GlobalSat WORLDCOM GROUP

Explore the Capabilities of LoRa

Sep 02, 2016

Knowing where & how

IoT Connectivity

RFID

Bluetooth®

ZigBee®

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

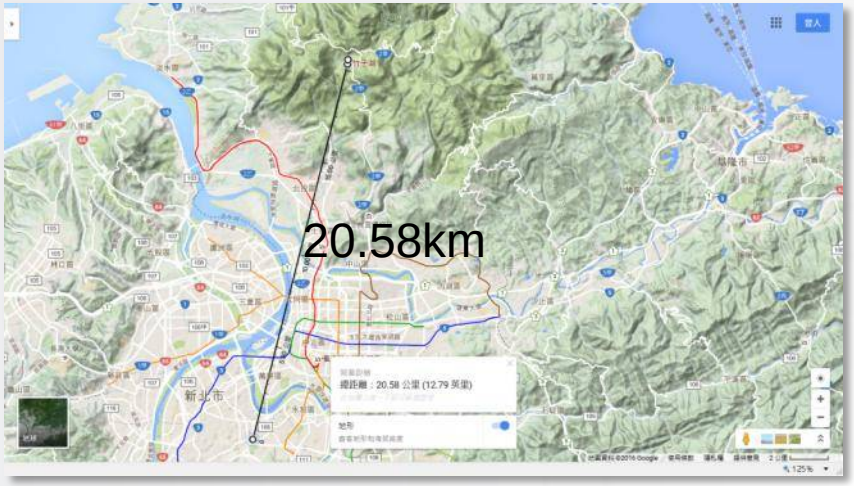
- High data rate
- Medium power
- Medium distance

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

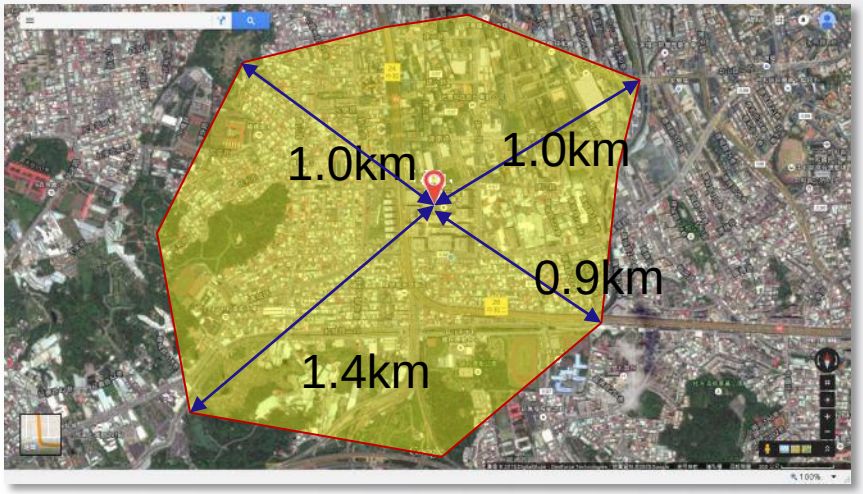
- High data rate
- High power
- Long distance
- Cell tower

