

UWB Ranging Messages

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Introduction

This document details how the UWB ranging messages are constructed for both single-sided ranging and double-sided ranging. All messages share a common message structure which is detailed in the next section. The one variance of the message structure is the payload itself. When using a logic clock, the common message structure is modified which is detailed in the next section as well.

Common Message Structure

This section details the message structure of the UWB ranging messages. This covers both the standard message structure and the modified message structure to accommodate a logic clock.

Standard Message Structure

The standard message structure is broken up into 7 fields: Frame control, sequence number, PAN ID, destination address, source address, function code, and CRC. The first 6 fields are contained in the header while the CRC makes up the footer. The standard ranging message structure is described below:

0	1	2	3	4	5	6	7	8	9	10	...	9+N	10+N	11+N
Frame Control		Sequence Number	PAN ID		Destination Address		Source Address		Function Code	Ranging Message			Frame CRC	
2 Bytes		1 Byte	2 Bytes		2 Bytes		2 Bytes		1 Byte	N Bytes			2 Bytes	
0x41	0xCC	0x00 ¹	2											

Modified Message Structure

A modified message structure was also introduced to accommodate a logic clock. It is very similar to the standard message structure, except the logic clock is appended to the header. The modified ranging message structure is described below:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	...	13+N	14+N	15+N
Frame Control		Sequence Number	PAN ID		Destination Address		Source Address		Function Code	Logic Clock				Ranging Message			Frame CRC	
2 Bytes		1 Byte	2 Bytes		2 Bytes		2 Bytes		1 Byte	4 Bytes				N Bytes			2 Bytes	
0x41	0xCC	0x00																

In order to use this message structure, it needs to be compiled in. This can be achieved by adding the following snippet to one of the Kconfig files:

```
CONFIG_UWB_LOGIC_CLK=y
```

Ranging Messages

There are two common ways of ranging that can be done with UWB: single-sided ranging and two-way ranging. In the single-sided scheme, there are a total of 2 messages, while there are a total of 4 messages in the two-way ranging scheme. Both schemes share the poll message and the response message, while the final and report messages are specific to the two-way ranging scheme. Each message has a different function code.

Poll Message

The poll message is basic. It has a function code of 0x61 and no payload.

¹ The sequence number is not used, thus is kept at the default value

² Blank fields indicate that these fields may vary during run time

Response Message

The response message varies based on the ranging scheme used. It has a function code of 0x50 and the payload varies based on the ranging scheme.

Single-Sided Ranging Payload

When single-sided ranging is used, there are two timestamps in the payload: The poll message receive time and the response message transmit time. These timestamps are in the perspective of the responder. The payload is described below:

0	1	2	3	4	5	6	7
Poll Message RX Timestamp				Response Message TX Timestamp			
4 bytes				4 bytes			

Two-Way Ranging Payload

When two-way ranging is used, there is no payload. The purpose of the response message is made more clear in the final message.

Final Message

The final message is only used in the two-way ranging scheme. It has a function code of 0x69, and it has 3 timestamps in the payload: poll message transmit time, response message receive time, and final message transmit time. These timestamps are in the perspective of the initiator. The payload is described below:

0	1	2	3	4	5	6	7	8	9	10	11
Poll Message TX Timestamp				Response Message RX Timestamp				Final Message TX Timestamp			
4 bytes				4 bytes				4 bytes			

Report Message

The report message is only used in the two-way ranging scheme. It has a function code of 0xE3, and it only contains a time-of-flight scalar value (unitless). The payload is described below:

0	1	2	3
Time of Flight DTU			
4 bytes			