Application Note

nanotron
A SENSERA COMPANY

AN0606-Utilizing Scalable Infrastructure for DW1000-based UWB Tag Hardware

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1. Introduction

nanotron offers a high accuracy location solution that can be used for multiple applications. This location solution consist of

- tags or transceivers that are placed on the moving object,
- a scalable location infrastructure with wireless anchor/reader synchronization and overhead-free infrastructure build-out without any cell-structure.

The infrastructure consists of anchors/readers (nanoANQ), location engine and server software (nanoLES) and standard IT data backbone – wired (Ethernet) or wireless (WiFi).[1]

This infrastructure can locate and track any DW1000 based tag, as long as they are configured to match with the 'Blink' format that the infrastructure expects.

This application note shows how to very easily adapt the blink format of any DW1000 based tag.

2. How to configure the device

2.1 Physical layer

The first step to allow communication between two transceivers is, obviously, to set them at the same frequency channel.

Second, the physical frame structure should be similar. IEEE802.15.4a defines the following physical frame format:

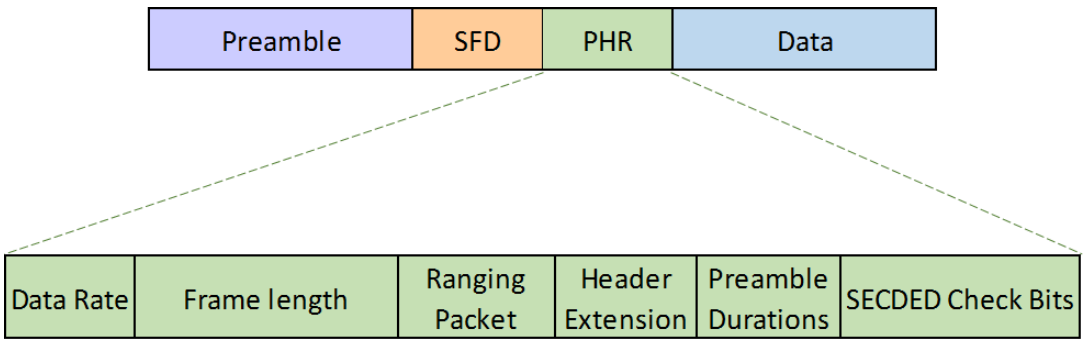

Figure 2-1 UWB PHY Frame Structure

Both *nanotron*'s and Decawave's devices respect this structure; thus, in order for two devices to 'see' messages from each other they just need to keep the same physical header.

- preamble length
- start of frame delimiter (SFD)

[1] Both nanoANQ and nanoLES products are available from nanotron Technologies GmbH.

- PHR
- pulse repetition frequency (PRF)
- bit rate
- packet acquisition chunk (PAC) size
- tx code
- rx code

nanotron gives freedom to configure the physical layer, however all devices must include some predefined modes that, when selected, determine the value of each of these parameters.

The values of the parameters mentioned above according to the selected mode are depicted in the table below.

Mode	Channel	PRF	Preamble Length	PAC Size	Tx Code Sequence	Rx Code Sequence	Std SFD Packet	Bit Rate	PHRMode
13	5	16M	2048	16	4	4	1	110k	Std
14	5	16M	1024	16	4	4	1	850k	Std
15	5	16M	256	16	4	4	1	6M8	Std

Table 2-1 nanotron's transmission modes

2.2 MAC layer

The data field in the PHY frame structure is the MAC frame. IEEE802.15.4a also specifies the MAC frame as shown in Figure 2-2.

MAC header							MAC Payload	MAC Footer
Frame Control	Sequence Number	Dest. PAN ID	Dest address	Source PAN ID	Source Address	Aux. Security Header	Frame Payload	FCS

Figure 2-2 UWB MAC Frame Structure

The value of each field should match with the values expected by nanotron's devices

- Frame control (see section 2.2.1)
- Sequence number: xx
- Destination PAN identifier: 0x6e6e The default PAN ID used by nanoton is 0x6e6e; however it is possible to change it.
- Destination address: 0xffff The blink is a broadcast message
- Source PAN ID: The PAN ID compress will be set; thus, this field disappears.
- Source Address: 8 bytes
- AUX Security Header: nanotron does not use auxiliary security header, so this field also disappears.

2.2.1 Frame control field

The frame control field consist of multiple subfields, depicted in Figure 2-3.

Bits 0 to 2	Bit 3	Bit 4	Bit 5	Bit 6	Bits 7 to 9	Bits 10 & 11	Bits 12 & 13	Bits 14 & 15
Frame Type	Security Enabled	Frame Pending	ACK Request	PAN ID Compress	Reserved	Dest. Address Mode	Frame Version	Source Address Mode

Figure 2-3 Frame Control field

- Frame type: 1 (data frame)
- Security enable: 0 (no security)
- Frame pending: 0 (no frame pending)
- ACK request: 0 (no ACK expected)
- PAN ID Compress: 1 (enabled)
- Dest. Address mode: 2 (short address)
- Frame version: 0
- Source Address Mode: 3 (long address)

The octets of the frame field will be: b 1000001000010011. They are sent in LSB order.

2.4 Payload

For nanotron anchors and location engine to properly react to the received blink the MAC payload should include the TDOA structure.

TDOA Blink Header								TDOA Blink Payload
Control	Type	Version	Blink ID	Length	Blink interval	Reserved	0x00	User Data

Figure 2-4 TDOA Blink Frame

Each field of the TDOA Blink Header is 1 octet; the corresponding values are:

- Control: 0x04
- Type: 0x02
- Version: 0x13
- Blink ID: 1 byte blink incremental counter with a range from 0 to 255.
- Length: 1 byte indicating how many bytes are to come after this field.
- Blink interval: 3 bytes to indicate how often the tag blinks, in ms.
- Reserved: 1 byte, recommended value: 0x00

The payload is free for the users to add any data they may want to transmit. At the result port, nanoLES will offer the position of the detected blink together with the payload.

3. Summary

nanotron's location solution can locate and track any tag based on the Deacwave's DW1000 transceiver. For that purpose the tag should be configured accordingly:

- The physical layer needs to configured according to the nanotron's selected mode
- The MAC header should follow the standard.
- The PAN ID needs to be adjusted according to the one used be the nanotron's system; the default PAN ID is 0x6e6e
- A TDOA blink header needs to be added in the MAC payload

References

[1] DW1000 User Manual, version 2.05, Decawave Ltd. 2015
[2] IEEE Std 802.15.4 – 2011: Standard for Local and metropolitan area networks – Part15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)

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