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



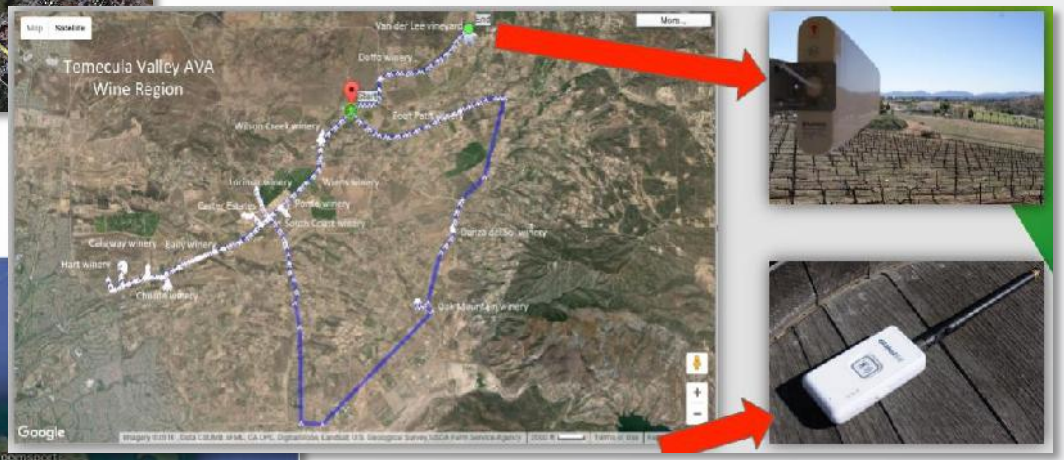
- Top to ground in urban area: average 4.0km (16F to ground)

- 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 Tamecula Valley, CA/US by Renier.
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

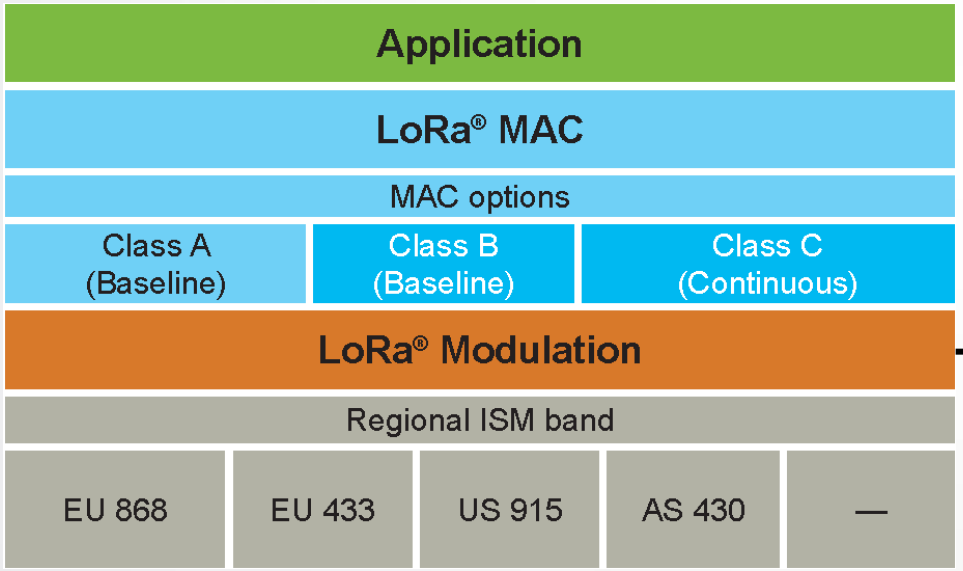
- Open standard protocol
- Single site deployment
- Integrated Gateway and Network Server

