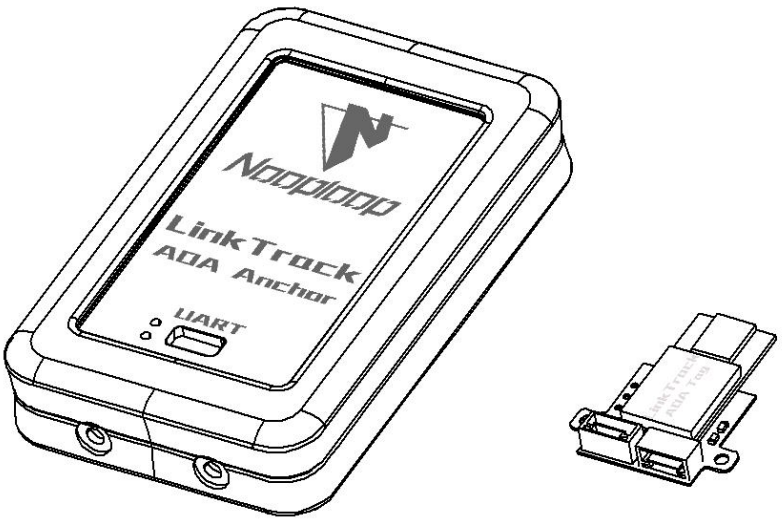
LinkTrack AOA

User Manual V1.1



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Contents

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1 Introduction

Please carefully read the following documents about how to use the LinkTrack AOA system and matters that need to be paid attention to:

- LinkTrack AOA Datasheet

  Please download relative documents from official website: www.nooploop.com

2 Basic Introduction

2.1 Node Installation

In general, M3 is used to the screw hole on the bottom of the external shell for LTAOAA;as for LTAOAT,M2 is used to the corresponding through hole;

2.2 About the Antenna

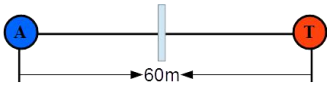
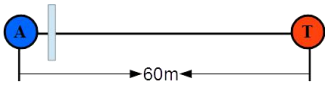
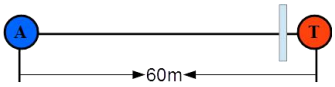
The direction of antenna will affect the ranging, direction-finding and communication distance. It is an effective way to optimize the direction of antenna. Generally, the front antenna of AOA Anchor shall be aimed to that of AOA Tag, which has optimal measuring effect.

2.3 About the Obstruction

While in communication, obstruction will make the signal weaken and shorten the communication distance; in case of ranging and direction-finding, obstructions also cause the increase of deviation. The impact on positioning for the obstructions will depend on the distance between Node, dimension and material:

The long and narrow objects such as pole, tree and human body:The impact on ranging and direction-finding for the obstructions relies on the distance between the TAG and the ANCHOR. For example, in case that the distance between the ANCHOR and the TAG is 60 meters, the impact is very small, however, when the distance is as close as 1 meter, the impact is quite big, please check Table 1.

Table 1: The impact on positioning for the distance between the obstruction to TAG and ANCHOR

Case	When the obstruction is in the middle of TAG and ANCHOR	When the obstruction is close to ANCHOR	When the obstruction is close to TAG
Graphic diagram			
Impact	Small	Big	Big

Solid wall:The communication distance through the wall will shorten, the measuring error is affected by the thickness of wall and material.

Glass wall:In general, the impact on UWB distance for glass thinner than 3cm is small.

Steel plate, iron plate and other metal: The absorption to UWB electromagnetic wave is quite significant, especially, when it is close to node, the electromagnetic wave cannot be conveyed to the other end of the obstruction that the measuring result is invalid.

Paperboard, plank and plastic: In general, the obstruction with a thickness of 10cm will not affect the measuring accuracy much, but the signal will be weaken.

3 AOA Quick Start

3.1 Introduction

LinkTrack AOA system includes two modules, AOA Tag and AOA Anchor. AOA Anchor module can be configured as ANCHOR and MONITOR through NAssistant. At least one TAG, 4 ANCHORs and any number of MONIOTR are supported in one system. The data, such as angle, distance, can only be output for at least “One TAG + One ANCHOR” or “One TAG + One MONITOR” (the MONITORwill not output the distance from itself to the TAG). Users can select suitable quantity of ANCHORs and MONIOTR according to the applied scenarios at their will.

3.2 Steps

1. **[Configuration System]** Generally speaking, the recommended configuration has been set before delivery for the AOA module received by users. If it is the first time to use LinkTrack AOA system or modify the relative configuration parameters, the configuration shall be proceeded accordingly. All data will be stored in each module after successful configuration, which will not need to be re-configured for next application through NAssistant. Prepare 1 each of AOA Tag module and 5 each AOA Anchor modules (The explain in detail by taking the application for 1 label, 4 ANCHORs and 1 MONITOR as an example) to connect them to the computer or other terminal devices through USB,click to enter into the configuration page, modify the required parameters and then click “Write Parameter” to write the parameters, click “Read Parameter” to confirm whether they have been written successfully. 4 each of AOA Anchor modules will be configured as 4 each of ANCHOR through NAssistant,which are respectively marked as A0、A1、A2 and A3. 1 each of AOA Anchor module will be configured as MONITOR and marked as M. 1 each of TAG module is configured as TAG, marking as T. The specific meaning and recommended configuration of each parameter have been listed as below.

