

User Manual

WISE-1510

M2.COM LoRa IoT Node



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This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For outof-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

- 1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
- 2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
- 3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
- 4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
- 5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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Declaration of Conformity

FCC Class B

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.

Additional testing and certification may be necessary when multiple modules are used.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the labelling area is small than the palm of the hand, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with

Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: M82-WISE1510 ".

If the labelling area is larger than the palm of the hand, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

IC

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This radio transmitter (9404A-WISE1510) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (9404A-WISE1510) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Part No.	MPN	Description
1750008625-01	TH-915i	Dipole Ant. SUB-1G 1.8dBi SMA/M BLK 902-928 IPX6

Antenna list:

IMPORTANT NOTE

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.

Additional testing and certification may be necessary when multiple modules are used.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the IC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains IC: 9404A-WISE1510 ".

The Host Model Number (HMN) must be indicated at any location on the exterior of the end product or product packaging or product literature which shall be available with the end product or online.

低功率電波輻射性電機管理辦法

茲「經型式認證合格之低功率射頻電機,非經許可,公司、商號或使用者均不得擅自 變更頻率、加大功率或變更原設計之特性及功能」。

- (1) 「低功率射頻電機之使用不得影響飛航安全及干擾合法通信;經發現有干擾現象時,應立即停用,並改善至無干擾時方得繼續使用。前項合法通信,指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾」。
- (2) 「本模組於取得認證後將依規定於模組本體標示審驗合格標籤, 並要求平台廠商於平台上標示「本產品內含射頻模組 CC AF 17 LP 640 T 0」。

Package List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, please contact your dealer immediately.

- 1 x WISE-1510
- 1 x Screw for WISE-1510
- 1 x China RoHs Notice

Optional Accessories

Part No.	Description
1750008598-01	Sub G antenna Dipole L=195mm, 1dBi 902~928 MHz
1750008599-01	Sub G antenna Dipole L=195mm, 1dBi 863~870 MHz
1750008569-01	Antenna Cable SMA to MHF4 L=300mm
1700015038	FPC Cable 10P-0.5mm 7.9cm for DCU2.0
9696WED200E	ASS'Y WISE-ED20 A101-1 M2.COM Daughter
1931000590	Screw M2.5x5L F/S D=5.3 H=0.8 (1+) ST Ni
1700023619-01	A cable USB-A 4P(M)/micro USB 5P(M) 1m ADAM-T212
1700025876-01	M cable USB-A 4P(M)/Plug-in 2P-5.0 90CM
XRISC-ADP-10HW-AG	ADP A/D 100-240V 10W 5V WM
193A231540	POST F=M3*6L M=M3*6L D=5 d=2.88 B=5 H=15 Cu

Development Board

Part No.	Description
9696150000E	ASS'Y WISE-DB1500 A101-1 M2.COM CARRIER

Ordering Information

Part No.	WISE-1510WMB-SDA1N
Frequency	Band 902-928MHz for North America (LoRa)
Part No.	WISE-1510WMB-SDA1E
Frequency	Band 863-870MHz for Europe (LoRa)
Part No.	WISE-1510WMB-SDA1J
Frequency	Band 902~928MHz for Japan (LoRa)
Part No.	WISE-1510WMB-SDA1C
Frequency	Band 470~510MHz for China (LoRa)
Part No.	WISE-1510WMB-SDA1T
Frequency	Band 920~925MHz for Taiwan (LoRa)

Safety Instructions

- 1. Read these safety instructions carefully.
- 2. Keep this User Manual for later reference.
- 3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
- 4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
- 5. Keep this equipment away from humidity.
- 6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
- 7. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
- 8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
- 9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
- 10. All cautions and warnings on the equipment should be noted.
- 11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
- 12. Never pour any liquid into an opening. This may cause fire or electrical shock.
- 13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
- 14. If one of the following situations arises, get the equipment checked by service personnel:
 - The power cord or plug is damaged.
 - Liquid has penetrated into the equipment.
 - The equipment has been exposed to moisture.
 - The equipment does not work well, or you cannot get it to work according to the user's manual.
 - The equipment has been dropped and damaged.
 - The equipment has obvious signs of breakage.

DISCLAIMER: This set of instructions is given according to IEC 704-1. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

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Product Overview

This chapter gives background information on the WISE-1510. Sections include:

- Introduction
- Specifications

1.1 Introduction

WISE-1510 is a wireless module integrated with ARM Cortex-M4 Processor and LoRa / LoRaWAN connectivity. This technology is the best solution for Low-Power Wide-Area Network (LPWAN) Applications. LoRaWAN is defined to optimize the power consumption and wide range. Your sensors or applications with low data rate requirement can be achieved years battery lifetime and kilometers long distance connection. Advantech WISE-1510 also provides multi-interfaces for sensor and I/O control. With ARM mbed embedded microprocessor operating system and add-on software stacks, it's convenient to build the application software or sensor algorithm over mbed OS. Data can be quickly and easily acquired and transformed into a different format to communicate with WISE-PaaS or other cloud services. Developer can build their application backbone faster and focus on their applications, value-added services.

The main features of WISE-1510 are:

- ARM Cortex-M4 Core Processor
- Built-in LoRa / LoRaWAN connectivity
- Great for Low Power Wide Range application
- Rich interfaces for sensor and I/O control
- Support mbed OS 5.8
- Support wide temperature -40 ~ 85 °C

1.1.1 Product Features

Processor System	MCU	ARM Cortex-M4 Core Processor 80MHz STM – STM32L443RC		
Memory	RAM	64KB		
	Flash	256KB		
Form Factor		M2.COM Type A 2230		
Spec. Standard		M2 COM Technical SPEC_v1.1		
	Standard	LoRa Proprietary (WISE-Link) / LoRaWAN		
	Frequency Band	863-870MHz for Europe 902-928MHz for North America and Japan 470~510MHz for China		
	Channels	Spreading Factor: 7 ~ 12		
	Topology	Star network		
Wireless Network	Transmit Power	Up to +18dBm		
	Receiver Sensitivity	Up to -136dBm at SF = 12 / 125KHz		
	RF Data Rate	50 kbps at FSK mode EU868 (Based on LoRaWAN spec 1R0 version) 21.9 kbps at SF7 mode US915 (Based on LoRaWAN spec 1R0 version)		
	Function	End node		
	Antenna connector	MHF4 connector		

	UART	1 (4-wire, support RTC/CTS)
	12C	1
	GPIO	8
I/O	PWM	1
	SPI	1
	ADC	4
	USB	1 (device only)
Programming / Debug Port		1 via WISE-ED20 (CN1)
Power		3.3V
Environment	Operational Temper- ature	-40 ~ 85° C
	Operating Humidity	5% ~ 95% Relative Humidity, non-condensing
Physical Characteristics	Dimensions (WxD)	22 x 30 mm
OS		mbed 5.8

Note! Frequency Band can be configurable for Japan or Korea by request.





