GlobalSat Worldcom Corp.

Knowing where & how

About GlobalSat

- Founded in 2000
- Cap: US$ 19M
- IPO since 2005
- H/C: 600

Headquarter

- New Taipei City, Taiwan
- RD Center
- Sales operation

Taiwan Factory

- New Taipei City, Taiwan
- Assembly, Testing
- 3,300 m^2

China Factory/Office

- Zengcheng, Guangzhou
- SMT, Assembly, Testing
- China Sales operation
- 35,000 m^2

USA Office

- Chino, California
- Sales/Service operation

Product Line

Sports & Outdoors

- Bike Computer
- GPS Watch
- Heart Rate Monitor
- Wrist band

Tracking

- Asset Tracker
- AVL Tracker
- Personal Tracker
- Accessory

IoT/M2M

- LoRa WAN
- RF Solution

Accessories

- GPS Module
- GPS Module-BDS, GLONASS
- GPS Receiver
- Others




GlobalSat WORLDCOM GROUP

Knowing where & how

GlobalSat WORLDCOM GROUP

Explore the Capabilities of LoRa

Feb, 2017

Knowing where & how

IoT Connectivity

RFID

ZigBee

Bluetooth

Wifi

LoRa™

4G

1 m

10 m

100 m

10,000 m

- Low data
- Very low power
- Very short distance

- Medium data rate
- Low power
- Short distance
- Paired

- Low data rate
- Low power
- Mesh structure

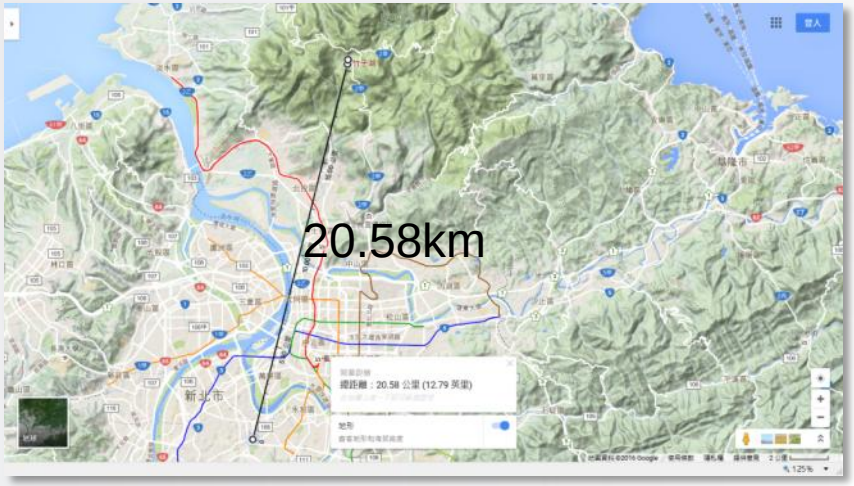
- High data rate
- Medium power
- Medium distance

- **Low data rate**
- **Very low power**
- **Long distance**
- **Low cost**
- **Star structure**

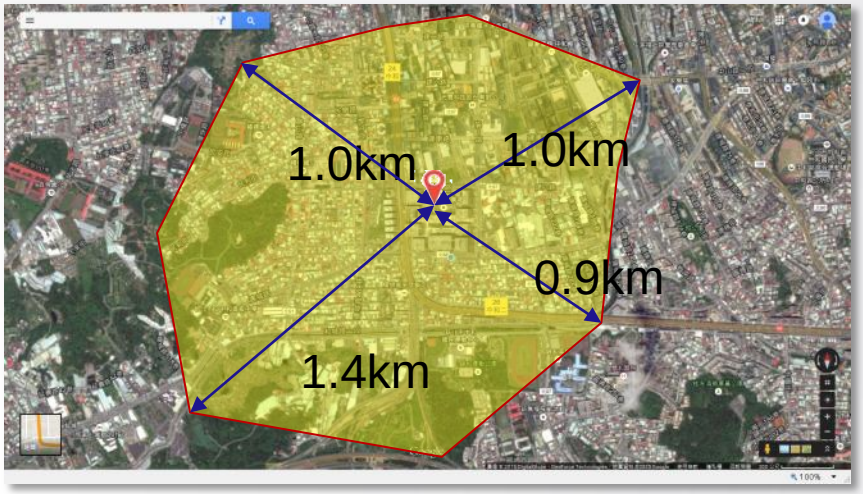
- High data rate
- High power
- Long distance
- Cell tower

LoRa Signal Coverage Test

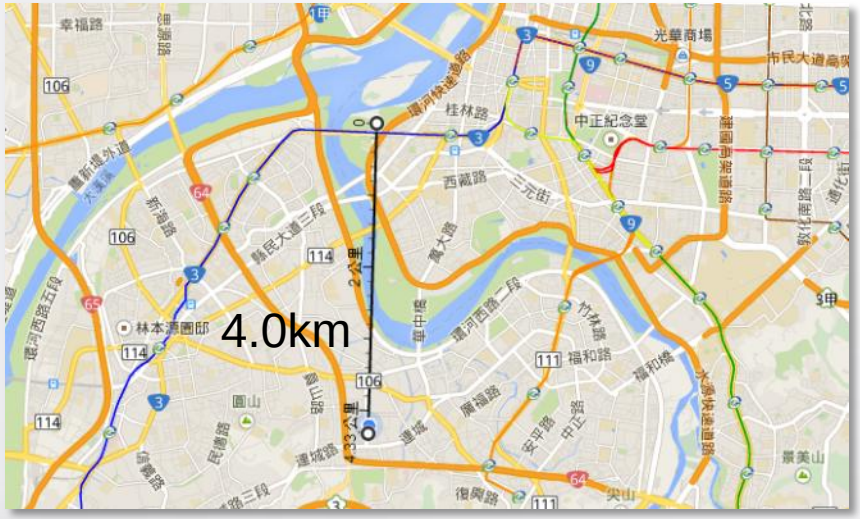
- Open air clear view: 20.58km (650m Yangming Mt. to 18F roof)



- Ground to ground in dense urban area: average 1.0km



- Top to ground in urban area: average 4.0km (16F to ground)

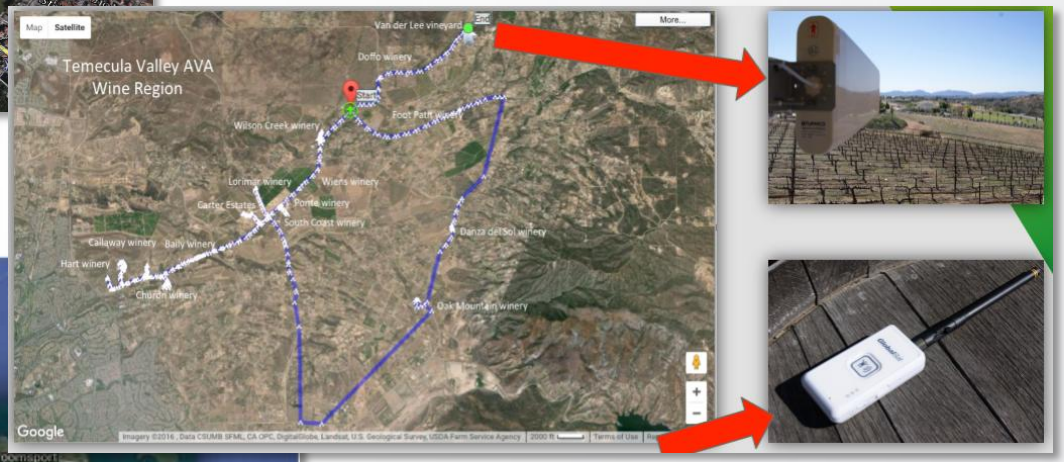


- In building: 16F to B1 parking penetration

Highlight of Field Test

Test at Busto, Italy by Eolo. 2.9km coverage.

- Thanks to our Partners for the test they made based on GlobalSat LoRa EVB/Tracker/Module



Test at Temecula Valley, CA/US by Reinier.
6 miles coverage

Test at Belfast, UK by Donard. 9.3km coverage.

IoT Deployment by Using LoRa Technology

LoRaWAN™ Public Network

- Open standard protocol
- Multi-sites/Multi-tenants deployment
- Backhaul Network Server required for Nodes mgt

LoRaWAN™ Private Network

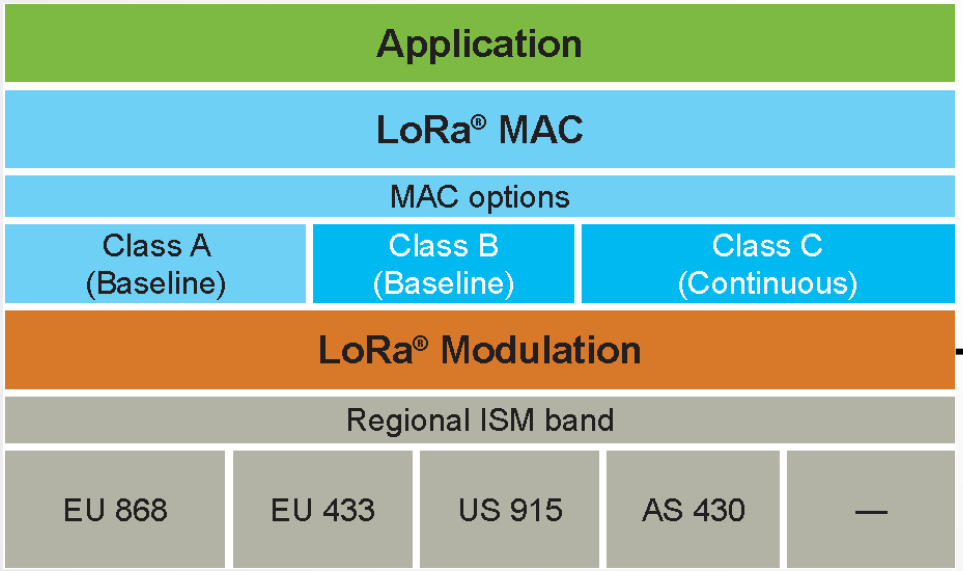
- Open standard protocol
- Single site deployment
- Integrated Gateway and Network Server

M.O.S.T. Private Network

- GlobalSat proprietary protocol
- Single site or P-to-P deployment
- PC tool and utility for Nodes mgt

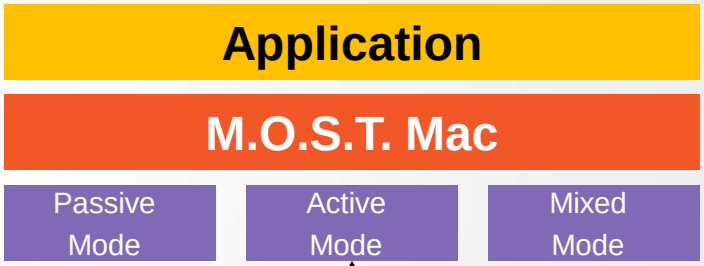
LoRaWAN vs M.O.S.T. Architecture

- LoRa Alliance Standard
- For IoT deployment
- Millions of access
- Well-established infrastructure