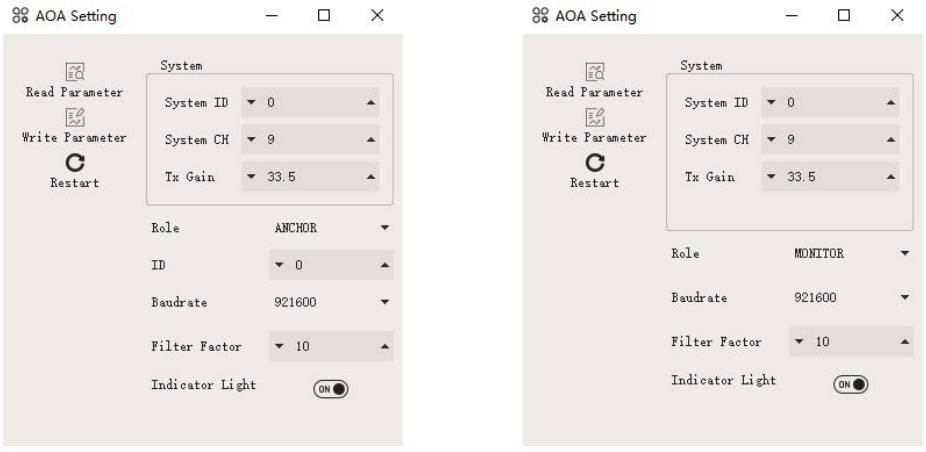


Figure 1: Left: Configuration diagram for A0; Right: Configuration diagram for M

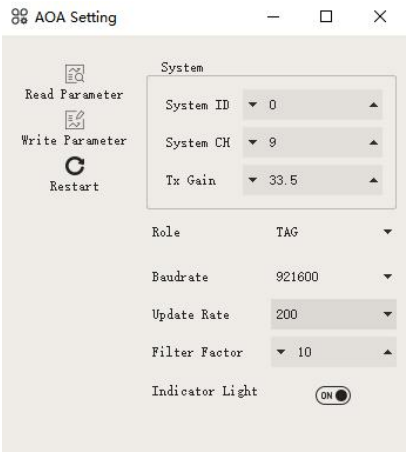


Figure 2: T Configuration diagram for T

System Parameter Configuration: It is worth to point out that for all node in the same system, the System ID and CH must be identical. For example, the System ID is 0 and the System CH is 9. Special attention shall be paid that the System CH is related to the product model. LTS has better performance when System CH is 9, the communication distance will be shorter when it is 7; LTS has good performance when System CH is 2 and 3 but poor in other number. At present, LinkTrack AOA recommends to set System CH to 9. TX Gain is also the identical configuration in general. The maximum value is 33.5 for the first application, allowing the sufficient communication distance.

Role Configuration: Select the corresponding Role according to the required configuration, such as ANCHOR、MONITOR、TAG and etc.

ID Configuration: Input the corresponding number according to the ID that needs to be configured, for example, the ID that A0 corresponds to is 0 and A3 is 3. It is worth to notice that for the node of the same Role, the ID requirement is not the same.

Baudrate Configuration: The corresponding Baudrate shall be selected according to user requirement. Baudrate refers to the communication speed for UART and USB. In this example, the Baudrate for A0, T and M are all configured as 921600. It is worth to notice that Baudrate only represents the communication speed for Node, therefore, the Baudrate of each Node can be different. For the Node of the same Role, the recommended Baudrate is the same so as to make it easy for users.

UpdateRate Configuration: The corresponding UpdateRate shall be selected based on the user's requirements. The UpdateRate for LinkTrack AOA can be as high as 200Hz, as for AOA, it only needs to configure UpdateRate in the TAG. The UpdateRate for T is 200Hz.

Filter Factor Configuration: The corresponding parameters for Filter Factor shall be selected upon user's requirements. Filter Factor represents the noise coefficient of Kalman Filter(KF for short). Among others, the role of Filter Factor for TAG is to determine the distance to ANCHOR. And the Filter Factor for ANCHOR and MONITOR is to determine the angle of TAG. The Filter Factor is relying on the filter effect: the larger the number, the better the smooth effect, but the larger the data delay; the smaller the number, the weaker the smooth effect and the smaller the delay; when the number is 0, it signifies that there is no filter and the output data is the original measuring data. In this example, the Filter Factor for A0, T and M is10.

Indicator Light configuration: It will operate normally when turn on the indicator light; it can be turned off to save energy if there is no need to observe the state of indicator light.

2. **[The Installation of ANCHOR and TAG]** Users can select the location to install the ANCHOR and the TAG based on the actual applied scenarios. Please pay attention to section 3.3 for

installation details.