H/W Installation

This chapter gives mechanical and connector information on the WISE-1510

Sections include:

- Board Connector
- Module Outline
- Connector Specifications
- WISE-1510 Pin-Out Map
- Quick Starter of WISE-1510

2.1 Board Connector

M2.COM Type A Module

- Module size: 22 mm x 30 mm
- PCB thickness: 0.8 mm ± 10%
- Pin count: 75 pins
- Module input voltage: 3.3V DC-in
- Connector mating force: 30N Maximum
- Connector current rating: 0.5A / Power contact
- Connector operation temperature range: -45 °C to +85 °C



Figure 2.1 Card Edge Bevel



Figure 2.3 Card Edge Outline-Backside

Reference from PCI Express M.2 Specification Rev 1.0 (Nov 1, 2013) Section 2.3.5 Card PCB Details

2.2 Module Outline

The mechanical dimension information of M2.COM form factor follows the Type A 2230 module size: 22×30 mm. Both module types use a 75-position host interface connector and have room to support up to four RF connectors in the upper section.



Figure 2.4 Type A 2230

2.3 Connector Specifications

2.3.1 **Top Side Connector Physical Dimensions**

The top-side scheme has two connectors that share a common footprint but have different stack-up requirements.

- Length 22 mm maximum including land pattern
- Width - 9.1 mm maximum including land pattern



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Height	A (MAX)	B (MAX)
H2.3	2.25	0.41
H2.5	2.45	0.61
H2.8	2.75	0.89
H3.2	3.20	1.54
H4.2	4.20	2.54

ALL DIMENSIONS mm

2.3.2 Carrier Board Connection Length

The carrier board connector of M2.COM follows the Type 2230 M.2 module connector:

- The additional increase in length is 7.05mm maximum for top-side connector to the module length.
 - The retention screw adds 2.75 mm maximum.
 - The maximum extension, including land pattern, beyond the module leading edge is 4.3 mm.
- M2.COM module lengths are 30 mm and 42 mm.



Figure 2.5 Carrier Board Connection Length

Reference from PCI Express M.2 Specification, Revision 1.0, November 1, 2013

2.3.3 Carrier Board Connector Height

The dimensions of M2.COM form factor follow the Type A 2230 -D3 M.2 module size. Hence, the carrier board connectors must choose H3.2-D3 or H4.2-D5 connector as in the following diagrams.



Figure 2.6 H3.2-D3

Reference from PCI Express M.2 Specification, Revision 1.0, November 1, 2013

2.4 WISE-1510 Pin-Out Map

PIN	M2.COM Signal name	STM32L443RCI Name	6 MCU Pin	M2.COM Signal name	PIN
1	GND	GND	3.3V	VCC	2
3	USB_DP	PA12	3.3V	VCC	4
5	USB_DM	PA11		N.C.	6
7	GND	GND		N.C.	8
9	N.C.			N.C.	10
11	N.C.			N.C.	12
13	N.C.			N.C.	14
15	N.C.		PC6	CB_RESET_OUT#	16
17	N.C.		GND	GND	18
19	N.C.		PC9	CB_PWR_ON	20
21	N.C.		PC4	UART TX (O)	22
23	N.C.			Connector Key	
	Connector Key			Connector Key	
	Connector Key			Connector Key	
	Connector Key			Connector Key	
	Connector Key		PB11	UART RX (I)	32
33	GND	GND	PB1	UART RTS (O)	34
35	N.C.		PB13	UART CTS (I)	36
37	N.C.		PA8	GPIO0	38
39	GND	GND	PC8	GPIO1	40
41	PWM0	PA5	PC7	GPIO2	42
43	N.C.		PC5	GPIO3	44
45	GND	GND	PB0	GPIO4	46
47	ADC0	PA7	PA3	GPIO5	48
49	N.C.		PA2	GPIO6	50
51	GND	GND	PB6	GPIO7	52
53	ADC2	PA6		N.C.	54
55	ADC3	PA4	PC2	W_DISABLE#	56
57	GND	GND	PC1	I2C_DATA	58
59	ADC4	PA0	PC0	I2C_CLK	60
61	N.C.		PB15	SPI_MOSI	62
63	GND	GND	PB14	SPI_MISO	64
65	VDD_RTC	VBAT(3.3V)	PB10	SPI_CLK	66
67	Backup#	PA1	PB12	SPI_CS0#	68
69	GND	GND	PB9	SPI_CS1#	70
71	RESET_IN#	NRST	3.3V	VCC	72
73	Wake#	PC3	3.3V	VCC	74
75	GND	GND			



Figure 2.7 M.2 Connector

2.5 Quick Starter of WISE-1510

WISE-1510 is a wireless module integrated with ARM Cortex-M4 Processor and LoRaWAN/Proprietary LoRa (WISELink 1.0 and WISELink 2.0) connectivity. In this document, we will guide you to build your own Low-Power Wide-Area Network (LPWAN) kit solution as fast as you think.

In this chapter, we will guide you to know the function protocol and limitation about LoRa solution. First, we will let you know the difference between LoRaWAN and our Proprietary LoRa(WISELink 1.0 and WISELink 2.0) solution, we will show you what's our advantage compare with LoRaWAN. Second, we will descript the difference between Class A and Class C. Third, we will descript the correspondence between data rate and signal distance. Forth, we will show you 4 cases to make you fully understand our Private LoRa (WISELink 1.0 and WISELink 2.0) solution.

Basing the knowledge in this chapter, you can quickly select a solution to fulfill your requirement and accelerate the development schedule.

2.5.1 LoRaWAN and Proprietary LoRa (WISELink 1.0 and WISELink 2.0)

We compare with LoRaWAN and our proprietary LoRa solution (WISELink 1.0 and WISELink 2.0). Please check the following table for more details.