M.O.S.T. Private Network

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

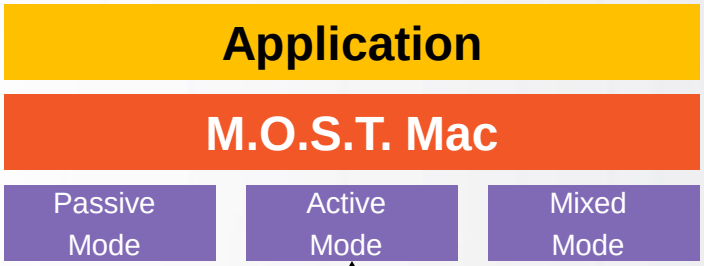
LoRaWAN vs M.O.S.T. Architecture

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



LoRaWAN™

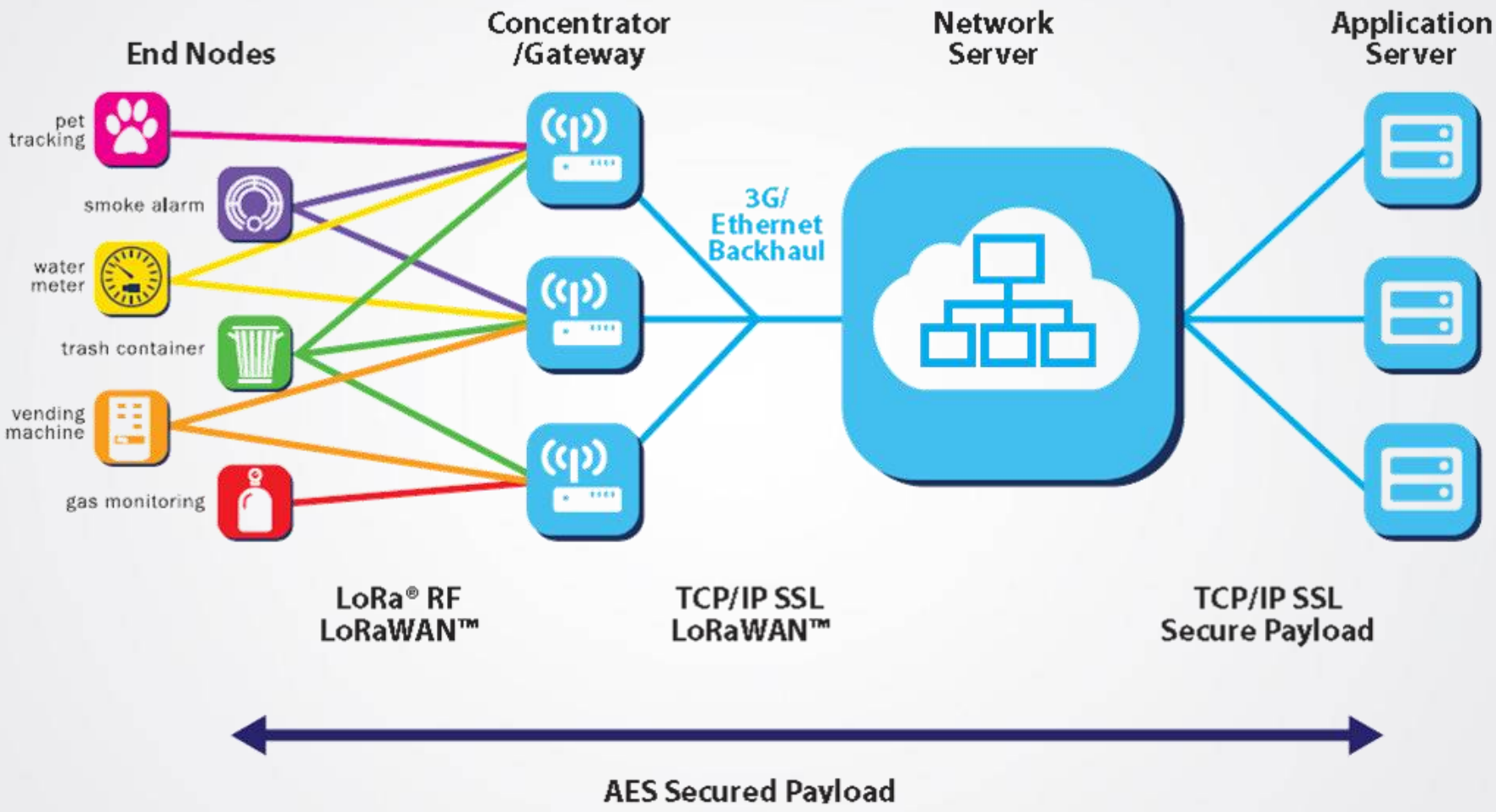
- Proprietary protocol
- For small group usage
- Limited access
- Low cost deployment



M.O.S.T.

