 12 : PHY parameters dependant on the regional parameters set*

END OF DOCUMENT