		LoRa WAN 1.0.x	WISELink 1.0	WISELink 2.0
	Join	Nodes initiate JOIN blindly even GW is out of range, which causes interference to other irrelevant GWs and their nodes	Nodes initiate JOIN blindly even GW is out of range, which causes interference to other irrelevant GWs and their nodes	 NetID is broadcast by GW. Nodes only initial the JOIN procedure after catching NetID.
Network Service	Roam ing	NetID is only known after JOIN, It is left for users to define how to use NetID to achieve Roaming	Roaming is not sup- ported	NetID identified by Nodes among clus- tered GWs.
	Multi cast	Multicast is not defined	Multicast is not defined	Support 1. GW can do multicast by assigning the packet of a multicast network address 2. Encrypt it using a multicast key.
Schedul	Multi tasking	Aloha: Sending packets by node control may cause collision between packets	Aloha: Sending packets by node control may cause collision between pack- ets	TDMA: GW send SPS through beacon and the node's transmission time is dependent on it.
ing	QoS	LoRaWAN defines confirmed data, which allows either GW or Nodes to retransmit data if it is not Acked	WISE-Link 1.0 defines confirmed data, which allows Nodes to retransmit data if it is not Acked	Guaranteed to send data without collision periodically by SPS cycle.
Security	Key lifetime	Once Nodes com- pleted JOIN, the life- time of session keys are permanent	Nodes are requested to do periodical JOIN, thus session keys can be refreshed on each JOIN	Nodes are requested to do periodical JOIN, thus session keys can be refreshed on each JOIN
	Multi- cast key	Undefined Multicast Key	Undefined Multicast Key	Two multicast keys are generated on each JOIN, and switch on half of max sequence number period
Radio Interfer- ence Man- agement	Chan- nel Assign- ment	Static Channel Assignment	Static Channel Assign- ment	GW use sniffer to find a non-used or least used channel
	Power Control	Unclear Power Con- trol	Not support	GW can control trans- mission power.

Service Model	Net- work	LoRaWAN is built into eco-system, and the service is provided by operators. The opera- tor will provide an interface (REST APIs, etc) for the fulfillment of end-to-end device and data manage- ment between their clouds and nodes. The business model all depends on opera- tors' policy	WISE-Link comes with Embedded Network Manager (ENM). ENM communicates with the embedded MQTT server of GW for fulfill- ment of device and data management. Users' clouds can communi- cate with ENM also via MQTT, and thus achieve Zero-Touch, Over-the-air firmware upgrade, end-to-end device and data man- agement. It doesn't involve with operators.	WISE-Link comes with Embedded Network Manager (ENM). ENM communicates with the embedded MQTT server of GW for fulfill- ment of device and data management. Users' clouds can com- municate with ENM also via MQTT, and thus achieve Zero- Touch, Over-the-air firmware upgrade, end- to-end device and data management. It doesn't involve with operators.
Communi- cation with Gateway		Uplink and Downlink	Uplink and Downlink	Uplink and Downlink
Scenario		Node is the Host	Node is the Host	Gateway is the Host
Coverage		1 st	1 st	2 nd
Price		1 st	2 nd	2 nd

2.5.2 Class A and Class C

Based on LoRa MAC layer operation, there are three classes of end devices in LoRa network. Our proprietary LoRa solution (WISELink 1.0 and WISELink 2.0) supports Class A and Class C. These two different class devices are designed to address different needs for the wide range of applications.

WISELink 1.0	Class A	Class C
Power Saving	0	Х
Bidirectional communications	0	0
Unicast messages	0	0
Multicast messages	0	0
Data Uplink	End-device initiates com- munication	End-device initiates com- munication
Data Downlink	End-device receives data via ACK	End-device is constantly receive

WISELink 2.0	Class A	Class C
Power Saving	0	Х
Bidirectional communications	0	0
Unicast messages	0	0
Multicast messages	0	0
Data Uplink	End-device initiates com- munication via SPS cycle	End-device initiates com- munication via SPS cycle
Data Downlink	End-device receives data via SPS cycle	End-device receives data via SPS cycle

Detail comparison as follow

Power Saving:

WISELink 2.0 Class A > WISELink 1.0 Class A > WISELink 1.0 Class C = WISELink 2.0 Class C

Wireless Coverage: WISELink 1.0 Class C = WISELink 1.0 Class A > WISELink 2.0 Class C = WISELink 2.0 Class A

2.5.3 Data rate vs Distance

LoRa has many parameters. The one which the research is focusing on is the Spreading Factor. The Spreading Factor is a set of parameters that specify transmit power, subfrequency and air time. LoRa defines spreading factors numbered from 6 to 12. The lower is the spreading factor, the higher is the throughput, and the lower is the distance covered. Also, lower spreading factor means lower power consumption.

At SF7, the distance is minimal, and the throughput is high. At SF12 (or SF11, depending on bandwidth - at 125 kHz, SF11 and SF12 are swapped), the distance is the max distance covered by LoRa standard, and the data rate is the lowest.

The spreading factor also changes the Air Time (or Time On Air). The Air Time is minimal at SF7. At each higher spreading factor, the value is nearly doubled.



Spreading factors were assigned manually since the difference of LoRa regulation between countries and countries.



How to choose your solution on WISELink

WISELink provides a variety of communication applications. In this section, we will guide you to understand the differences between WISELink 1.0 and WISELink 2.0 by using 4 different IoT projects, which are Parking Lot, Aquaculture, Environment Monitoring and Factory.

3.1 Parking Lot: WISELink 1.0 with Class A, ABP mode

This application has been massive implemented in Parking lot IoT solutions. The basic function requirement is in the following table.

Function Requirement
Sleep Mode (Power Saving Mode)
Clock Setting
MCUs communication via AT Command
Confirm data needed
Low Data Rate
Long Range Wireless Coverage

The flow chart as follow.



Figure 3.1 Work Flow on Parking Lot solution

- Node handshakes and binding with Gateway.
 Note: This procedure only happens in the first binding process between node and gateway.
- Node change state from LoRa Join into Sleep Mode
 Note: The sleep cycle is depending on the define in the SDK of 1510.
- 3. Magnetic Sensor is be triggered.
- 4. Host MCU will wake up the node via hardware wake up pin.
- 5. Host MCU will deliver the sensor data to the node.
- 6. Node will package the data and report to gateway. After that, node will change state and back to Sleep Mode (Step2).

3.2 Aquaculture: WISELink 1.0 with Class C, ABP mode

This application has been massive implemented in Aquaculture IoT solutions. The basic function requirement is in the following table.

Function Requirement
MCUs communication via AT Command
Confirm data needed
High Data Rate (Multi-sensors)
Long Range Wireless Coverage
Downlink control needed

The flow chart as follow.