LoRaWAN

LoRaWAN Architecture



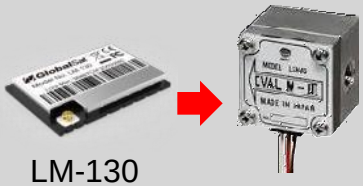
GlobalSat LoRaWAN Eco-system

Tracker Node

LT-100

by GlobalSat

Sensor Node



LM-130

Module

by GlobalSat

Gateway

by 3rd Party

Network Server

LoRa™

by 3rd Party

Tracking Application

Webtrack2 ezfinder

by GlobalSat

Application Server

by 3rd Party

LM-130H/E LoRaWAN Compliant Module

Dimension: 25x18 mm

LM-110
• PIN type module

LD-11
• mPCIe module

LM-130 EVB
• Evaluation board

LM-130H/E Features

- LoRaWAN Compliant certified module
- Frequency: 902-928Mhz (H), 865-868MHz (E)
- 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:
  - PIN type form factor
  - Mini-PCI Express form factor
  - Evaluation board w/battery, sensor I/O, antenna

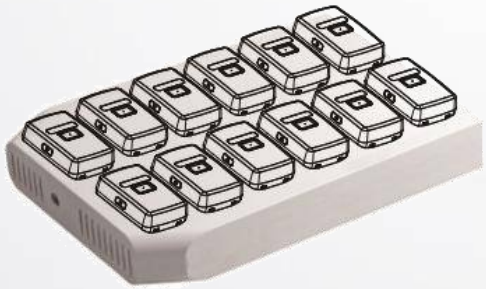
LT-100H/E LoRa GPS Tracker

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

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

Carry bag
(in production)



Charging Station
(in preparation)

LS-11x LoRa Sensor Node

LS-111 CO2

LS-112 CO

LS-113 PM2.5

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

LS-111 Carbon Dioxide CO_2 + Temp/Hum Node

- Integrated with calibrated CO2 sensor
  - Accuracy ±30 ppm
  - Range 0 ~ 2000 ppm
- Integrated with Compensated Temp/RH sensor
- 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

- Integrated with calibrated CO sensor
  - Accuracy ± 5% or ±20ppm
  - Range 0 ~ 500 ppm
- Integrated with Compensated Temp/RH sensor
- 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

- Integrated with Dust Particles sensor
  - Accuracy µg/m3
  - Range 0 ~ 500 µg/m3
- Integrated with Compensated Temp/RH sensor
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V

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	Actility	WebTraq
	Multitech	Loriot	EzFinder
	Link-lab	Orbiwise	myDevices
	Haxiot	Flashnet	SentrolCloud
	Foxconn	Everynet	Stream
	Gemtek	The Things Network	
	IMST	Stream	
Under going	Cisco	Sagemcom	
	Tektelic		

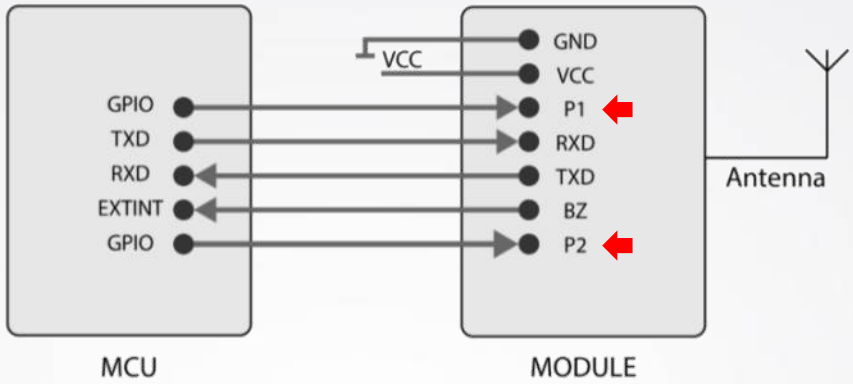
M.O.S.T.

M.O.S.T. System Architecture

Node | **Gateway** | **Network Utility** | **Applications**

M.O.S.T. Operating Mode

Application circuit



LM-230

• 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

What M.O.S.T. Can Do?