3. **[Observe The Data]** Once install the ANCHOR and TAG, electrify them (no special request for the order). Connect any ANCHOR to observe the relative data to TAG through NAssistant. If it is necessary to MONITOR from the computer, the USB Serial Port Module can be used to connect the MONITOR. The data can be observed from the Data window of the NAssistant software.

   From Line window, the curve chart of each parameter can be directly observed. Click  to open the serial port assistant of NAssistant to check the original protocol data. When the system operates properly , TAG will output the distance, direction, signal to all anchors through serial port(Please note that two UART terminals are electrically connected and both terminals connect to the same UART and please check section 1.3 of the data manual for the line sequence. Please check chapter 2 for voltage and signal line level). The users can process and apply the information output from the TAG through the MCU or the processor of robot. The ANCHOR will output the information, including the distance, direction and signal from TAG to ANCHOR through UART. The MONITOR will output the information, including the distance, direction and signal from TAG to ANCHOR and from TAG to MONITOR through serial port (The distance from TAG to MONITOR will not be output).

4. **[Data Transmission Test]** Proceed this step for data transmission function. Send data to T through communication port (transparent transmission,such as “20180803”), then, NLink_LinkTrack_Node_Frame0 including T data will be output through any ANCHOR and MONITOR;send data to A0 (or other ANCHOR) through communication port(transparent transmission,such as “20190702”),then, NLink_LinkTrack_Node_Frame0 including A0 (or other ANCHOR) will be output through TAG and MONITOR. Please refer to chapter 6.1.3 for protocol analysis.

3.3 Precautions

Please pay attention to the following points in order to improve effect:

1. Avoid Obstruction

The node shall be installed at an open space.

When start to operate, keep an open space between TAG and ANCHOR so as to avoid the deviation caused by obstruction, otherwise, the measuring accuracy will be reduced. If the angle of TAG to MONITOR that output by MONITOR is used, please avoid any obstruction between MONITOR and TAG.

2. Avoid Reflection

Some special circumstances may affect the measuring accuracy, such as the metal existed in the emitting surface of the antenna.

Ground:The recommended distance for ANCHOR/TAG to ground shall be higher than 0.5 meter, for instance, when place ANCHOR on the ground, the measuring effect of the TAG will be poor.

Wall:If to install the ANCHOR close to the wall, generally, it can be directly attached to the wall, if the measuring effect is not good, then, it is recommended to keep over 10cm away from the wall.

3. The Direction of Antenna

Please try to optimize the direction of antenna to improve the measuring effect. Please refer to chapter 2.2 for the recommendation of the direction of antenna.

4. Configuration

For the same system, the System CH、System ID and Mode shall be the same. The ID for the same Role shall not be repeated, otherwise, the system shall not operate properly. The System CH is related to the product; therefore, the suitable System CH shall be selected for proper operation.

5. Power Supply

Please pay attention to the power ripple.

6. Interference

It is recommended to keep Node far away from the wireless emitter with large power to avoid interference.

4 NAssistant Operations

The chapter introduces the routine operation of LinkTrack AOA based on NAssistant.

4.1 Quick Start

Please click Menu—Help & Wizard—Quick Start to check how to use NAssistant software.

4.2 Firmware Update

There are two steps to update the firmware.

1. The method to obtain firmware
    a. Automatically obtained by software【Public Firmware】
    b. To obtain test code, please click【Beta Firmware】,input the test code to obtain the beta version of firmware
    c. If local firmware is available, please click【Local Firmware】to load local firmware
2. If the firmware obtained from previous step is higher than that of the direct connected node of the computer, please directly click【Local Update】for update,if it is necessary to update compulsorily or return to the previous version, please click【Ignore Version】and continue to update.

Figure 1: The firmware update interface

4.3 Record, Replay and Export

NAssistant provides data recording, rewinding and exporting function. Users can click any time to start the recording of real-time original data, click again to stop recording and output *.dat file. Click to open the defaulted storage path to extract the recorded*.dat file to engineer for identifying the problems or load the recorded history data. The software has the control bar for play

for easily adjusting the play speed and progress.

For real-time state or rewinding state, please click to export the text data to the local.xlsx file, click again to stop exporting and open the folder for subsequent data analysis.