- Node handshakes and binding with Gateway.
 Note: This procedure only happens in the first binding process between node and gateway.
- 2. Node changes state to get the sensor data from sensors.
- Node will package the data and report to gateway. After that, node will scheduling wait for next time report (Step4). In the meanwhile, node can receive a downlink data from gateway anytime.
 Note: The scheduling waiting time is depending on the define in the SDK of 1510.

3.3 Environment Monitoring: WISELink 2.0 with Class A, OTAA mode

This application has been massive implemented in Environment Monitoring IoT solutions. The basic function requirement is in the following table.

Function Requirement
Sleep Mode (Power Saving Mode)
Clock Setting
Confirm data needed
Low Data Rate
Long Range Wireless Coverage
Scheduling Monitoring
Downlink control needed

The flow chart as follow.



Figure 3.2 Work Flow on Environment Monitoring solution

- Node handshakes and binding with Gateway.
 Note: This procedure only happens on the Join Event (rejoin) and the rejoin cycle is defined on gateway.
- 2. Node changes state to get the sensor data from sensors.
- 3. Node packages the data and wait for suitable time and report the data to gateway. After report the data, node can receive a downlink data via gateway's beacon (Step 3.1) but normally this function won't be use in Environment Monitoring IoT solutions.

Note: Node will know when can report the data to gateway via the message which is hiding in the beacon.

- Node changes state to Sleep Mode
 Note: The sleep cycle is depending on the SPS cycle settings on gateway..
- 5. Times up to wake up and directly go to step 2 when node doesn't need to rejoin the gateway.

3.4 Factory: WISELink 2.0 with Class C, OTAA mode (Default SDK Setting)

This application has been massive implemented in Factory IoT solutions. The basic function requirement is in the following table.

Function Requirement	
Sleep Mode (Power Saving Mode)	
Clock Setting	
Confirm data needed	
Low Data Rate	
Long Range Wireless Coverage	
Scheduling Monitoring	
Downlink control needed	
The flow chart as follow.	



Figure 3.3 Work Flow on Factory solution

- Node handshakes and binding with Gateway.
 Note: This procedure only happens on the Join Event (rejoin) and the rejoin cycle is defined on gateway.
- 2. Node changes state to get the sensor data from sensors.
- 3. Node packages the data and wait for suitable time to report the data to gateway. In the meanwhile, node can receive a downlink data via gateway's beacon every 2.4 seconds.

Note: Node will know when can report the data to gateway via the message which is hiding in the beacon.

 Node will keep listening the beacon from gateway and will get the sensor data again when the times up.
 Note: The waiting cycle is depending on the SPS cycle settings on gateway.

Note: The waiting cycle is depending on the SPS cycle settings on gateway.



Development Environment Setup

4.1 File Structure

4.1.1 Mbed OS

Current Mbed OS version is 5.8.4, please check the following link for more detail information.

https://os.mbed.com/docs/mbed-os/v5.8/introduction/index.html

4.1.2 WISELink

Current WISELink version is 1108, please check more information as following setps.

- Please download the SDK file by following links. https://support.advantech.com/support/ DownloadSRDetail_New.aspx?SR_ID=1-1B15Z5O&Doc_Source=Download
- 2. Unzip the SDK and open the index.html for more information. The link as follow. file://{SDK}/docs/html/index.html

4.2 OS Version

Current Mbed OS version is 5.8.4

4.3 Environment Setup Procedure

ARM mbed is used for you to create applications running on WISE-1510. Your application code is written in C++. It uses the application programming interfaces (APIs) that mbed OS provides. These APIs allow your code to work on different microcontrollers in a uniform way. This reduces a lot of the challenges in getting started with microcontrollers and integrating large amounts of software. Besides, we also provide you node APIs which facilitates LoRa node development. Our offline development tool is the mbed CLI, a command-line tool. This requires having a toolchain installed on your computer. mbed CLI is the name of the ARM mbed command-line tool, packaged as mbed-cli, which enables the full mbed workflow: repositories version control, maintaining dependencies, publishing code, updating from remotely hosted repositories and invoking ARM mbed's own build system and export functions, among other operations. The basic workflow for mbed CLI is to:

- 1. Initialize a new repository, for either a new application (or library) or an imported one.
- 2. Build the application code.
- 3. Test your build.
- 4. Publish your application.

Tools Version

Tools	Version
Pythan	2.7.11
gcc	4.9

4.3.1 Installation

To install mbed CLI, related tools are required to be installed first. Please refer to the video tutorial (https://www.youtube.com/watch?v=cM0dFoTuU14). Please follow the steps described in the tutorial video to install mbed CLI.

1. Install Python

mbed CLI supports Windows, Linux and Mac OS X operating systems. You can select the OS you prefer to work with. mbed CLI is a Python script, so you'll need Python to use it. The version 2.7.11 of Python has been verified with mbed CLI.

https://www.python.org/downloads/release/python-2711/

Note: mbed CLI is incompatible with Python 3.

2. (Optional) Install Git or Mercurial

If you would like to maintain your source code in repositories, you can continue with the next step. mbed CLI supports both Git and Mercurial repositories, you can install which one you prefer:

Git - version 1.9.5 or later (https://git-scm.com/).

Mercurial - version 2.2.2 or later (https://www.mercurial-scm.org/).

If you don't want to use repositories, you can just skip it.

3. Install gcc

mbed CLI invokes the mbed OS 5 tools for various features, such as compiling, testing and exporting to industry standard toolchains. To compile your code, you will need either a compiler or an IDE:

Compilers: GCC ARM, ARM Compiler 5, IAR.

■ IDE: Keil uVision, DS-5, IAR Workbench.

We select GCC ARM Embedded, so you can install version 4.9 of GCC ARM Embedded (https://launchpad.net/gcc-arm-embedded).



Version 5.0 or any other versions above may be incompatible with the tools.

4. Install mbed CLI

You can get the latest stable version of mbed CLI from PyPI

\$ pip install mbed-cli



On Linux or Mac, you may need to run with sudo.