LoRaWAN™

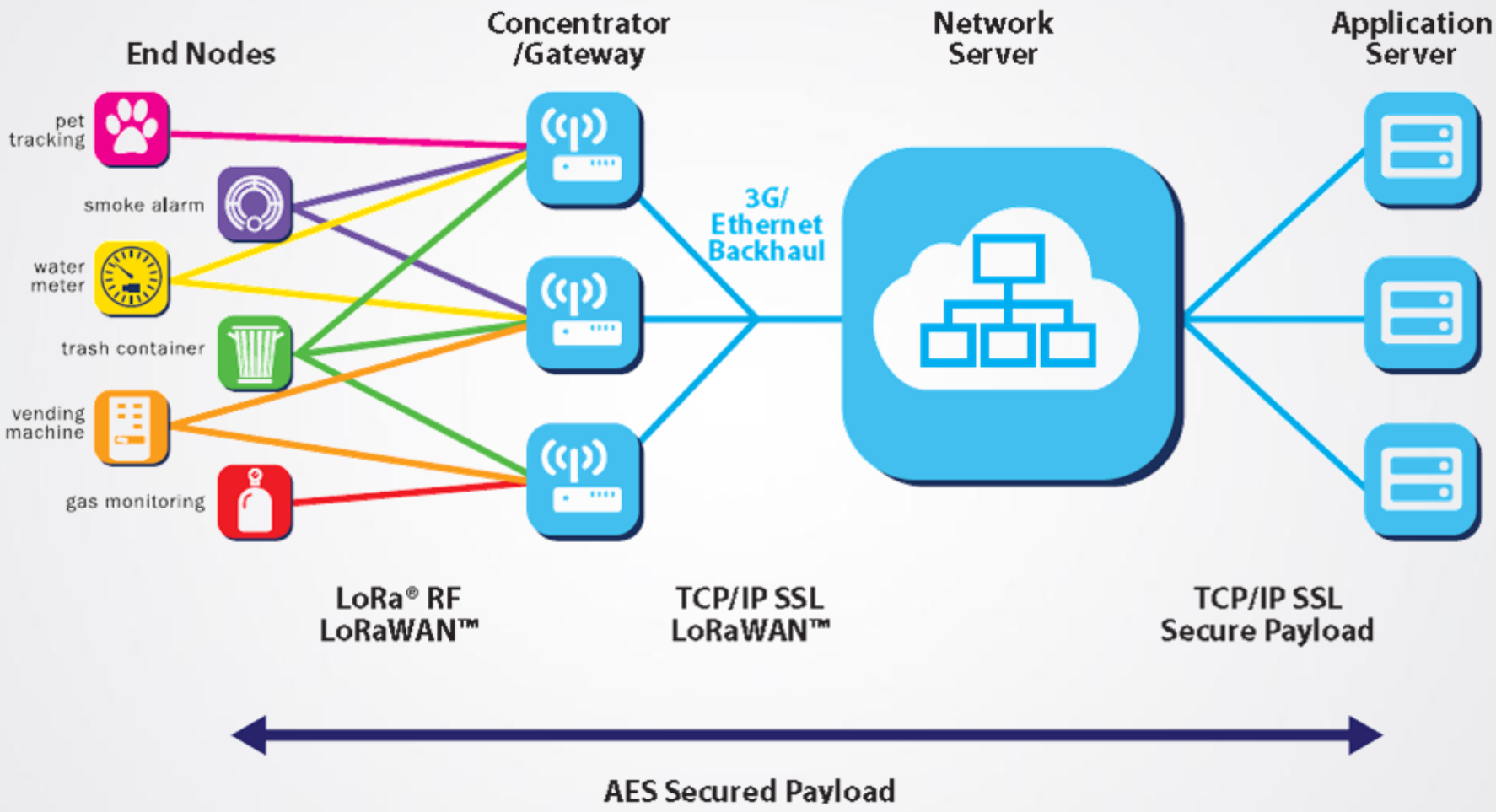
- Proprietary protocol
- For small group usage
- Limited access
- Low cost deployment



M.O.S.T.

LoRaWAN

LoRaWAN Architecture

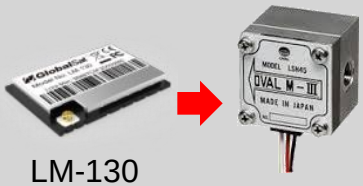


GlobalSat LoRaWAN Eco-system

Tracker Node

by GlobalSat

Sensor Node



LM-130

Module

by GlobalSat

Gateway

by 3rd Party

Network Server

LoRa™

by 3rd Party

Tracking Application

Webtrack2

ezfinder

iMOST™

by GlobalSat

Application Server

by 3rd Party

LM-130 LoRaWAN Compliant Module

Dimension: 25x18 mm

LD-11
• mPCIe module

LM-130 EVB
• Evaluation board

LM-130 Features

- LoRaWAN Compliant certified module
- Frequency: 902-928Mhz, 865-868MHz. A923Mhz, load with different profile
- Ultra-high sensitive receiving ability by LoRa spread spectrum modulation technology
- Maximal output power100mW(20dBm) · output power adjustable between 2-20dBm
- Long-distance transmission (1KM to 10KM)
- Built-in watchdog
- Accord FCC,ETSI, TELEC standard
- Optional:
  - Mini-PCI Express form factor
  - Evaluation board w/battery, sensor I/O, antenna

LM-130 H1 2-in-1 LoRa Module

Dimension: 25x18 mm

LD-11H1
• mPCIe module

LD-110H1
• Pin-type module

LM-130H1 EVB
• Evaluation board

LM-130 H1 features

- Built-in standard LoRaWAN and proprietary MOST FW in same module
- Share same PCB/device design for both LoRaWAN and RF data communication
- Choose LoRaWAN or MOST by PIN-out Hi/Low on PCB or AT-command by FW
- Pin-to-pin compatible with LM-130H
- LoRaWAN frequency: 902-928Mhz, 865-868MHz. AS923Mhz, load with different profile
- MOST RF frequency: 862Mhz – 1,020Mhz
- Accord FCC,ETSI, TELEC standard
- Optional:
  - Mini-PCI Express form factor
  - UART Pin-type module
  - Evaluation board w/battery, sensor I/O, antenna

LT-100H LoRa GPS Tracker

Dimension: 69.5x45.5x19.6 mm
Weight: 56g

Carry bag

Charging Station

LT-100H Feature List

- LoRaWAN compliant GPS Tracker
- Frequency: 902–928Mhz (H), 865-868MHz (E)
- Built-in 820mA rechargeable Li-on battery
- Built- in 3 axis accelerometer for motion detection
- Vibrating alert / Buzzer alert
- Built-in HELP button for emergency
- Power Low/Off alert
- Support both OTAA and ABP mode
- IPX7 water proof equivalent
- Optional:
  - Carry bag with belt holder
  - Multiple sets power charging station
- Application Server:
  - EzFinder platform & App for personal/pet/SMB tracking application
  - WebTraQ platform for commercial AVL/Asset tracking application

LT-100 Battery Cycle-time

- The following battery cycle-time is based on theoretical simulation when LT-100 is used under such conditions:
  - LT-100 is placed under open and clear sky, GPS can always be fixed in 15 seconds.
  - LT-100 is under warm-start condition, not to turn off during tests.
  - LoRaWAN: GPS payload is 11 bytes, ACK ON, ADR ON, ABP mode.
  - Battery capacity 820mA, run down 90% power.

Report Interval	Cycle-time (Hours)	Cycle-time (Days)
1 min	44	1.8
5 min	188	7.8
10 min	318	13.2
30 min	588	24.5
1 hr	748	31
6 hr	965	40
12 hr	995	41
24 hr	1,010	42

* Actual battery cycle-time varies from place-to-place and case-by-case. The above number is ONLY for reference.

LS-11x LoRa Sensor Node

LS-111 CO2

LS-112 CO

LS-113 PM2.5

LS-111 Carbon Dioxide CO_2 + Temp/Hum Node

- CO2 sensor: Gold-plated infrared (NDIR) wave-guide technology with Automatic Baseline Correction (ABC) and passive gas diffusion (no moving parts)
  - Accuracy ±30 ppm
  - Range 0 ~ 2000 ppm
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V
- Display CO2 concentration, Temp/ RH

LS-112 Carbon Monoxide CO + Temp/Hum Node

- CO sensor: electrochemical sensor
  - Accuracy ± 5% or ±20ppm
  - Range 0 ~ 500 ppm
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V
- Display CO concentration, Temp/ RH

LS-113 Particles (PM2.5) + Temp/Hum Node

- Dust Particles sensor: laser light scattering principle
  - Accuracy µg/m3
  - Range 0 ~ 500 µg/m3
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V

Dimension: 113.57(H) x 80(W) x 28.79(D) mm

LoRaWAN Inter-operability

- GlobalSat has worked with following 3rd Parties, and the list is growing..

Test Status	Gateway	Network Server	Application Server
LoRaWAN compliant or certified	Kerlink Multitech Link-lab Haxiot Foxconn Gemtek IMST Cisco Tektelic Kiwi	Actility Loriot Orbiwise Flashnet Everynet The Things Network Stream Sagemcom	WebTraq EzFinder iMOST myDevices ThingPark SentrolCloud Stream HPE

Fit-in Your LoRaWAN

FW Pre-setting

- Your GW/NS
- Verify your setting
- Fill in your Ch Plan
- Pre-load profile in module/node
- Delivery
- Onsite AT-Command setting

Questionnaire

2. Network Server NS1: _____
NS2: _____
NS3: _____

3. Gateway: GW1: _____ **Model Name:** _____
GW2: _____ **Model Name:** _____
GW3: _____ **Model Name:** _____

4. Class: _____

5. Please check if the setting vaules below are the same as yours.
(If **NOT**, please go to item 6.)

		DR0~5 (EU) / DR0~3 (US)				DR6 (EU) / DR4 (US)			RX2			
Check	Region	Channel Frequency (MHz)				Bandwidth (kHz)	Frequency (MHz)	FSK (kHz)	Frequency (MHz)	DR	SF	Bandwidth (kHz)
☐	EU	CH1	868.1	CH5	867.3	250	868.3	868.8	869.525	DR0	12	125
		CH2	868.3	CH6	867.5							
		CH3	868.5	CH7	867.7							
		CH4	867.1	CH8	867.9							
☐	US	CH1	902.3	CH5	903.1	500	903.0		923.3	DR8	12	500
		CH2	902.5	CH6	903.3							
		CH3	902.7	CH7	903.5							
		CH4	902.9	CH8	903.7							

6. Please assist in completing the table below at your request.
(If your setting is the same as our standard above, please skip this item and go to item 7.)

		DR0~DR5 (EU) / DR0~DR3 (US)				DR6 (EU) / DR4 (US)			RX2			
	Region	Channel Ferqency (MHz)				Bandwidth (kHz)	Frequency (MHz)	FSK (kHz)	Ferqency (MHz)	DR	SF	Bandwidth (kHz)
Network Server		CH1		CH9								
		CH2		CH10								
		CH3		CH11								
		CH4		CH12								
		CH5		CH13								

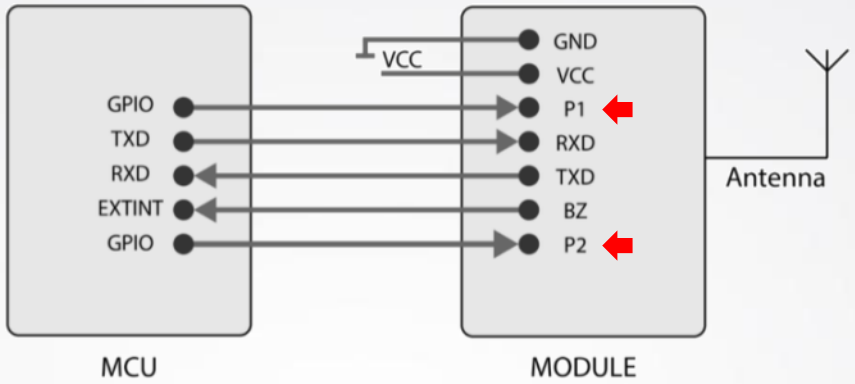
M.O.S.T.