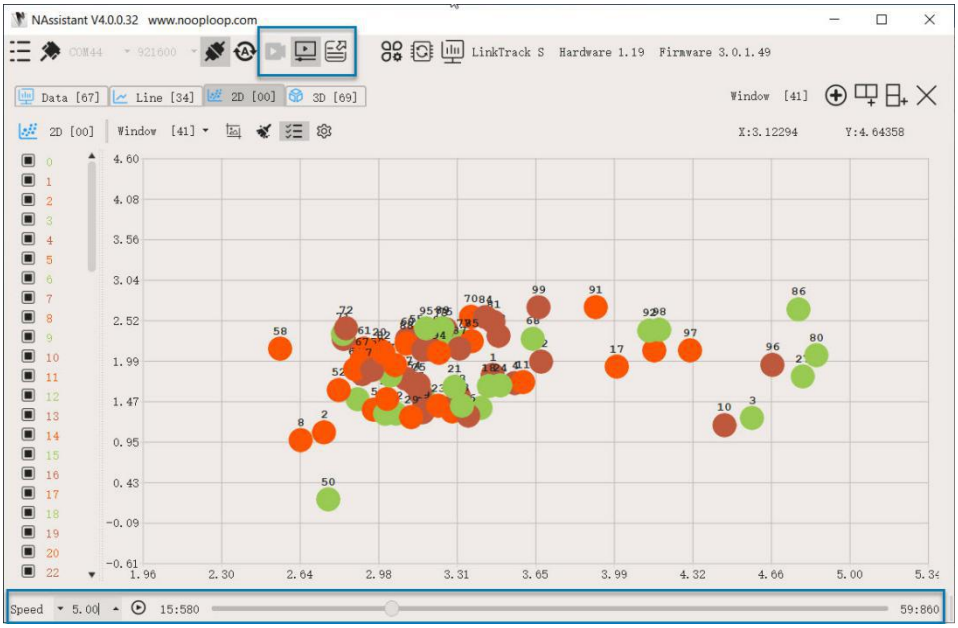


Figure 2: Data recording, rewinding and exporting

5 Variable

The chapter introduces the major variable of the protocol.

5.1 Dis

Dis is short for Distance,in the protocol, it signifies:dis. It refers to the relative distance for the TAG to all ANCHOR within the range at present, which is on the lengthy Block. When the distance is invalid, the Block that corresponds to the distance will not be output.

5.2 Angle

In the protocol, it means:angle.It represents the relative angle for the TAG to all ANCHOR within the range at present, which is on the lengthy Block. When the angle is invalid, the Block that corresponds to the distance will not be output.

5.3 RSSI

In the protocol, it signifies:fp_rssi and rx_rssi.The RSSI in TAG and ANCHOR means the signal of the ANCHOR received within the range, as for the RSSI of MONITOR, it means the signal of the TAG received within the range at the moment, which is on the lengthy Block. When the distance is invalid, the Block that corresponds to the distance will not be output.

Node can output the signal of the first path received fp_rssi and the total received signal rx_rssi and the distance (in general, when “rx_rssi - fp_rssi” is less than 6dB, it is probably under LOS state,when it is more than 10dB,it is likely under the NLOS state or multi-path state)

5.4 Valid Node Quantity

In the protocol, it signifies as:valid_node_quantity. For the valid_node_quantity of TAG and ANCHOR, it means that the valid number of ANCHOR received by TAG at present, which corresponds to the number of lengthy parts. As for the valid_node_quantity of MONITOR, it refers to the sum total of the valid number of ANCHOR received by TAG at present and the number of TAG received by the MONITOR (The fixed number is 1), which corresponds to the number of Block of the lengthy parts.

5.5 Role & ID

In the protocol, they are signified as:role、id.

If it occurs in the non-Block part,then, the Role and ID that corresponds to output only occur once.

If it occurs in Block,then, the Role and ID correspond to the Block and the occurrence shall be the same as the number of Block.

5.6 Data Length & Data

In the protocol, they are signified as:data_length、data.They exist in each Block and represent the corresponding Data Length and Data.

5.7 Time

Time includes Local Time and System Time,which are signified in the protocol as:local_time and system_time.

Local Time:represents the local system time corresponds to the node of protocol, when the node is electrified to start,local_time is 0.

System Time:represents the lock-in time of the entire system, that will be open soon and the fixed output at present is 0.

5.8 Voltage

In the protocol, it is signified as:voltage. It means that the voltage the corresponds to the node of the protocol.

6 Protocol Unpack

6.1 NLink Protocol

6.1.1 Introduction

The exampled protocol analysis of this chapter is based on NLink protocol. It also provides the exampled analysis code of NlinkUnpack that is developed based on C language, which can effectively reduce the development cycle for users. Please refer to the NLink ROS drive for C++ code.

According to the product data of LinkTrack, in order to use less byte to signify more data, the floating-point number is represented by an integer, transmitted through the protocol frame, so, unpacking the data that is plastic but with a multiplier is actually floating point, and you have to divide that by the multiplier that is identified in NLink.

In particular,for int24 type,we need to convert to int32. In order to keep the same symbol, we can move it left and then divide 256. For example, with regarding to the location data, we use int24 and the rate is 1000, then, the analysis code shall be as following:

```
uint8_t byte[] = {0xe6,0x0e,0x00};// represents decimal value:3.814
int32_t temp = (int32_t)(byte[0] << 8 | byte[1] << 16 | byte[2] << 24) / 256;
float result = temp/1000.0f;
```

The variable of uint24 is the same.

The current protocol is based on a single byte at the end of a frame and validation: add all the bytes in a frame except the last byte and take the lowest byte. The exampled code:

```
uint8_t verifyCheckSum(uint8_t *data, int32_t length){
    uint8_t sum = 0;
    for(int32_t i=0;i<length-1;++i){
        sum += data[i];
    }
    return sum == data[length-1];
}
```

6.1.2 Protocol Content

The measuring output frame for TAG 、 ANCHOR and MONITOR are all NLink_LinkTrack_AOA_Node_Frame0,the format is shown in Table 2.