Finally, you've to extract the source code to the working directory from the SDK we released. The structure of the working directory is as below:

docs/<-- Documents for SDK</th>loranode_L443_sdk_R1_0_02/mbed-os/<-- mbed os</td>loranode_L443_sdk_R1_0_02/libHLLoraNode.a<-- Node API header file</td>loranode_L443_sdk_R1_0_02/node_api.h<-- Node API header file</td>loranode_L443_sdk_R1_0_02/main.cpp<-- Sample code</td>

4.3.2 Configuration

After the installation of required tool chains, please set up the directory of mbed CLI to link the folder of toolchains which you want to use for compiling the source tree. You can set the GCC ARM Embedded location via the command as below:

\$ mbed config -G GCC_ARM_PATH "C:\Program Files (x86)\GNU Tools ARM Embedded\4.9 2015q3\bin"

[mbed] C:\Program Files (x86)\GNU Tools ARM Embedded\4.9 2015q3\bin now set as global GCC_ARM_PATH

\$ mbed config toolchain GCC_ARM

[mbed] GCC_ARM now set as default toolchain in program "xxxx"

You can see the active mbed CLI configuration via:

\$ mbed config --list [mbed] Global config: GCC_ARM_PATH=C:\Program Files (x86)\GNU Tools ARM Embedded\4.9 2015q3\bin [mbed] Local config (xxxx): TOOLCHAIN=GCC_ARM TARGET=NUCLEO_L443RC

4.3.3 Compilation

mbed CLI uses the current directory as a working context. This means that before calling any mbed CLI command, you must first change to the working directory containing the code. Then, Use the mbed compile command to compile your code:

\$ mbed compile -c

4.4 Firmware Upgrade

To flash runtime image, your terminal program needs to support "YMODEM". Tera Term is used for demonstration here.

1. Connect WISE-ED20 and WISE-1510 with FPC cable



2. Insert WISE-1510 into WISE-DB1500's m2.com slot



3. Connect the antenna with WISE-1510 module



4. Connect WISE-1510 to your laptop or computer.



5. Switch off both botton which is on the WISE-ED20.







Chapter 4 Development Environment Setup

6. UART port connect via debug board

Connect USB-to-microUSB cable from WISE-ED20 to the USB port on your Windows PC. Opening the corresponding COM port in serial program, ex: Tera Term, and set the baud rate as 115200.

Port:	COM6	~
Baud Rate:	115200	~
Data Bits:	8	~
Stop Bits:	1	~
Parity:	None	~
Flow Control:	None	~

7. Runtime image upgrade mode

Press 'u' on the PC keyboard and "Press reset button" on ED-20 debug board. The terminal will show messages as follow.



COM3 - Tera Term VT	
文件(E) 編輯(E) 設定(S) 控制(Q) 視窩(W) 幫助(H)	
Invalid Number ! ==> The number should be either 1, 2, 3 or 4 ====================================	*
Download image to the internal Flash 1	
Upload image from the internal Flash 2	
Execute the loaded application 3	
Enable the write protection 4	
Invalid Number ! ==> The number should be either 1, 2, 3 or 4 ====================================	
Download image to the internal Flash 1	
Upload image from the internal Flash 2	
Execute the loaded application 3	
Enable the write protection 4	HI +

🚾 COM3 - Tera Term VT	
文件(F) 編輯(E) 設定(S) 控制(O) 視窗(W) 幫助(H)	
Upload image from the internal Flash 2	^
Execute the loaded application3	
Enable the write protection 4	
Invalid Number ! ==> The number should be either 1, 2, 3 or 4 ====================================	
Download image to the internal Flash 1	
Upload image from the internal Flash 2	
Execute the loaded application 3	
Enable the write protection 4	
Haiting for the file to be sent (press 'a' to abort)	

8. Start upgrading via Y modem Select the run-time image ".bin" file via YMODEM.

Edit Setup Control	Window	KanjiCode Help	
New connection	Alt+N		
Duplicate session Cygwin connection	Alt+D Alt+G	e number should be either 1, 2, 3 or 4	
Log Comment to Log		internal Flash 1	
View Log Show Log dialog		internal Flash 2	
Send file	1	ligation 3	
Transfer		Kermit +	
SSH SCP_		XMODEM .	
Change directory		YMODEM Receive	
Replay Log_		ZMODEM Send	
TTV Record TTV Replay		B-Plus Quick-VAN , be either 1, 2, 3 or 4	
Print_	Alt+P	internal Flash 1	
Disconnect	Alt+I		
Exit	Alt+Q	internal Flash 2	
	-		

Waiting for run-time image transmission is complete.

文件名:	loranode_stm.bin
協定:	YMODEM (1k)
包號:	1
傳輸字節數:	C
耗時:	0:00
	0.0%
电時;	0:0

After downloading completed, the terminal will show as below.

📶 COM3 - Tera Term VT	
文件(E) 編輯(E) 設定(S) 控制(Q) 視裔(W) 幫助(H)	
Maiting for the file to be sent (press 'a' to abort) CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	~ 222222222222222222222222222222222222
Name: loranode_stm.bin Size: 147172 Bytes	
Main Menu	
Download image to the internal Flash 1	
Upload image from the internal Flash 2	
Execute the loaded application 3	
Enable the write protection 4	
	11

9. Reset device

Press reset button on ED-20 debug board to reset device.





Binding Process between WISE-1510 and WISE-3610

5.1 CLI Command Description

The parameters settings on WISE-3610 and WISE-1510 need to be the same. Before you had your own solution on WISELink, you can try to change the WISELink solution via CLI command.

There are 13 parameters to establish the WISE-3610 and WISE-1510 links which includes Beacon(DevOpMode), Device EUI(DevEUI), App EUI(AppEUI), App Key(AppKey), Device Class(Devclass), Activation(DevActMode), App Key(AppKey), NetWork ID(DevNetID), Data Rate(DevAdvwiseDataRate), Channel Frequency(DevAdvwiseFreq), Device Address(DevAddr), Network Session Key(NwkS-Key) and Application Session Key(AppSKey).

In this section, we will guide you to do the settings with each solution which are WISELink 1.0 with Class A ABP, WISELink 1.0 with Class C ABP, WISELink 2.0 with Class A OTAA and WISELink 2.0 with Class C OTAA. Each solution needs to adjust some parameters both on WISE-1510 and WISE-3610. Please check the following table for the detail parameter description.