M.O.S.T. Eco-System

Node	Gateway	Network Utility	Applications

M.O.S.T. Operating Mode

Application circuit



LM-230
LM-130H1

• By properly programming P1 and P2 pin from external MCU, this LoRa module will be operated as a Modem under various application scenarios.

M1 **Mode 1: Normal mode** Set P1=0, P2=0 ✓Open for communication.	**M2** **Mode 2: Wake-up mode** Set P1=0, P2=1 ✓Set Gateway to wake up End Nodes and receive data
M3 **Mode 3: Power-saving mode** Set P1=1, P2=0 ✓Set End Node to sleep and wait for Gateway to call	**M4** **Mode 4: Setup mode** Set P1=1, P2=1 ✓Set up parameters for Gateway and End Node or deep sleep

Use of M.O.S.T. - P2P Application

- Simply setup and open the communication channel between both sides.
- Data is transmitted freely between two sides, as Peer-to-Peer operation.

P2P Scenario

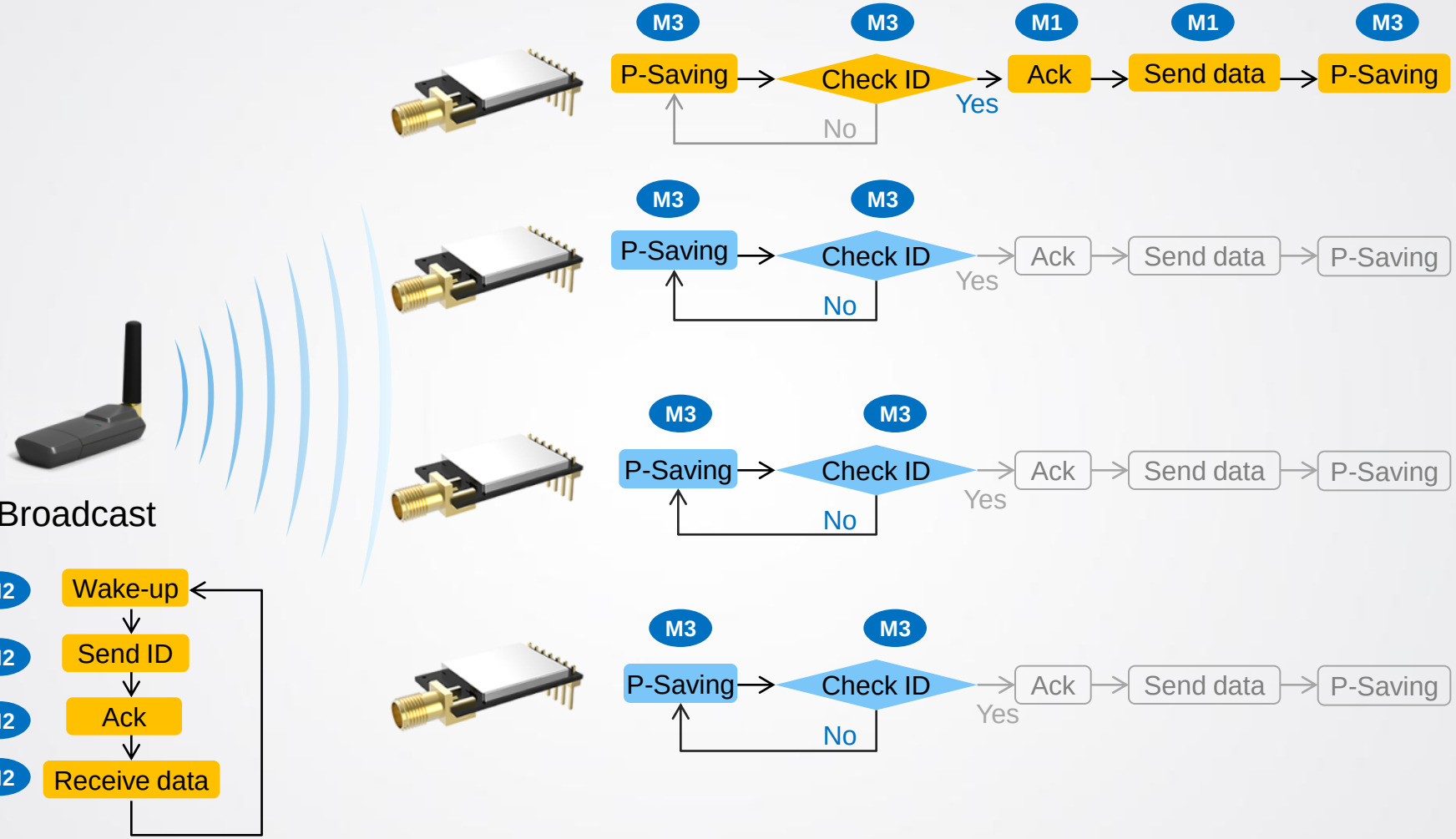
LoRa™

Pet tracker

Receiver

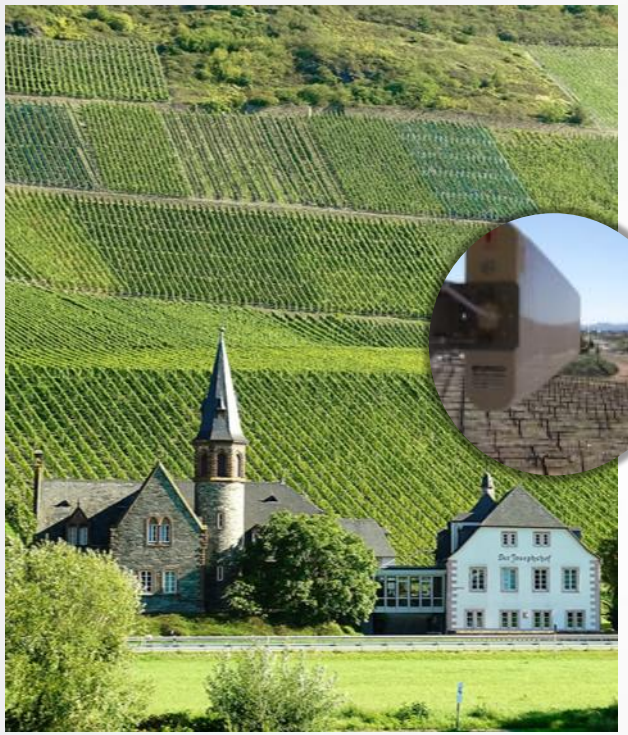
Motorbike
Anti-theft tracker

Use of M.O.S.T. - Passive Polling

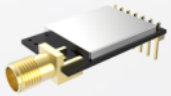


- Gateway broadcasts signal to all End Nodes, and only the matched-ID will reply.
- End Nodes wake-up to listen to broadcasting signal periodically.

Passive Polling Scenario



Gateway

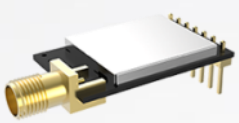


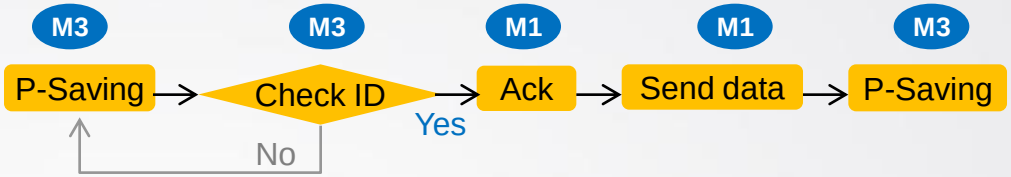
Moisture sensor

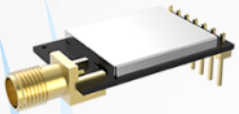
Use of M.O.S.T. - Polling + Trigger

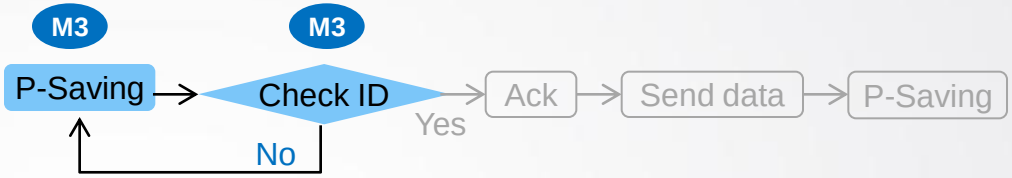
Ch 1: for regular use

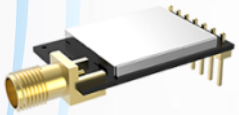
Ch 2: for emergency use

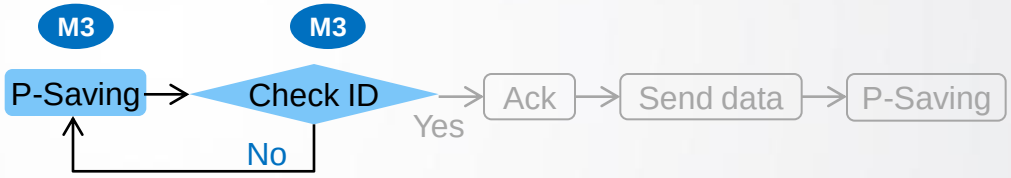


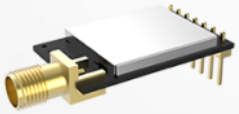


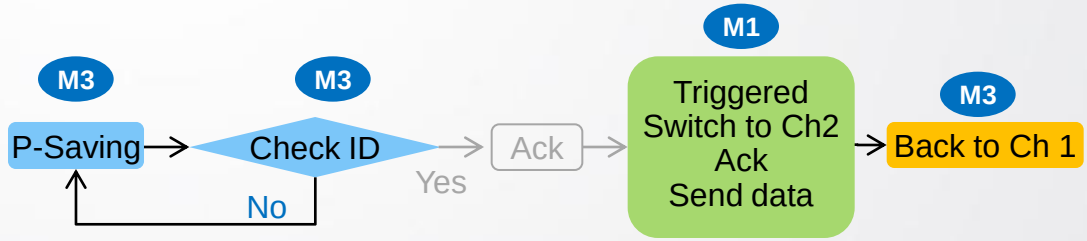


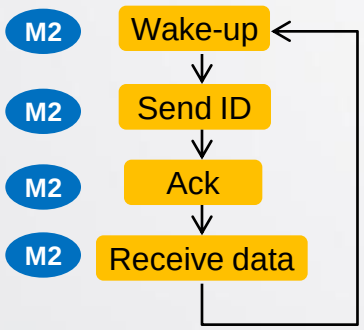










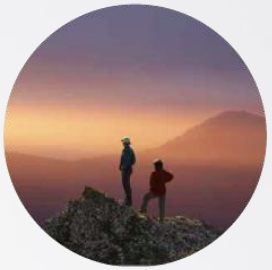


- While regular polling is taking place, an Alert triggered at End Node can be sent to Gateway at Channel 2, to avoid channel conflict with regular channel.
- This requires two LoRa modules at Gateway side, and End Node module be set to Ch 2 when triggered.