Table 2: NLink_LinkTrack_AOA_Node_Frame0 Format

NLink_LinkTrack_AOA_Node_Frame0 (Length: Frame_Length Bytes) --- RO				
Data	**Type**	**Length (Bytes)**	**Description**	**Index**
Frame Header	uint8	1	Value = 0x55	0
Function Mark	uint8	1	Value = 0x07	1
Frame Length	uint16	2	Frame length	2
role	uint8	1	Local node role, refer to the Role Table for more information	4
id	uint8	1	Local node ID	5
local_time	uint32	4	Time of local node, unit:ms	6
system_time	uint32	4	Time of system, unit:ms	10
reserved	*	4	Reserved	14
voltag * 1000	uint16	2	Interface supply voltag of the local node, unit: V	18
valid_node_quantity	uint8	1	Total valid nodes	20
role	uint8	1	Role corresponding to this block, refer to the Role Table for more information	Block0
id	uint8	1	ID corresponding to this block	
dis * 1000	int24	3	Distance from the tag to the corresponding anchor, unit: m	
angle*100	int16	2	Range: [-180,180], unit: deg	
fp_rssi * (-2)	uint8	1	First path power level, unit: dB	
rx_rssi * (-2)	uint8	1	Received power level, unit: dB	
reserved	*	2	Reserved	
role	uint8	1	Role corresponding to this block, refer to the Role Table for more information	Block1
id	uint8	1	ID corresponding to this block	
dis * 1000	int24	3	Distance from the tag to the corresponding anchor, unit: m	
angle*100	int16	2	Range: [-180,180], unit: deg	
fp_rssi * (-2)	uint8	1	First path power level, unit: dB	
rx_rssi * (-2)	uint8	1	Received power level, unit: dB	
reserved	*	2	Reserved	
……				Block...
Checksum	uint8	1	The Checksum is equal to all previous bytes added	Frame_Length - 1

The digital transmission frames for TAG 、 ANCHOR and MONITOR are all NLink_LinkTrack_Node_Frame0,the format is shown in Table 3.

Table 3. NLink_LinkTrack_Node_Frame0 Format

NLink_LinkTrack_Node_Frame0 (Length: Frame_Length Bytes) --- RO				
Data	**Type**	**Length (Bytes)**	**Description**	**Index**
Frame Header	uint8	1	Value = 0x55	0
Function Mark	uint8	1	Value = 0x02	1
Frame Length	uint16	2	Frame length	2
role	uint8	1	Refer to the **Role Table** for more information	4
id	uint8	1	Current node ID	5
reserved	*	4	Reserved	6
valid_node_quantity	uint8	1	Total valid nodes	10
role	uint8	1	Role corresponding to this block, refer to the **Role Table** for more information	11
id	uint8	1	ID corresponding to this block	12
data_length	uint16	2	Transparent data length	13
data[length]	uint8	1*length	Transparent data	15
role	uint8	1	Role corresponding to this block, refer to the **Role Table** for more information	16
id	uint8	1	ID corresponding to this block	17
data length	uint16	2	Transparent data length	18
data[length]	uint8	1*length	Transparent data	20
……				Block...
Checksum	uint8	1	The Checksum is equal to all previous bytes added	Frame_Length - 1

Role Table is shown as Table 4.

Table 4: Role Table

Role Table
enum{RESERVED,**ANCHOR**,**TAG**,RESERVED,RESERVED,RESERVED,**MONITOR**}

6.1.3 Example

The section will introduce the analysis examples for communication protocol. The documents take "1TAG + 4ANCHORs + 1MONITOR" as the example to introduce the analysis principle for communication protocol.

In the experiment, 4ANCHORs are configured as A0~A3,1 TAG is configured as T and 1 MONITOR is configured as M.

6.1.3.1 NLink_LinkTrack_AOA_Node_Frame0 collected from terminal T

Data Source: The operation node in the system is one ANCHOR of A0~A3, including 4ANCHORs, Tag (T) and Monitor (M). The upper computer connects to T for original data and A0、A1、A2、A3 and M will provide power separately.

Original Data:55 07 42 00 02 00 be 73 02 00 00 00 00 00 00 00 f1 06 ef 12 04 01 00 ff 02 00 22 0b a3 9f 9e 00 01 01 02 03 00 ad 00 a4 9f 00 00 01 02 ec 03 00 cb 03 a5 a0 00 00 01 03 88 05 00 99 ec a3 a0 00 00 33