Use for	Mode Setting		Scenario
	Gateway	Node	
P2P	M1	M1	Open communication channel for data transmission between both sides
Passive Polling	M2	M3 + M1	Sequentially request each Node to report status by identifying unique Node ID
Group Calling	M2	M3 + M1	Broadcast command to specific group of Nodes to take action
Grouping + Polling	M2	M3 + M1	Access to individual Node inside Group, 2-tier for Node management
Active Mode	M2	M4 + M1	Each Node is set to wake-up and report data at different time slot, or remains at deep sleep
Trigger	2nd Ch M2	M1 jump to 2nd Ch	Reserve for emergency when Node detects abnormal condition/signal

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

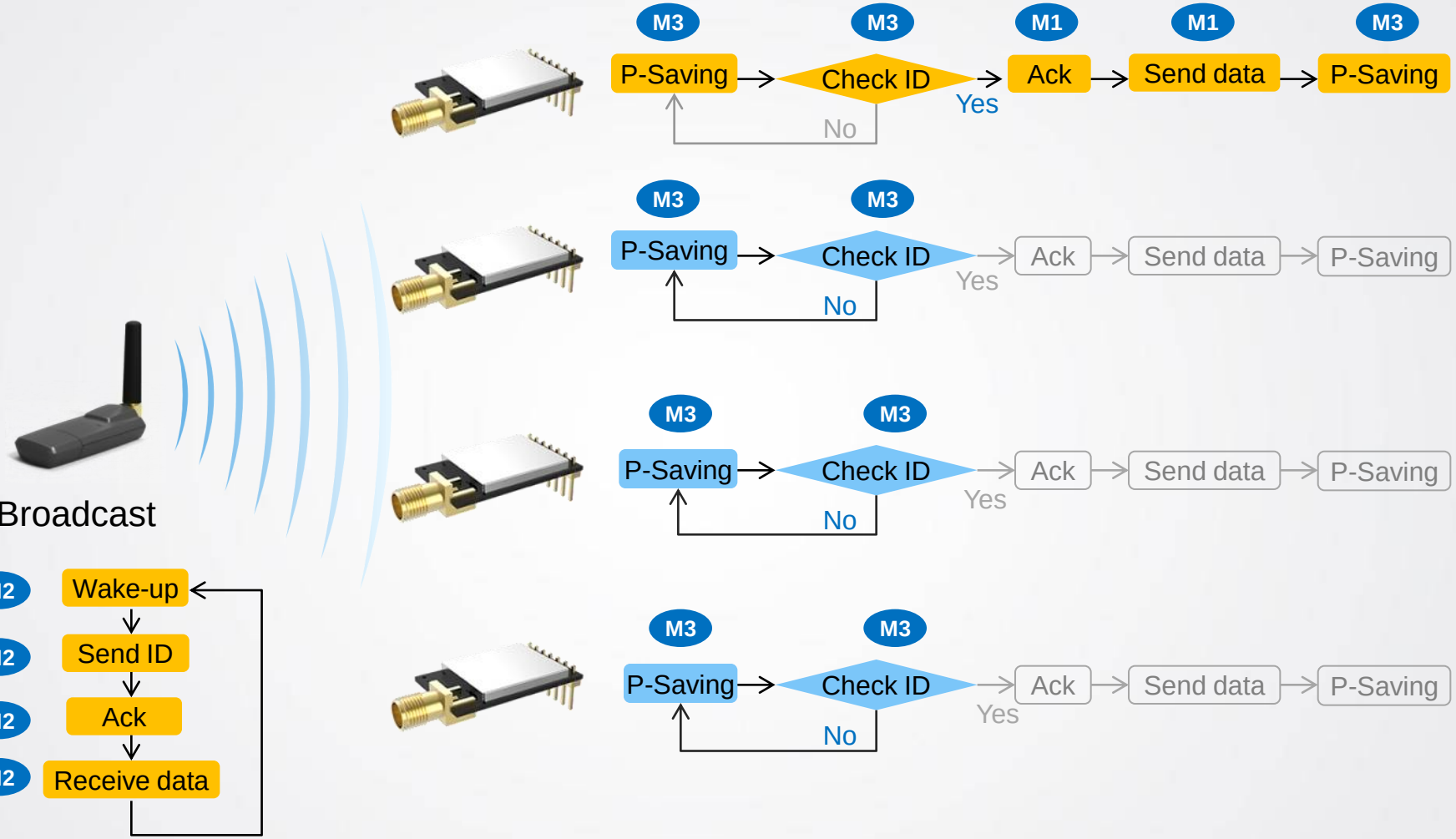
LoRa™

Pet tracker

Receiver

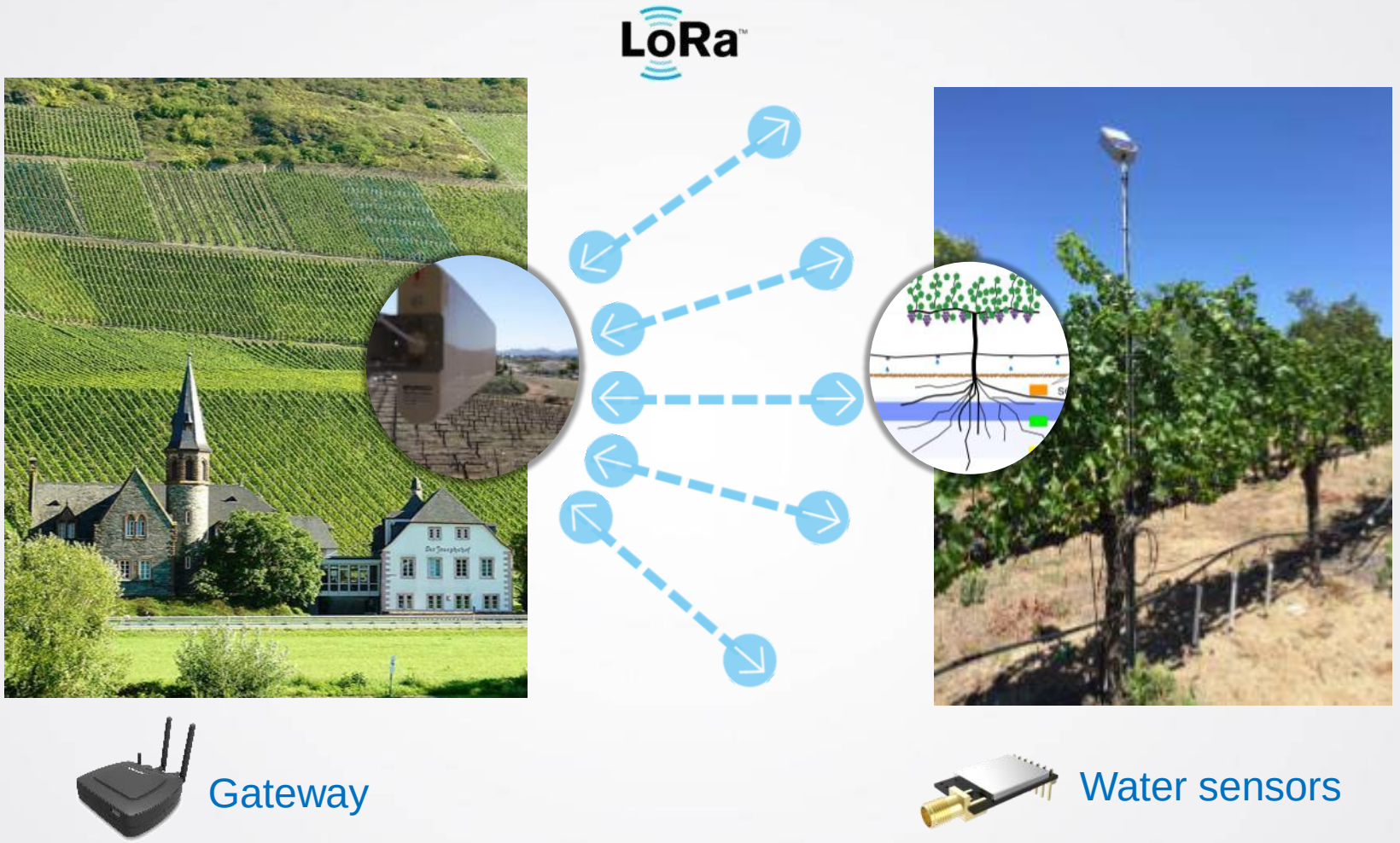
Motorbike
Anti-theft tracker

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



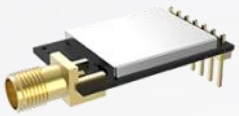
Gateway

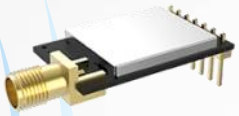
Water sensors

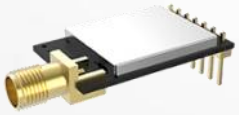
Use of M.O.S.T. - Polling + Trigger