Polling & Trigger Scenario

Gateway
@ base

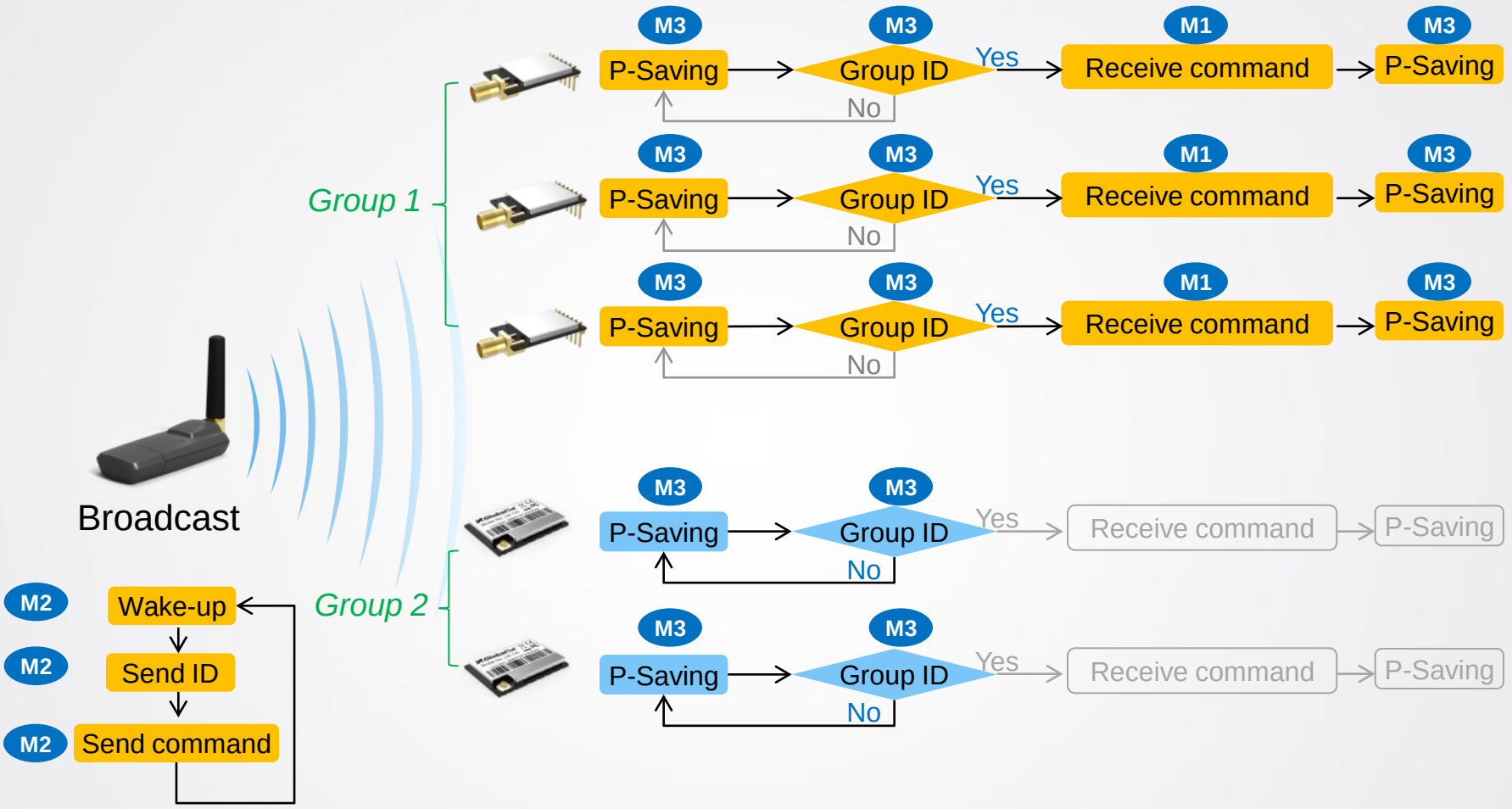
Security tracking



Individual record
@ polling

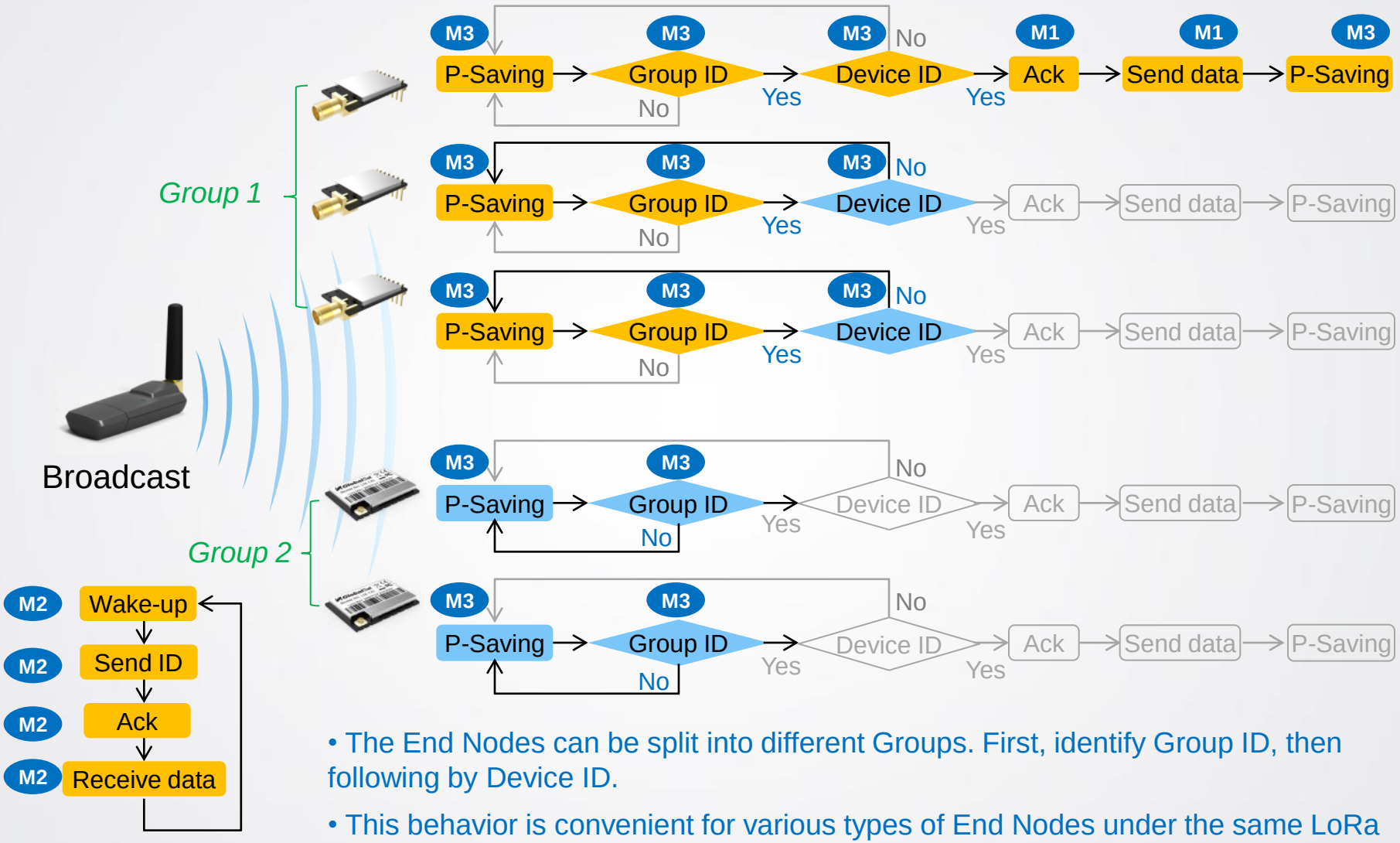
Help button
@ trigger

Use of M.O.S.T. – Group Command



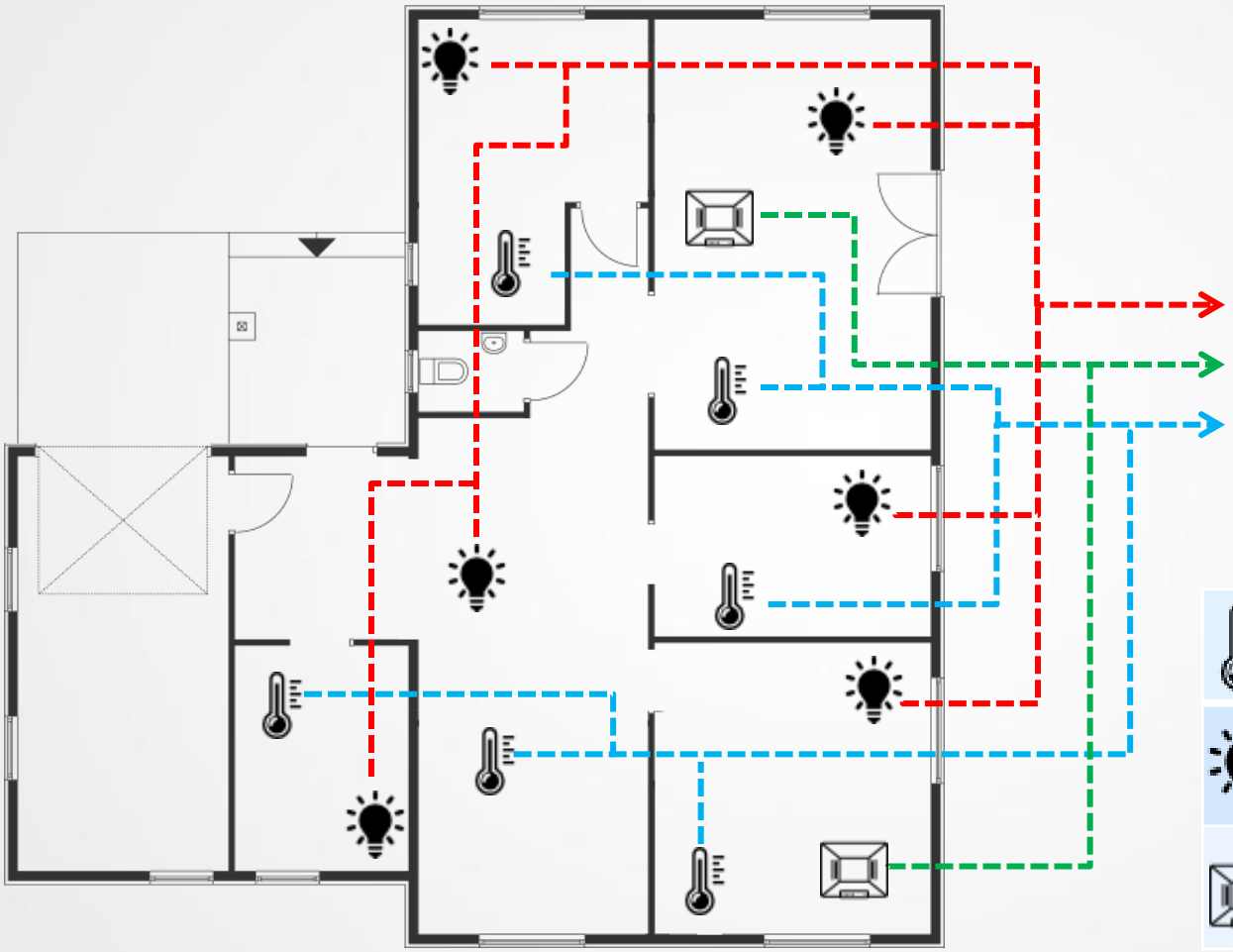
• User can group End Nodes into several groups, so only Nodes in the same Group will respond to the call, no need to identify individual Device ID.