Table 5: Analysis table for NLink_LinkTrack_AOA_Node_Frame0 of terminal T

Data	Type	Length (B)	Hex	Result
Frame Header	uint8	1	55	0x55
Function Mark	uint8	1	07	0x07
Frame Length	uint16	2	42 00	66
role	uint8	1	02	TAG
id	uint8	1	00	0
local_time	uint32	4	be 73 02 00	160702 ms
system_time	uint32	4	00 00 00 00	0 ms
reserved	*	4	...	*
voltag * 1000	uint16	2	ef 12	4.847 V
valid_node_quantity	uint8	1	04	4
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
dis * 1000	int24	3	ff 02 00	0.767 m
angle*100	int16	2	22 0b	28.50°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	01	1
dis * 1000	int24	3	02 03 00	0.770 m
angle*100	int16	2	ad 00	1.73°
fp_rssi * (-2)	uint8	1	a4	-82 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	02	2
dis * 1000	int24	3	ec 03 00	1.004 m
angle*100	int16	2	cb 03	9.71°
fp_rssi * (-2)	uint8	1	a5	-82.5 dB
rx_rssi * (-2)	uint8	1	a0	-80 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	03	3
dis * 1000	int24	3	88 05 00	1.416 m

angle*100	int16	2	99 ec	-49.67°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB
rx_rssi * (-2)	uint8	1	a0	-80 dB
reserved	*	2	...	*
Sum Check	uint8	1	33	0x33

6.1.3.2 NLink_LinkTrack_AOA_Node_Frame0 collected from terminal A0.

Data source: The operation node in the system is one ANCHOR of A0~A3, including 4 ANCHORs, TAG (T) and MONIOTR (M). The upper computer connects to M for original data and A0、A1、A2、A3、T and M will provide power separately.

Original data:55 07 42 00 01 00 97 e7 00 00 00 00 00 00 00 00 6b 06 1a 12 04 01 00 3e 03 00 6d 0b a3 9e 9f 00 01 01 2a 03 00 45 02 a3 9f 00 00 01 02 1a 04 00 ae 05 a4 a0 00 00 01 03 64 05 00 4d ee a4 9f 00 00 13

Table 6: Analysis table for NLink_LinkTrack_AOA_Node_Frame0 of terminal A0

Data	Type	Length (B)	Hex	Result
Frame Header	uint8	1	55	0x55
Function Mark	uint8	1	07	0x07
Frame Length	uint16	2	42 00	66
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
local_time	uint32	4	97 e7 00 00	59287 ms
system_time	uint32	4	00 00 00 00	0 ms
reserved	*	4	...	*
voltag * 1000	uint16	2	1a 12	4.634 V
valid_node_quantity	uint8	1	04	4
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
dis * 1000	int24	3	3e 03 00	0.830 m
angle*100	int16	2	6d 0b	29.25°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB
rx_rssi * (-2)	uint8	1	9e	-79 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	01	1
dis * 1000	int24	3	2a 03 00	0.810 m
angle*100	int16	2	45 02	5.81°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR

id	uint8	1	02	2
dis * 1000	int24	3	1a 04 00	1.050 m
angle*100	int16	2	ae 05	14.54°
fp_rssi * (-2)	uint8	1	a4	-82 dB
rx_rssi * (-2)	uint8	1	a0	-80 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	03	3
dis * 1000	int24	3	64 05 00	1.380 m
angle*100	int16	2	4d ee	-45.31°
fp_rssi * (-2)	uint8	1	a4	-82 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
Sum Check	uint8	1	13	0x13

6.1.3.3 NLink_LinkTrack_AOA_Node_Frame0 collected from terminal M

Data source: The operation node in the system is one ANCHOR of A0~A3, including 4 ANCHORs, Tag (T) and Monitor (M). The upper computer connects to M for original data and A0、A1、A2、A3 and T will provide power separately.

Original data:55 07 4d 00 06 00 15 2b 01 00 00 00 00 00 00 00 ac ff 99 12 05 01 00 02 03 00 f3 09 a3 9f 9f 00 01 01 02 03 00 8f ff a3 9e 9f 00 01 02 fc 03 00 dc 05 a4 9f 9f 00 01 03 46 05 00 b1 ee a4 a0 00 00 06 00 00 00 00 58 05 a5 9f 00 00 41

Table 7: Analysis table for NLink_LinkTrack_AOA_Node_Frame0 of terminal M

Data	Type	Length (B)	Hex	Result
Frame Header	uint8	1	55	0x55
Function Mark	uint8	1	07	0x07
Frame Length	uint16	2	4d 00	77
role	uint8	1	06	MONITOR
id	uint8	1	00	0
local_time	uint32	4	15 2b 01 00	76565 ms
system_time	uint32	4	00 00 00 00	0 ms
reserved	*	4	...	*
voltag * 1000	uint16	2	99 12	4.761 V
valid_node_quantity	uint8	1	05	5
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
dis * 1000	int24	3	02 03 00	0.770 m
angle*100	int16	2	f3 09	25.47°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB

rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	01	1
dis * 1000	int24	3	02 03 00	0.770 m
angle*100	int16	2	8f ff	-0.08°
fp_rssi * (-2)	uint8	1	a3	-81.5 dB
rx_rssi * (-2)	uint8	1	9e	-79 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	02	2
dis * 1000	int24	3	fc 03 00	1.020 m
angle*100	int16	2	dc 05	15.00°
fp_rssi * (-2)	uint8	1	a4	-82 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
role	uint8	1	01	ANCHOR
id	uint8	1	03	3
dis * 1000	int24	3	46 05 00	1.350 m
angle*100	int16	2	b1 ee	-44.31°
fp_rssi * (-2)	uint8	1	a4	-82 dB
rx_rssi * (-2)	uint8	1	a0	-80 dB
reserved	*	2	...	*
role	uint8	1	06	MONITOR
id	uint8	1	00	0
dis * 1000	int24	3	00 00 00	*
angle*100	int16	2	58 05	13.68°
fp_rssi * (-2)	uint8	1	a5	-82.5 dB
rx_rssi * (-2)	uint8	1	9f	-79.5 dB
reserved	*	2	...	*
Sum Check	uint8	1	41	0x41