Command	Option	Parameters	Description
node	get/set	AppEUI	Application EUI for OTAA mode
		BKey	Broadcast key
		АррКеу	Application key for OTAA mode (16 Digit)
		DevAddr	Device Addr for ABP mode
		NwkSKey	Network session key for ABP mode (32 Digit)
		AppSKey	Application session key for ABP mode (32 Digit)
		DevNetId	Device Net ID for WISE mode
		DevActMode	Activation mode (1:OTAA 2:ABP; Default:1)
		DevOpMode	Device operating mode (1:WISELink 1.0 2:LoRaWAN 4:WISELink 2.0; Default:4)
		DevAdvwiseFreq	Frequency Band
		DevAdvwiseDataRate	Data Rate
		DevAdvwiseTxPwr	RF Transmit Power (dbm)
	savecfg		Save all changes to the WISE-1510
	reboot		Reboot WISE-1510

	Command example	Description
Example 1	node getAppEUI	Get AppEUI parameter
Example 2	node setDevAddr 11111111	Set DevAddr is 11111111
Example 3	node savecfg	Save all changes to the WISE-1510
Example 4	node reboot	Reboot WISE-1510

5.2 WISELink 1.0 with Class A, ABP mode

5.2.1 Settings on WISE-1510

All the commands and steps on WISE-1510

Steps	Command	Description
1.	node set -devclass 1	Set devcalss to class A
2.	node setdevopmode 1	Set devopmode to WISE-Link 1.0
3.	node setdevactmode 2	Set devactmode to ABP mode
4.	node setdevadvwiseFreq 924500000	Set transmit frequency as 924.5MHz
5.	node getDevAddr	Get DevAddr parameter
6.	node getAppSKey	Get AppSKey
7.	node getNwkSKey	Get NwkSkey
8.	node savecfg	Save all change
9.	node reboot	reboot WISE-1510

5.2.2 Settings on WISE-3610

1. Go to "WISE Manager" and "Managemet"



2. Click setting and click "Edit"

Gateway EUI	Region	WISE Link		Radio F	requency Actio
		BEACON			
		Beacon	On		
		Network ID			
		Sub Frame Index	50 ms		
		Max Tx Time	1200 ms		
		JOIN			
		Timestamp	Off		
		Rejoin Period	24 h		
		SEMI-PERSISTENT SCHEDULING			
		Semi-Persistent Scheduling	On		
		SPS	2.5 s	Channel Frequency	923.900 MHz
E48FFFF19D315	TW	MULTICASTING		Data Rate	DR10 - SF10/500KHz 1.

3. Click "WISE Link" and turn off "Beacon" then save the setting

WISE Link Join		
Beacon	Off	Y
Periodical Join	On	¥
Radio Frequency		
EUI	74:FE:48:FF:FF:19:D3:19	

4. Check "Channel Frequency" and "Data Rate" then "Click Add LoRa Node"

Gateway EUI	Region	Radio Fre	quency #1	Radio Fre	quency #2	Action
		Channel Frequency	920.900 MHz	Channel Frequency	924.500 MHz	
74FE48FFFF19D315	TW	Data Rate	DR8 - SF12/500KHz	Data Rate	DR13 - SF7/500KHz	•
₹a Node w 4 • entries		TX Power	20 dBm	TX Power	20 dBm Search:	
Ra Node w 4 • entries # 11 Device	EUI	TX Power	20 dBm	TX Power	20 dBm Search:	Action
Ra Node w 4 v entries # 4 Device	EUI	TX Power	20 dBm	TX Power Activation	20 dBm Search:	Action

5. Fill in the WISE-1510 information in the table and save the setting

74FE48FFFF19D13C		
000000000000AB		
A	Y	
ABP	Y	
11111111		
	4P]
******	₫₽	1
Enabled	¥	
Remark		
	74FE48FFFF19D13C 000000000000AB A ABP 11111111 Enabled Remark	74FE48FFFF19D13C 00000000000AB A ABP 11111111 I1111111 Enabled Remark

6. It will show as below

¥ 11	Device EUI	App EUI 11	Class 11	Activation 11	Remark 11	Action 1
1	74FE48FFFF19D13C	0000000000000AB	A	ABP		\$

7. If the link establish, it will show as follow

4 v entries					Search:	
Element	ID	Status	Data	Timestamp	Timer	Action
WISE Manager	00112358	2	-	7.		ር
LoRa Gateway	74FE48FFFF19D315	2	-	-	-	-
LoRa Node	74FE48FFFF19D13C	2	-35 dBm / 7 dB	2019/4/11 16:57:41	15s	\$

5.3 WISELink 1.0 with Class C, ABP mode

5.3.1 Settings on WISE-1510

All the commands and steps on WISE-1510

Steps	Command	Description
1.	node set -devclass 3	Set devcalss to class C
2.	node setdevopmode 1	Set devopmode to WISE-Link 1.0
3.	node setdevactmode 2	Set devactmode to ABP mode
4.	node getDevAddr	Get DevAddr parameter
5.	node getAppSKey	Get AppSKey
6.	node getNwkSKey	Get NwkSkey
7.	node savecfg	Save all change
8.	node reboot	reboot WISE-1510

5.3.2 Settings on WISE-3610

1. Go to "WISE Manager" and "Managemet"



2. Click setting and click "Edit"

Gateway EUI	Region	WISE Link		Radio F	requency Action
		BEACON			
		Beacon	On		
		Network ID			
		Sub Frame Index	50 ms		
		Max Tx Time	1200 ms		
		JOIN			
		Timestamp	Off		
		Rejoin Period	24 h		
		SEMI-PERSISTENT SCHEDULING			
		Semi-Persistent Scheduling	On		
		SPS	2.5 s	Channel Frequency	923.900 MHz
E48FFFF19D315	TW	MULTICASTING		Data Rate	DR10 - SF10/500KHz 1.
		Multicasting	On	TX Power	20 dBn2 Edit

3. Click "WISE Link" and turn off "Beacon" then save the setting

WISE Link		
WISE Link Join		
Beacon	Off	v
Periodical Join	On	Y
Radio Frequency		
EUI	74:FE:48:FF:FF:19:D3:19	

4. Check "Channel Frequency" and "Data Rate" then "Click Add LoRa Node"

Gateway EUI	Region	Radio	Frequency #1	Radio Frequ	uency #2	Action
		Channel Frequency	920.900 MHz	Channel Frequency	924.500 MHz	
4FE48FFFF19D315	TW	Data Rate	DR8 - SF12/500KHz	Data Rate	DR13 - SF7/500KHz	\$
		TX Power	20 dBm	TX Power	20 dBm	
Ra Node					Search:	
Ra Node	EUI I	App EUI	IT Class IT	Activation 1	Search: Remark 11	Action 1
Ra Node w 4 v entries # 4 Device	EUI I	App EUI	Class 11 No data available in table	Activation 👫	Search: Remark 11	Action

5. Fill in the WISE-1510 information in the table and save the setting

LoRa Node		
General Settings		
Device EUI	74FE48FFFF19D13C	
App EUI	000000000000AB	
Device Class	C	
Activation	ABP	
Device Address	11111111	
Network Session Key		8
Application Session Key		1
Payload Field	Enabled	3
Remark	Remark	