Use of M.O.S.T. – Grouping + Polling



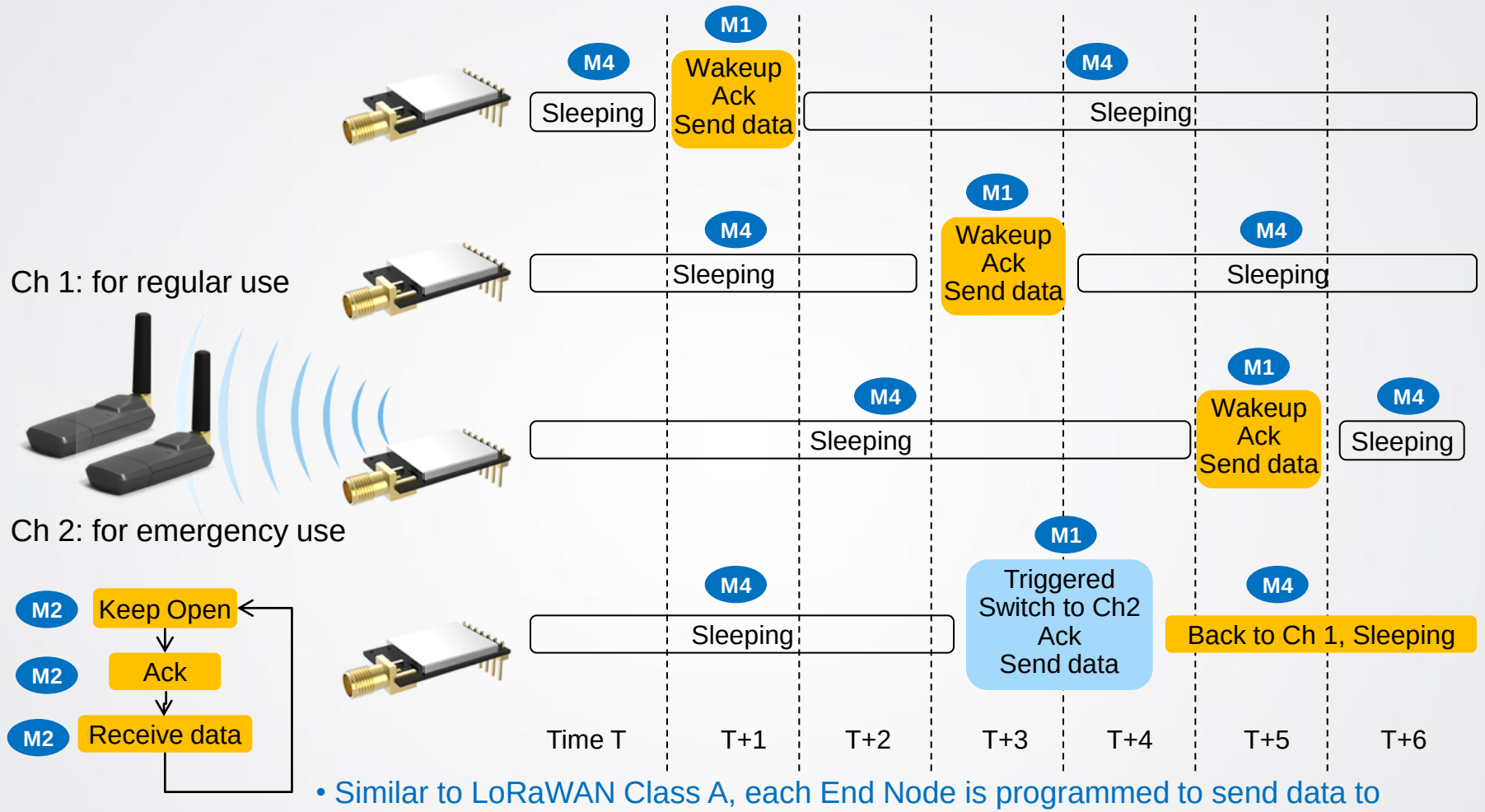
- The End Nodes can be split into different Groups. First, identify Group ID, then following by Device ID.
- This behavior is convenient for various types of End Nodes under the same LoRa umbrella.

Grouping & 2-tier Mgt Scenario



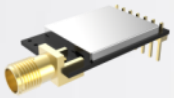
	Group 1:Temperature sensor
	Group 2: Lighting control
	Group 3: Smoke alert

Use of M.O.S.T. - Active + Trigger

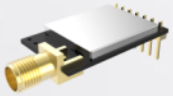


- Similar to LoRaWAN Class A, each End Node is programmed to send data to Gateway at different time slot and only be activated at the designated time and remains idle otherwise, tremendous saving of power.
- In case of Alert at End Node, jump to Ch 2 to send alert signal back to Gateway to avoid channel conflict with other Nodes.

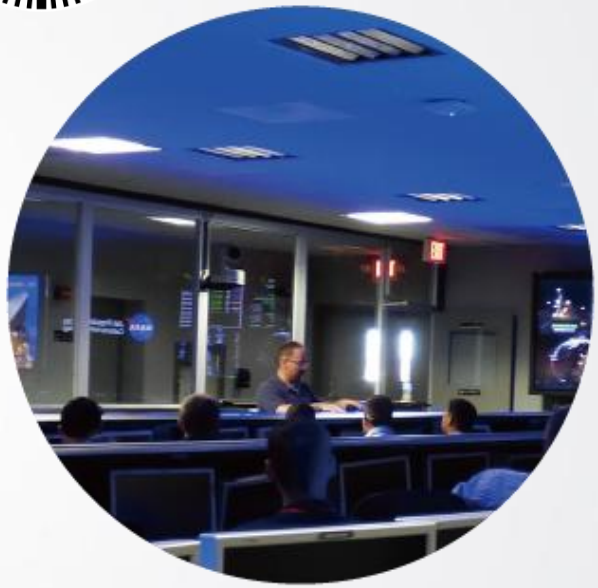
Active Mode Scenario



Electricity meter



Gas meter



Control Center

M.O.S.T. Configurations

- Accessible and/or configurable parameters of MOST-Link:

	Item	Description
1	Module model name	In Flash, non-changeable
2	FW version	In Flash, non-changeable
3	Group ID	Max 255 groups, default=0 for disabling group function
4	LoRa unique ID	Use last 8 bytes of MCU ID as unique ID
5	RF frequency	in KHz, default=915000
6	RF transmission rate	0.81Kbps ~ 18.23Kpbs, default=4.56 Kbps
7	RF power	0 to 7 grade, incremental @ 2 dBm, max 7=20 dBm
8	UART baud rate	1200~56000 bps, default=9600 bps
9	UART parity check	Check sum
10	Wake-up time	50 msec ~ 5 sec, default= 1 sec

LM-230 M.O.S.T. RF Module

Dimension: 25x18 mm

LD-20 USB Dongle

LM-210 Pin-type module

LM-230 Features

- M.O.S.T. proprietary protocol for LoRa RF
- Frequency: 862Mhz – 1,020MHz
- Ultra-high sensitive receiving ability by LoRa spread spectrum modulation technology
- Maximal output power100mW(20dBm)，output power adjustable between 2-20dBm
- Long-distance transmission (1KM to 10KM)
- Built-in watchdog
- Accord FCC,ETSI standard
- Optional:
  - USB Dongle for PC/NB
  - UART Pin-type module

LT-200H/E M.O.S.T. GPS Tracker

Dimension: 69.5x45.5x19.6 mm
Weight: 56g

Carry bag

Charging Station

LT-200H Features

- M.O.S.T. proprietary protocol for LoRa RF
- Frequency: : 862Mhz – 1,020MHz
- Built-in 820mA rechargeable Li-on battery
- Built- in 3 axis accelerometer for motion detection
- Vibrating alert / Buzzer alert
- Power Low/Off alert
- IPX7 water proof equivalent
- Optional:
  - Carry bag with belt holder
  - Multiple sets power charging station
- Application Server:
  - EzFinder platform & App for personal/pet/SMB tracking application
  - WebTraQ platform for commercial AVL/Asset tracking application

LG-S201 M.O.S.T. Station Gateway

146 x 104.6 x 47 mm

LG-S201 Features

- M.O.S.T. proprietary protocol for RF Tx/Rx and internet connection, web monitoring
- Frequency: 862Mhz – 1,020MHz
- Android over ARM-based Platform
- HDMI output
- USB I/F for KB/Mouse
- Micro SD Card slot
- 2x LoRa mini-PCIe slots
- Built-in WiFi 2.4GHz, 802.11 b/g/n
- Built-in Ethernet (RJ45)
- Optional:
  - 4G communication module (mPCIe slot)

LG-M202 M.O.S.T. Pocket Gateway

67 x 40 x 13 mm

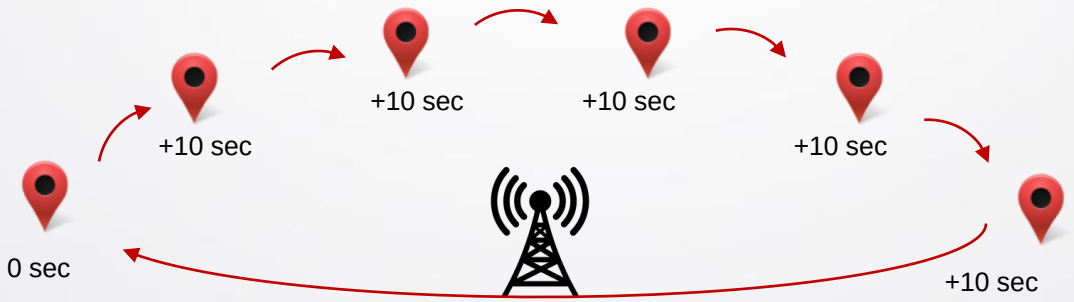
LG-M202 features:

- LoRa and BLE signal interchange device
- Support proprietary M.O.S.T. command set & MOST-Link protocol
- Support iOS and Android utility for smartphone
- Two LoRa channels, 1 for Tx/Rx (as regular channel), 1 for Rx (as emergency channel), based on SX-1272
- BLE connectivity with smartphone at slave mode
- Built-in 500mA rechargeable battery w/micro USB connector
- Stage I (Apr'17): for EzFinder App and LT-200/300 GPS tracker
- Stage II (Q3'17): utility/tool for other end-node devices and smartphone App
- Optional:
  - Clipping Holder for holding at fixed position

M.O.S.T. Management Scale

- Typical access time per command per Node is 10 sec for 2-way communication between Gateway and Node.
- The maximum Nodes number per Gateway is limited by the cycle time that each Node is accessed to Gateway.
- The more complexity of Nodes installation, the more error or failure may occur during data transmission. Within LoRa transmission range, the successful rate is over 90%. MOST can be configured to recover failure by re-send or switching frequency.