6.1.3.4 NLink_LinkTrack_Node_Frame0 collected from terminal A0

Data source: The operation node in the system is one ANCHOR of A0 and a TAG T. Two computers respectively connect A0 and T. Open the serial port debugging assistant of the upper computer of NAssistant to send data “11 22 33 44 55 66 77 88 99” at a frequency of 50Hz to T and obtain the original data from the serial port assistant connected to A0.

Original data:55 02 19 00 01 00 ef 72 02 32 01 02 00 09 00 11 22 33 44 55 66 77 88 99 0f

Table 8: Analysis table for NLink_LinkTrack_Node_Frame0 of terminal A0

Data	Type	Length (B)	Hex	Result
Frame Header	uint8	1	55	0x55
Function Mark	uint8	1	02	0x02
Frame Length	uint16	2	19 00	25Bytes
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
reserved	*	4	...	*
valid_node_quantity	uint8	1	01	1
role	uint8	1	02	TAG
id	uint8	1	00	0
data_length	uint16	2	09 00	9Bytes
data[length]	uint8	1*length	11 22 33 44 55 66 77 88 99	data
Sum Check	uint8	1	0f	0x0f

6.1.3.5 NLink_LinkTrack_Node_Frame0 collected from terminal T

Data source: The operation node in the system is one ANCHOR of A0 and a TAG T. Two computers respectively connect A0 and T. Open the serial port debugging assistant of the upper computer of NAssistant to send data “11 22 33 44 55 66 77 88 99” at a frequency of 50Hz to A0 and obtain the original data from the serial port assistant connected to T.

Original data:55 02 19 00 02 00 6f 27 39 de 01 01 00 09 00 11 22 33 44 55 66 77 88 99 27

Table 9: Analysis table for NLink_LinkTrack_Node_Frame0 of terminal T

Data	Type	Length (B)	Hex	Result
Frame Header	uint8	1	55	0x55
Function Mark	uint8	1	02	0x02
Frame Length	uint16	2	19 00	25Bytes
role	uint8	1	02	TAG
id	uint8	1	00	0
reserved	*	4	...	*
valid_node_quantity	uint8	1	01	1
role	uint8	1	01	ANCHOR
id	uint8	1	00	0
data_length	uint16	2	09 00	9Bytes
data[length]	uint8	1*length	11 22 33 44 55 66 77 88 99	data
Sum Check	uint8	1	27	0x27

7 How to Deal with

7.1 Read Manuals Carefully

Nooploop is trying their best to introduce any many problems as possible, especially for the data manual and user manual. The data manual mainly introduces the product parameters, working principle and experimental data; while, user manual mainly introduces how to use the product, what needs to be paid attention to and FAQ.

7.2 Poor Performance and Abnormal Analysis

Please contact the company if these problems cannot be solved after troubleshooting.

Table 10: Failure information feedback table

Item	Content
Version of firmware	The firmware version for the current node, normally, the version No. shall be consistent, otherwise, please classify. For example, V4.0.2.
NAssistant version	Current version for NAssistant, for example, V4.0.4.
Role and number	The role and number in the current operation. Such as TAG:1 each;ANCHOR:1 each;MONITOR:0 each
Description	To describe details. Such as distance, large deviation and etc.
The node configuration	Please connect important role through NAssistant(Generally, it requests at least one configuration parameter diagram for each role). Read the parameters and provide the corresponding screenshot. Such as configuration for T0、A0 and M.
Abnormal diagram	Please capture the related abnormal diagram through NAssistant graphic interface. For example, when the distance deviation is too large, capture the oscillograph.
Real photo	Provide real photos where the nodes are installed
Recording	If the performance is poor, please use NAssistant to connect the corresponding recording function for the data with problems, please provide the file in .dat format.

7.3 Feasibility Analysis

Users may feel confused about the product model, ANCHOR deployment location, number and model for complicated or unconventional scenarios, please seek assistance from official channels.

8 FAQ

Q1. **Can it be used outdoors (Can the ranging and direction-finding be done outdoors)? What is the difference compared with indoor positioning?**

Yes, it can. There is no obvious difference from the indoor use and effect.

Q2. Will it communicate through UWB if it is positioned through UWB?

Yes.

Q3. Is there any sequential order to electrify in the node of TAG, ANCHOR and MONIOTR? Can it be added or reduced dynamically?

There is no sequential order to electrify. It can be added and reduced dynamically.