6. It will show as below

↓ <u>k</u>	Device EUI 11	App EUI 11	Class 1	Activation 1	Remark 1	Action	11
1	74FE48FFFF19D13C	0000000000000AB	с	ABP		\$	
ng 1 to 1	of 1 entries					Previous 1	Next

7. If the link establish, it will show as follow

4 v entries					Search:	
Element	ID	Status	Data	Timestamp	Timer	Action
WISE Manager	00112358	2	<i>a</i> .			Ċ
LoRa Gateway	74FE48FFFF19D315	2	-	÷	-	-
LoRa Node	74FE48FFFF19D13C	2	-35 dBm / 7 dB	2019/4/11 16:57:41	15s	\$

5.4 WISELink 2.0 with Class A, OTAA mode

5.4.1 Settings on WISE-1510

All the commands and steps on WISE-1510

Steps	Command	Description
1.	node set -devclass 1	Set devcalss to class A
2.	node setdevopmode 4	Set devopmode to WISE-Link 2.0
3.	node setdevadvwiseFreq 924500000	Set transmit frequency as 924.5MHz
4.	node getAppkey	Get Appkey parameter
5.	node savecfg	Save all change
6.	node reboot	reboot WISE-1510

5.4.2 Settings on WISE-3610

1. Go to "WISE Manager" and "Managemet"



2. Click setting and click "Edit"

Gateway EUI	Region	WISE Link		Radio F	requency Action
		BEACON			
		Beacon	On		
		Network ID			
		Sub Frame Index	50 ms		
		Max Tx Time	1200 ms		
		JOIN			
		Timestamp	Off		
		Rejoin Period	24 h		
		SEMI-PERSISTENT SCHEDULING			
		Semi-Persistent Scheduling	On		
		SPS	2.5 s	Channel Frequency	923.900 MHz
E48FFFF19D315	TW	MULTICASTING		Data Rate	DR10 - SF10/500KHz 1.
		Multicasting	On	TX Power	20 dBn2 Edit

3. Click "WISE Link" and turn on "Beacon" then save the setting

WISE Link				
WISE Link Beacon	Join Semi-Persistent Sc	heduling	Multicast	Adaptive Data Rate
Beacon	On	•		
Periodical Join	On	¥		
Semi-Persistent Scheduling	On	Ŧ		
Multicasting	On	Y		
Radio Frequency				
EUI	74:FE:48:FF:FF:19:D3:19			
Region	TW			
Channel Frequency	923.9 MHz	T		
Data Rate	DR10 - SF10 / 500KHz	T		

4. Check the Network ID is 3610 in the Beacon tag.

WISE Link						
WISE Link	Beacon	Join	Semi-Persis	tent Scheduling	Multicast	Adaptive Data Rate
	Network ID	3610				
Sul	b Frame Index	50 ms		Ŧ		
	Max Tx Time	1200 n	ıs	•		
Radio Freq	LIENCY					
	uonoy	74-55	10-EE-EE-40-D	0.40		
	EUI	74:FE:4	48:FF:FF:19:D	3:19		
	EUI Region	74:FE:4	48:FF:FF:19:D	3:19		
Chan	EUI Region nel Frequency	74:FE:4 TW 923.91	48:FF:FF:19:D MHz	3:19		
Chan	EUI Region nel Frequency Data Rate	74:FE:4 TW 923.91 DR10 -	48:FF:FF:19:D WHz SF10 / 500KH	3:19 ¥ z ¥		

- Chapter 5 Binding Process between WISE-1510 and WISE-3610
- 5. For test purpose, SPS Cycle can set short time in "Semi-Persistent Scheduling".

	Beacon	Join	Semi-Persistent	Scheduling	Multicast	Adaptive Data Rate
	SPS Cycle	2.5 s		Y		
adio Fregu	IODOV					
aulo riequ	lency					
	EUI	74:FE	48:FF:FF:19:D3:19			
	Region	TW				
Chanr	iel Frequency	923.9	MHz	¥		
Chanr	el Frequency Data Rate	923.9 DR10	MHz - SF10 / 500KHz	T T		

6. Click "Add LoRa Node"

Ra Node	▼ entries				Search:	
# 11	Device EUI 11	App EUI 👔	Class 🕼	Activation 1	Remark 1	Action 4
			No data available in table	3		
owing 0 to 0) of 0 entries					Previous Ne

7. Fill in the WISE-1510 information in the table and save the setting

FFF19D13C 0000000AB	
FFF19D13C 0000000AB	-
000000AB	
٣	
•	
FFF19D13C74FE48FFFF	
٣	
¥	
	FFF19D13C74FE48FFFF

8. If the link establish, it will show as follow.

4 v entries					Search:	
Element	ID	Status	Data	Timestamp	Timer	Action
WISE Manager	00112358	2	-	=	-	ن
LoRa Gateway	74FE48FFFF19D315		-	-	-	
LoRa Node	74FE48FFFF19D13C	2	-35 dBm / 7 dB	2019/4/11 16:57:41	15s	\$

5.5 WISELink 2.0 with Class C, OTAA mode

5.5.1 Settings on WISE-1510

All the commands and steps on WISE-1510

Steps	Command	Description
1.	node set -devclass 3	Set devcalss to class C
2.	node setdevopmode 4	Set devopmode to WISE-Link 2.0
3.	node getAppkey	Get Appkey parameter
4.	node savecfg	Save all change
5.	node reboot	reboot WISE-1510

5.5.2 Settings on WISE-3610

1. Go to "WISE Manager" and "Managemet"



2. Click setting and click "Edit"

Gateway EUI	Region	WISE Link		Radio F	requency Actio
		BEACON			
		Beacon	On		
		Network ID			
		Sub Frame Index	50 ms		
		Max Tx Time	1200 ms		
		JOIN			
		Timestamp	Off		
		Rejoin Period	24 h		
		SEMI-PERSISTENT SCHEDULING			
		Semi-Persistent Scheduling	On		
		SPS	2.5 s	Channel Frequency	923.900 MHz
FE48FFFF19D315	TW	MULTICASTING		Data Rate	DR10 - SF10/500KHz 1.
		Multicasting	On	TX Power	20 dBn2

3. Click "WISE Link" and turn on "Beacon" then save the setting

WISE Link					
WISE Link Beacon	Join Semi-Persistent So	cheduling	Multicast	Adaptive Data Rate	
Beacon	On	•			
Periodical Join	On	¥			
Semi-Persistent Scheduling	On	٣			
Multicasting	On	¥			
Dadia Fraguanay					
Radio Frequency					
EUI	74:FE:48:FF:FF:19:D3:19				
Region	TW				
Channel Frequency	923.9 MHz	T			
Data Rate	DR10 - SF10 / 500KHz				