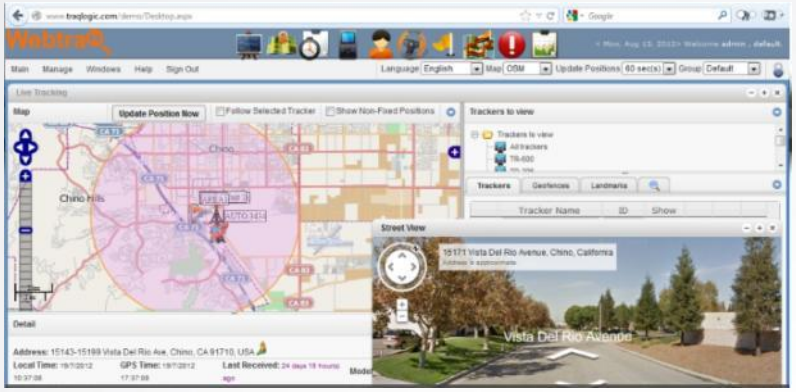
Report Cycle Time	per Minute	per Hour	per 12 Hour	per Day
Max Nodes per Gateway	6	300	3,750	7,750



1 min cycle time for 6 Nodes

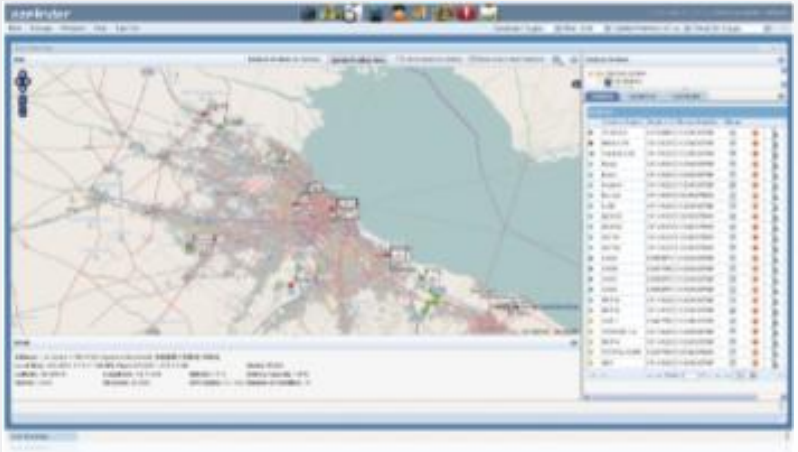
Application

Application Service: Tracking



WebTraq	EzFinder
Commercial tracking platform	SMB/Personal tracking platform
•Multiple tracking setup	
•Maps, street view, landmark	
•Geo-fencing, various alerts	
•Support LoRa & GSM trackers on same platform	
•Multi-layer management	•Simplified mgt and report layer
•Comprehensive report	•Fit in personal or small scale use
•Customizable UI	•App for smartphone/pad

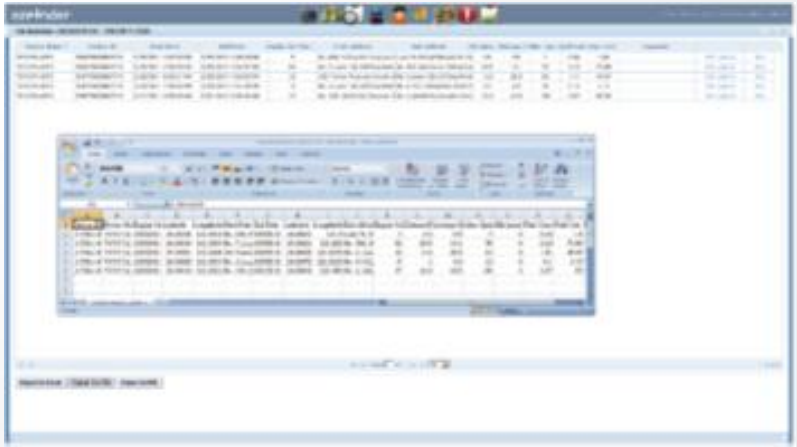
EzFinder Introduction



Real Time Tracking

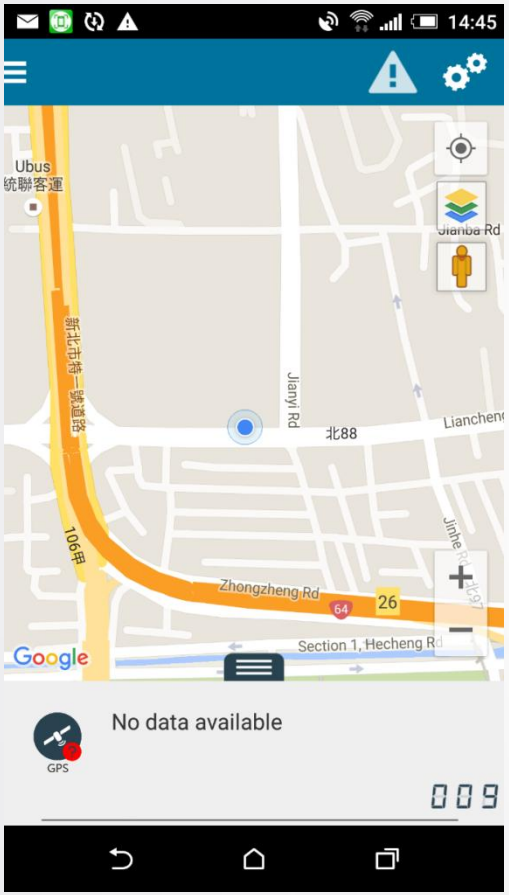
Route History

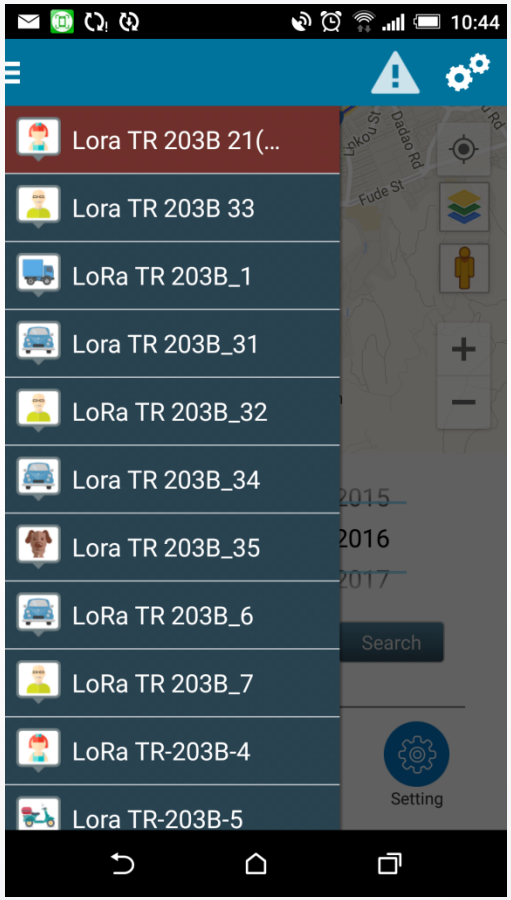
Geofences

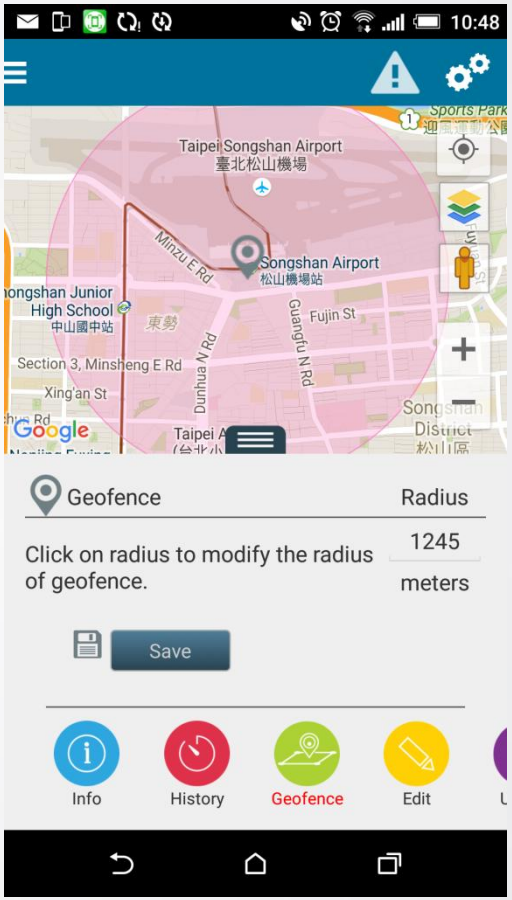


Different Report Types

EzFinder App

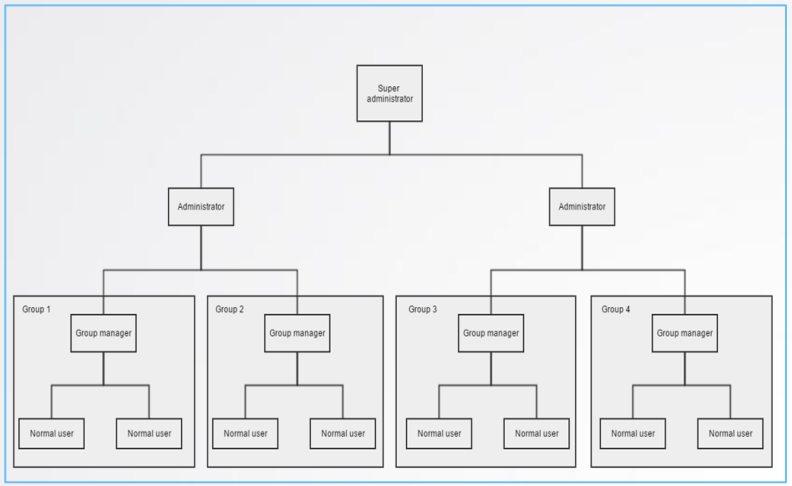




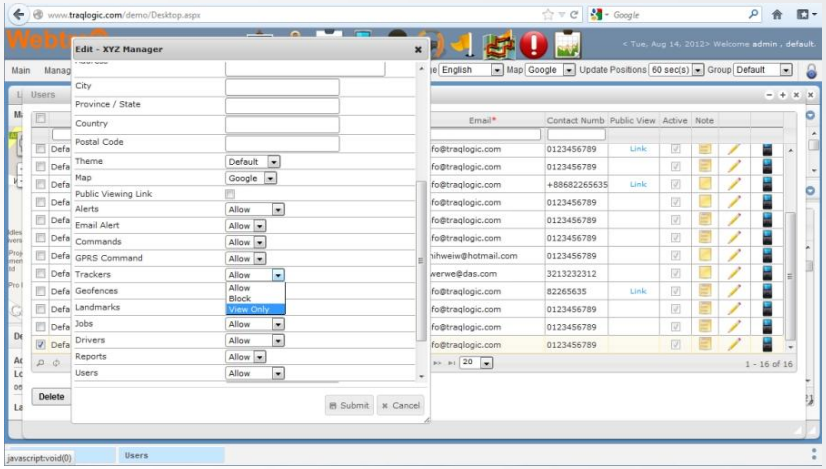


- Find location
- Multi objects
- Geofencing

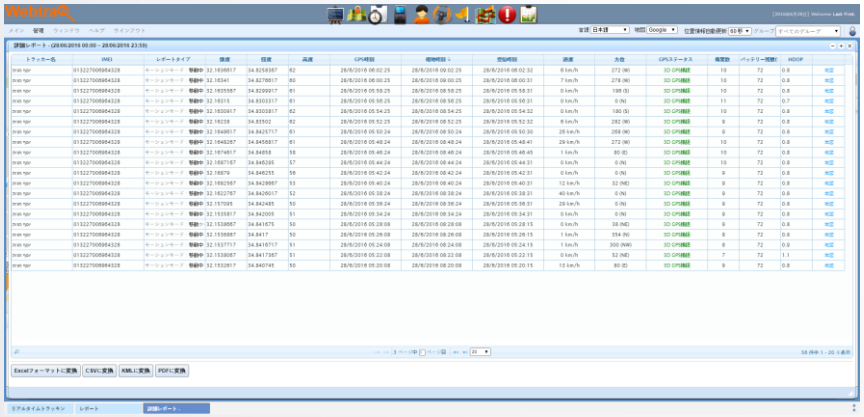
WebTraq Additional Features



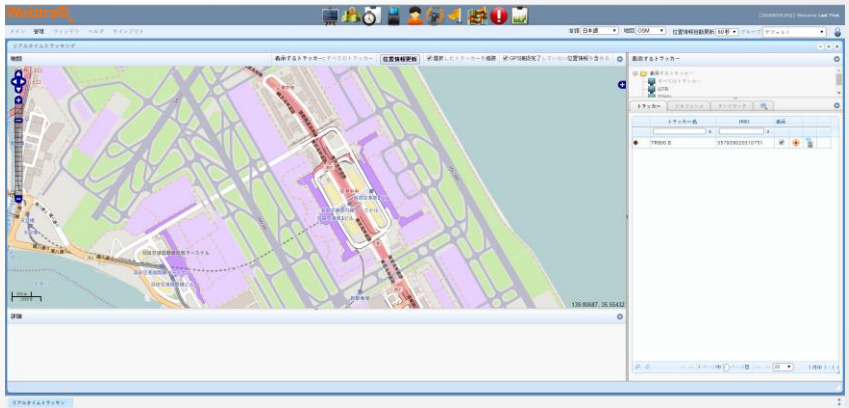
Multi-layer management



User access privilege control



Multi-lingual support



Various map data format

EzFinder & WebTraq Biz Model

WebTraq	EzFinder
Commercial tracking platform	SMB/Personal tracking platform
• Cloud-based Host Service - Per tracker annual service fee - MOQ: 20 sets - Customizable	• Cloud-based Host Service - Free for real time tracking for registered tracker - Charge for historical data access w/ on-line payment
• Local license & server installation - One-time license fee - Annual maintenance fee - Qty-based license	• App for smart phone - Free download