Q4. Is the physical interface for ranging and direction-finding and data transmission same? How to output positioning frame and digital frame?

Yes, they share the same UART physical interface. When the corresponding role fails to receive the transmitted data, the positioning frame will be output only, when the corresponding role receives the transmitted data, the positioning frame will be output firstly and wait for about 1ms to output the digital frame.

Q5. In case that the product cannot be identified through NAssistant:

- Please check whether the serial port is available, if not, there might be something wrong with the USB cable or the drive for USB is not installed (CP2102 drive is installed for official standard configuration UTTL module)
- If the serial port is available, please check whether there are many of them, please select the corresponding port for the product.
- Repeated ID or wrong configuration.Cut off the other nodes that are in operation, re-identify and electrify the nodes.

Q6. Can ANCHOR in motion?

Yes. The TAG ranging will always be relative to the coordinate system of ANCHOR, and direction-measuring is always relative to the coordinate system of ANCHOR or MONIOTR.

Q7. Can different version of firmware be used together?

Generally, it is suggested to keep the same firmware for all nodes in operation, the different firmware may lead to the malfunction of the system.

Q8. Must the NAssistant be operated at the terminal for system to operate properly?

No. All networking and positioning algorithm can be completed in the module. The main functions for NAssistant are monitoring, displaying and configuring.

Q9. Will MONITOR not be used if there are ACNHOR and TAG only?

Yes.

Q10. Will the update rate and bandwidth of data transmission decline for more anchors and monitors?

No. As long as it does not exceed the maximum number of anchors(there is no limit for monitors), the update rate and bandwidth for each node will not be affected.

Q11. How to test the communication distance of modules?

Prepare two modules, one is for TAG, the other one is for ANCHOR (assuming the configuration is A0), connect the TAG to NAssistant through UART and test it from near to far (the mobile terminal is easier for ANCHOR to test) and check the change of the wave curve of dis0.

Q12. Why the communication distance is quite different from what has been described in the manual?

- The communication distance is tested under the correct System CH condition,please check the configuration of the product.
- The communication distance is tested when the TX Gain is 33.5dB, make sure that the setup of the TX Gain is large enough.
- The communication distance is tested in an open space, please check whether there are any obstructions between nodes.

Q13. Will the TAG obstruct the ANCHOR if the distance between ANCHORs is too close?

No, all nodes can be closer to each other without any obstruction.

Q14. Will the obstruction between anchors or ANCHOR and MONITOR affect the ranging and direction-finding?

No.

Q15. Will vibration affect the ranging and direction-finding?

Barely. For example, the TAG on the UAV will generate high-frequency vibration, but it will barely affect the ranging and direction-finding.

Q16. What is the model of the serial communication terminal for the module? What shall be done if there is no such terminal on flight control and SCM?

GH1.25 terminal is used.Patch cord for GH1.25 can be purchased or cut off the wiring GH1.25-GH1.25 of the product and weld any other terminal. Please refer to the line sequence, voltage and signal line level in the data manual.

Q17. How to transmit data? The NLink_LinkTrack_Node_Frame0 protocol cannot be selected in the configuration page of the module.

As long as the module operate properly, the data can be transmitted and it is not necessary to select the NLink_LinkTrack_Node_Frame0 protocol.

Q18. Why the update rate cannot be set in the ANCHOR and MONITOR?

With the upgrade of the firmware, it is all right to just set up update rate in TAG.

Q19. What is the difference for the filter factor in the TAG and ANCHOR (or MONITOR)?

The Filter Factor in TAG can affect the ANCHOR distance. While, the Filter Factor in ANCHOR and MONITOR can affect the angle of the TAG.

Q20. Why 2D and 3D display cannot be seen from the upper computer?

So far, AOA does not support 2D and 3D display. Please check oscillogram of variables on line.

Q21. How to feedback to the R&D team of Nooploop for more firmware?

Please send email to dev@nooploop.com.

9 Abbreviation and Acronyms

Table 11: Abbreviation and Acronyms

Abbreviation	Full Title
UWB	Ultra Wideband
AOA	Angle of Arrive
PNT	Positioning.Navigation. And Timing
PNTC	Positioning.Navigation.Timing.And Communication
DT	Data Transmission
LOS	Line of Sight
NLOS	Non-Line of Sight
RSSI	Received Signal Strength Indication
PLR	Packet Loss Rate

10 Reference

[1] LinkTrack AOA Datasheet

11 Update Log

Table 12: Update log

Version	Data	Description
1.0	20200623	● Released the initial manual
1.1	20200812	● Adapted the latest firmware and upper computer ● Added description for NLink_LinkTrack_Node_Frame0、Role Table ● Add FAQ ● Added Filter Factor and modified Bardrate ● Changed the export file format of NAssistant from.txt to .xlsx

12 Further Information

Company: Shenzhen Nooploop technology Co., Ltd

Address: A2-207, Peihong building, No. 1, Kehui Road, Science Park community, Yuehai street, Nanshan District, Shenzhen

E-mail address: marketing@nooploop.com

Website: www.nooploop.com