4. Check the Network ID is 3610 in the Beacon tag.

WISE Link Beacon	Join Semi-Persistent Scheduling	Multicast	Adaptive Data Rate
Network ID	3610		
Sub Frame Index	50 ms 🔻		
Max Tx Time	1200 ms 🔻		
Radio Frequency			
tudio i requeriey			
EUI	74:FE:48:FF:FF:19:D3:19		
EUI	74:FE:48:FF:FF:19:D3:19		
EUI Region Channel Frequency	74:FE:48:FF:FF:19:D3:19 TW 923.9 MHz		
EUI Region Channel Frequency Data Rate	74:FE:48:FF:FF:19:D3:19 TW 923.9 MHz • DR10 - SF10 / 500KHz •		

5. For test purpose, SPS Cycle can set short time in "Semi-Persistent Scheduling".

WISE LINK	Beacon	Join	Semi-Persistent S	Scheduling	Multicast	Adaptive Data Rate
	SPS Cycle	2.5 s		Y		
adio Freq	uency					
	EUI	74:FE:4	18:FF:FF:19:D3:19			
	Region	TW				
Chan	nel Frequency	923.9 N	ИНz	Ŧ		
	Data Rate	DR10 -	SF10 / 500KHz	y		

6. Click "Add LoRa Node"

w 4	• entries								Search:			
# 11	Device EUI	41	App EUI	11	Class	11	Activation	л	Remark	11	Action	11
				1	No data available	e in table						
owing 0 to 0) of 0 entries									Pr	evious I	Vex

7. Fill in the WISE-1510 information in the table and save the setting

LoRa No	ode		
General S	ettings		
	Device EUI	74FE48FFFF19D13C]
	App EUI	0000000000000AB	
[Device Class	C	
	Activation	OTAA •	
	App Key	74FE48FFFF19D13C74FE48FFFF	
	Payload Field	Enabled]
	SPS	Enabled]
	Remark	Remark]

8. If the link establish, it will show as follow.

4 v entries					Search:	
Element	ID	Status	Data	Timestamp	Timer	Action
WISE Manager	00112358	2	-		-	Ċ
LoRa Gateway	74FE48FFFF19D315	2	÷	÷	-	÷
LoRa Node	74FE48FFFF19D13C	2	-35 dBm / 7 dB	2019/4/11 16:57:41	15s	\$



Application Interface Description (WISELink Application)

A.1 Application Interface Description (WISELink Application)

Please check the SDK for more information. Link as follow file://{SDK}/docs/html/ index.html



Application Sample Code Flow

B.1 Application Sample Code Flow





Sensor Data Format

C.1 Sensor Data Format

In the sample application, node_get_sensor_data() encodes sensor data according to the following format:

Length MsgTyp (1 Octet) (1 Octe	e Multiple TLVs
------------------------------------	-----------------

,where

Length: Total TLV length

MsgType: Fixed as 0xc

Multiple TLVs are one or more Tag-Length-Values: tag matches with gateway's setting, length is sensor data length, and value is sensor data. All octets are in hexadecimal.

For example, LoRa Payload Field setting on WISE-3610 is as below:

App EUI	Port	Payload Field	ld	Name		Тур	•	Decimal Point	Sign	Unit	Minimum	Maximum	Dele
00000000000000000000000000000000000000		2.7		Temperature	۰.	Value	.*	2 .	0a *	142103	-50	50	
			2	Humidity		Value		2. *	ot +	5	0.	3100	

If temperature is 25.55 Celsius degree, translate decimal 2555 to hexadecimal 9FB. Similarly, if humidity is 60.55%, translate from decimal 6055 to hexadecimal 17A7. The encoded data will be

0x9 | 0xc | 0x1 | 0x3 | 0x1 | 0x9 | 0xFB | 0x2 | 0x2 | 0x17 | 0xA7

, where

0x9: the Total TLV length, included two TLVs

Oxc: the fixed MsgType

0x1 | 0x3 | 0x1 | 0x9 | 0xFB: the first TLV with tag id (0x1), value length (0x3), and positive (0x1) value (0x9FB)

 $0x2 \mid 0x2 \mid 0x17 \mid 0xA7$: the second TLV with tag id (0x2), value length (0x2), and unsigned value (0x17A7)

Be reminded temperature "Sign" setting is On, 1 extra byte is required to indicate (0 means negative, and 1 means positive), but humidity "Sign" setting on gateway is Off, so no extra 1 byte is required.

Users are free to define their own payload field format, but only sensor data encoded according to the above format can be decoded successfully, and displayed on LoRa Dashboard on WISE-3610.

		Payload Field					
		and the second sec					
		+ Add Payload Field					
signed char node_get_sensor_data (char							
		App EUI	Port	Payload Field	Id	Name	Туре
unsigned char sensor data[32];							
		000000000000000000	101			-	
memset(sensor_data, 0x0, sizeof(sensor		000000000000000000000000000000000000000		-		Temperature	Value
#11 NODE BENSOR TEMP HOM ENABLE	tag id (0x1)					Linguidity	Makun
Sensor_data[ien+2]=011;	tag id (oxi)				- 2	numury	value
sensor data[len+2]=0x3;	value length (byte)				3	Carbon Dioxide	Mahan
	positive(0v0) pegative(0vEE)		-			COLOCIT DIGNIDU	. varue
sensor_data[len+2]=0x0;	positive(oxo), negative(oxi i)				4	VOC	Value
len++; //me is positive. Will be or					0.30		
Sensor_data[ien*2]=(node_sensor_temp	value(temperature)						
sensor data[len+2]=node sensor temp	hunsöxtf:						
sensor_data[len+2]=0m2;	tag id (0x2)						
len++; // hus/dity	value length (byte)						
Sensor_Gata[len+2]=282;	vulde leliger (byte)						
sensor data[len+]]=[node sensor temp	hum>>14140vffr to the second						
	value(humidity)						
<pre>sensor_data[len+2]=(node_sensor_temp</pre>	hum>>16) 40xff;						
len++;							
sensor data[len+2]=0x3;							
len++; // lense bytes							
lentt:							
sensor data[len+2]=(node sensor voc							
sensor_data[len+2]=0x4;							
len++;							
len++:							
sensor data[len+2]=(node sensor voc							
sensor_data[len+2]=node_sensor_voc_c							



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