Application Service: Group Security

iMOST™

interactive **M**oving **O**bject **S**ecurity & **T**racking

An Application Service specifically designed for a Group of People

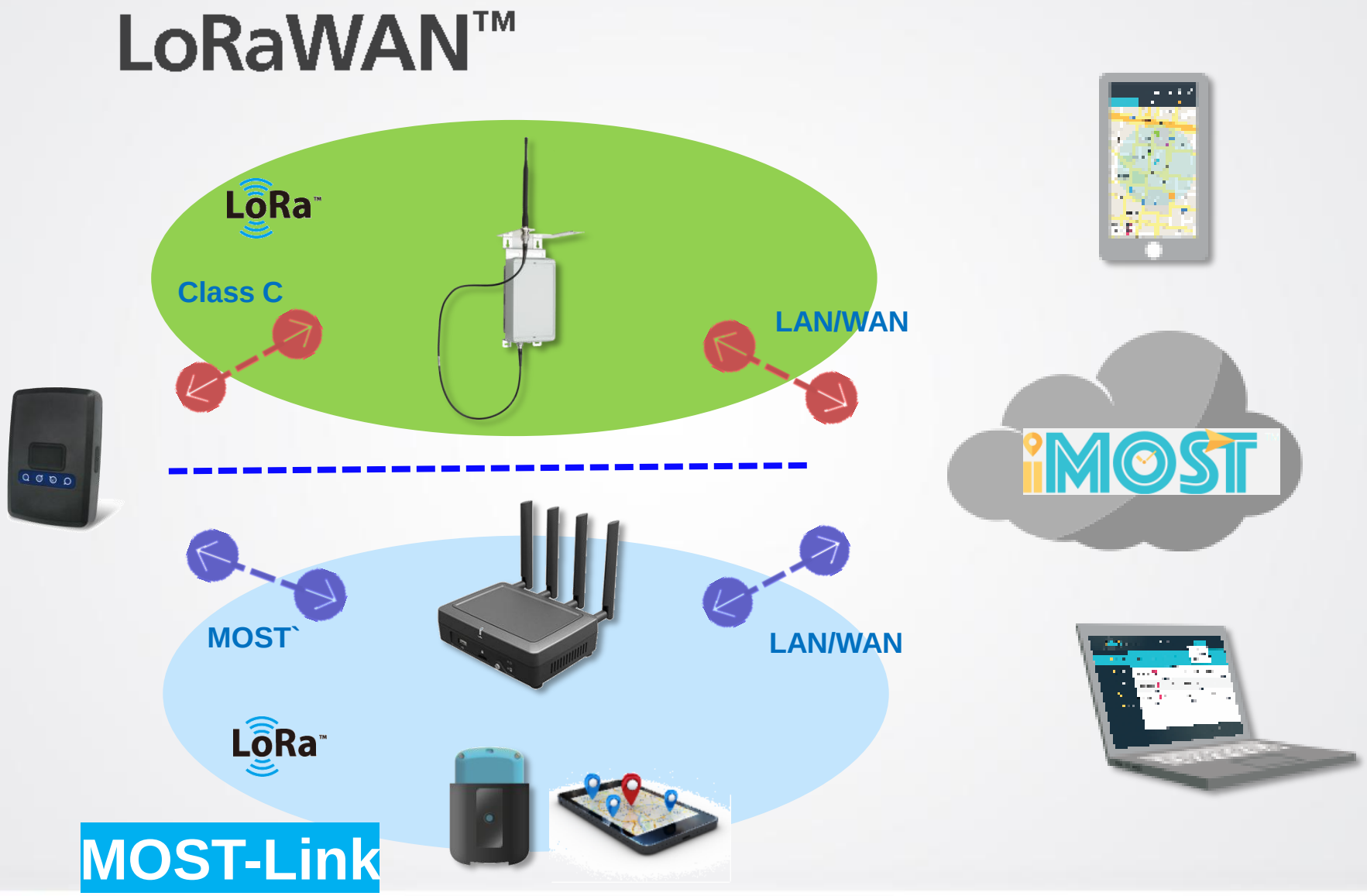
Mgt by team & individuals

Security monitoring

Call Help or Alert

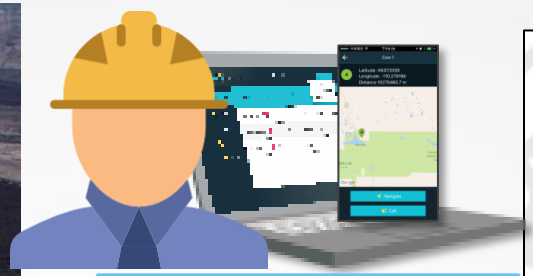
Guide to help

iMOST System



Mountaineer Security

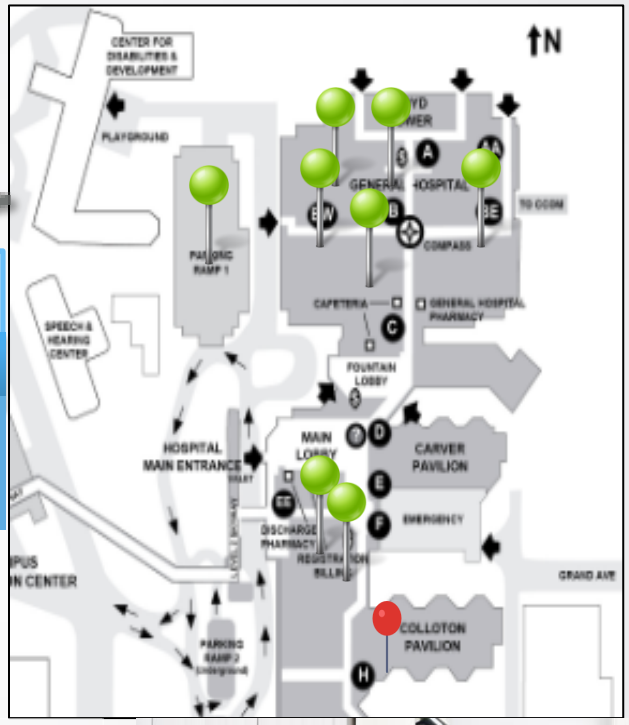
Hazardous-zone Worker Security



Team Lead

Web, Mobile App

- Team Management
- Member tracking
- Receive Help Request



Workers

Tracker, Sensors

- Report Location, Sensor information
- Send Help Notification

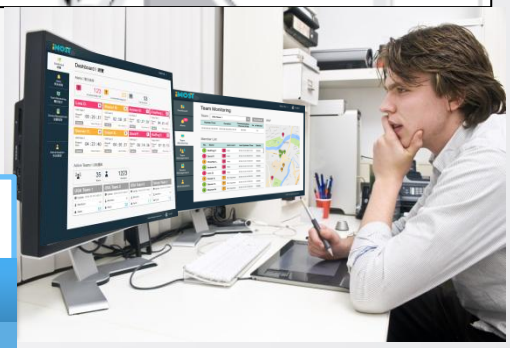
Report location
Sensor Info.

Help !!

Security Guard

Gateway

- Group roll call
- Group tracking
- Receive HELP request



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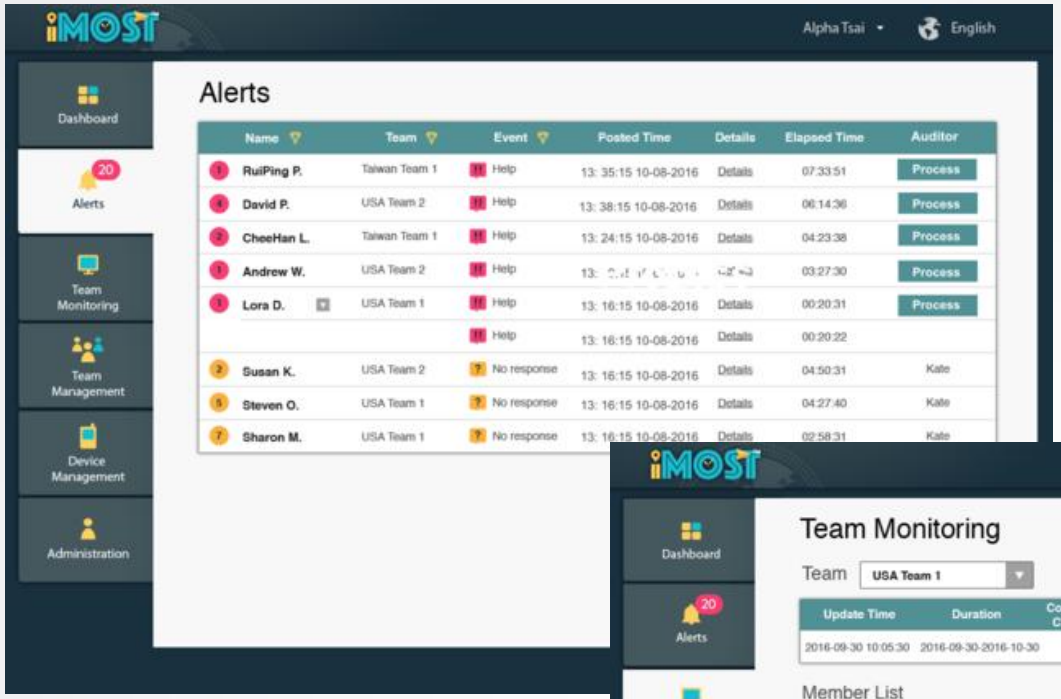
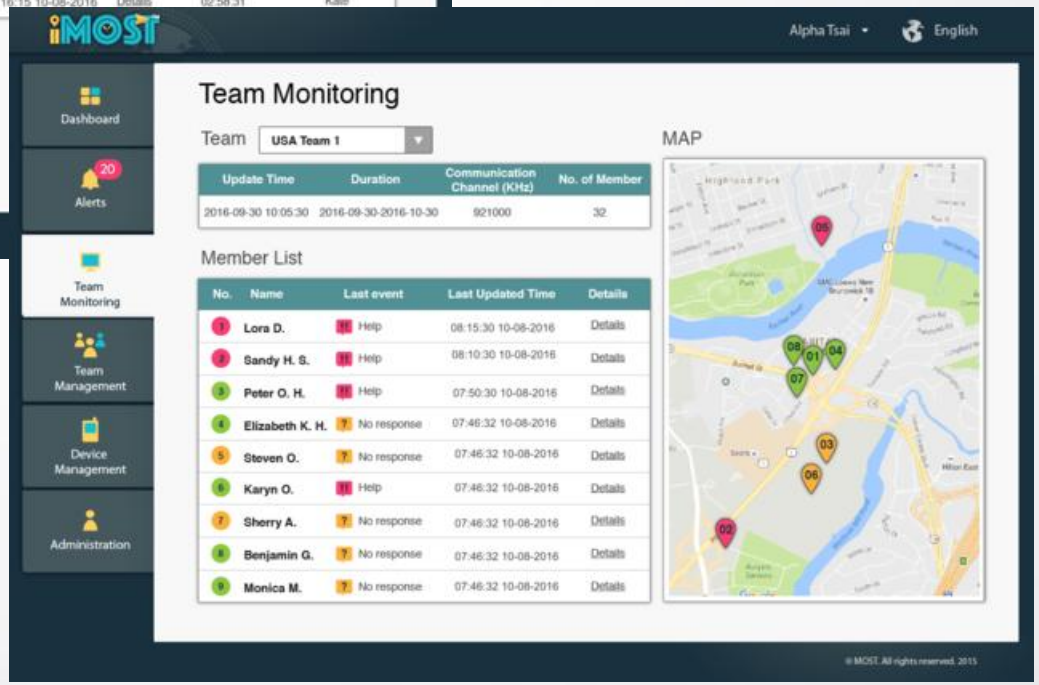
Knowing where & how

iMOST Supervising Dashboard

iMOST Management Panel





Alerts

Provides you…

- **Who** needs help
- **What** happened?
- **When** alert reported
- **How long** it takes (to process)

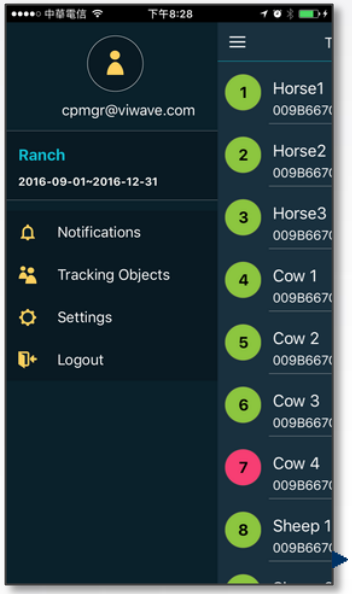
Team Monitoring

Provides you…

- **Overview** of member status
- **Location** of each individual
- **Who** needs help

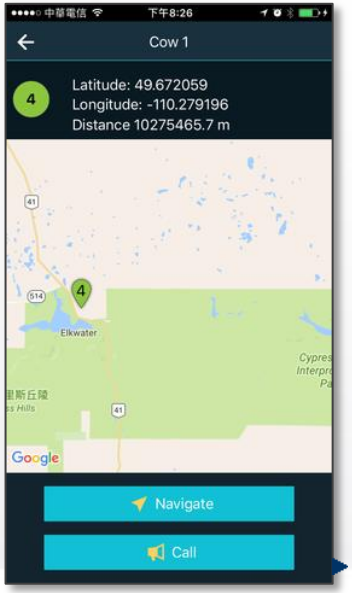
iMOST App for Smartphone

Login page

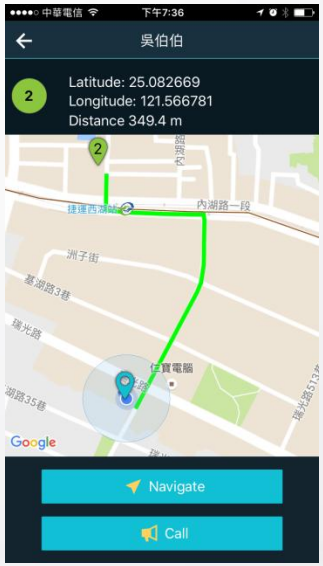


Member list

Member Location



Locate individual.



Guide to help

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Knowing where & how

Experiencing LoRa & Building Up LoRa

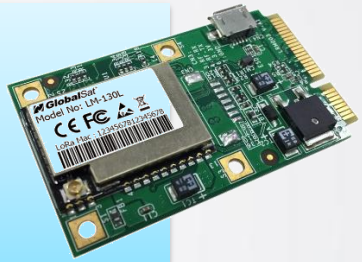
Tools & Utilities for Various Platform

For PC/NB

- LD-20 USB Dongle
- For M.O.S.T. system
- Turn your PC/NB into a single channel LoRa Gateway

For Embedded System

- LD-11/22 Mini PCI Express form factor
- For LoRaWAN and M.O.S.T. system
- Bridge LoRa signal with your system/device

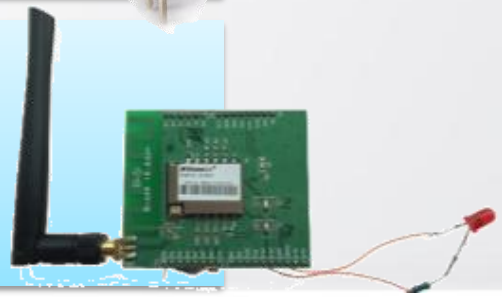


For Raspberry Pi

- LM-110/210 PIN out through UART
- For LoRaWAN and M.O.S.T. system
- Easily hook up to your board for quick design

For Arduino

- LoRa Shield for Arduino platform
- For LoRaWAN and M.O.S.T. system
- For Makers, Trainee, Designer quick deployment



LoRa Evaluation & Development Kit

LoRaWAN Evaluation Board (EVB)

- LoRaWAN compliant module
- 820mA rechargeable battery
- Temp/Humility sensor
- Push button trigger
- LED status indication

✓ For coverage and loading test
✓ For GW & NS inter-operability test
✓ For pre-deployment evaluation

M.O.S.T. Evaluation Kit (EVK)

- 1x LoRa USB Dongle
- 2x LoRa GPS Tracker
- Evaluation SW package
- EzFinder account

✓ For coverage and loading test
✓ For pre-deployment evaluation

M.O.S.T. Development Kit (DVK)

- 2x LoRa USB Dongle
- 5x LoRa module LM-210
- Schematic and pin out
- Development SW kit

✓ For engineer study and deployment

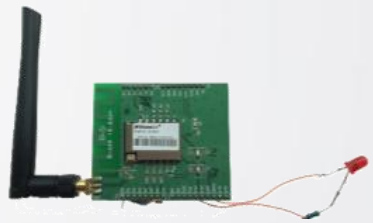
LoRa Starter Kit

LoRa Starter Kit

✓ For Maker, Developer, Research, Training
✓ Full set of tools, ready-for-use, easy-to-go
✓ For Arduino, Raspberry Pi, LinkIT One

- LoRa Gateway EVB
  - 2x LoRa RF channels
  - Built-in LAN & WiFi
  - 1x mPCIe slot, 1x USB port
  - HDMI output
- LoRa Shield
  - Support Arduino, Raspberry Pi and LinkIt ONE
- Arduino Uno
- Temp/humidity sensor & LED kit
- MOST-Link SW Package and Cloud Platform
  - LoRa configuration utility
  - Provide sample code and library for Node, Gateway, Cloud Server and Mobile App
  - Support AES 128 encryption
  - Support bi-direction control between Node, Gateway and Cloud Platform


• Gateway EVB

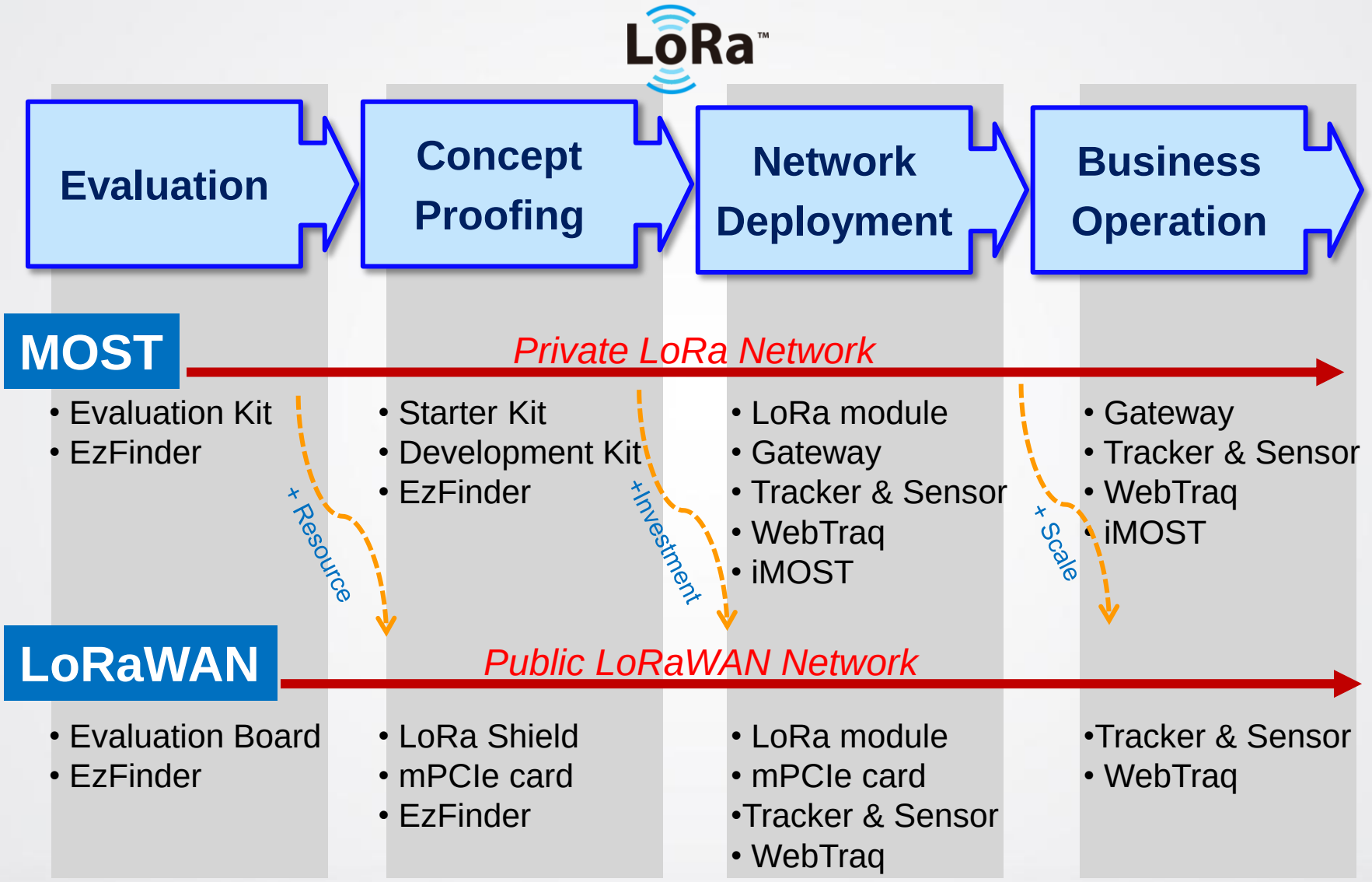

• LoRa Shield


• Arduino Uno

• SW Package


• Sensor Kits

Step Forward



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Thank You!