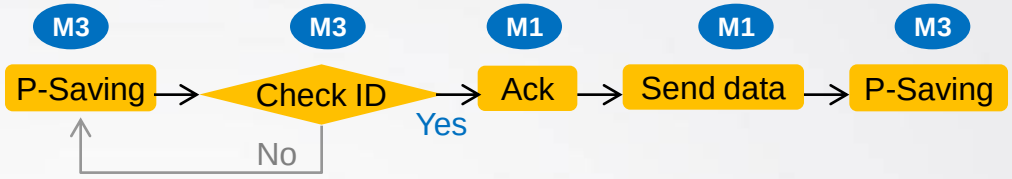
Ch 1: for regular use

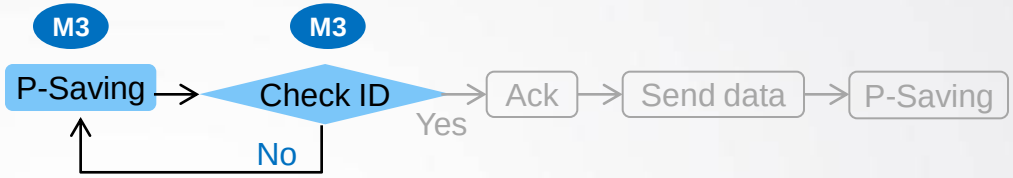
Ch 2: for emergency use

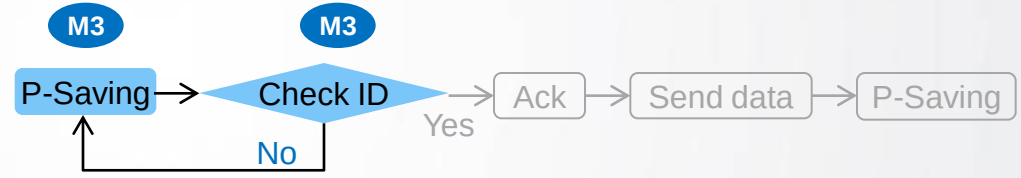


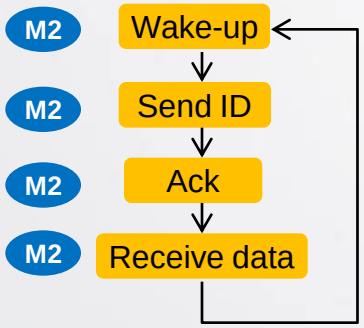












- While regular polling is taking place, an Alert triggered at End Node can be sent to Gateway at Channel 2, to avoid channel conflict with regular channel.
- This requires two LoRa modules at Gateway side, and End Node module be set to Ch 2 when triggered.

Polling & Trigger Scenario

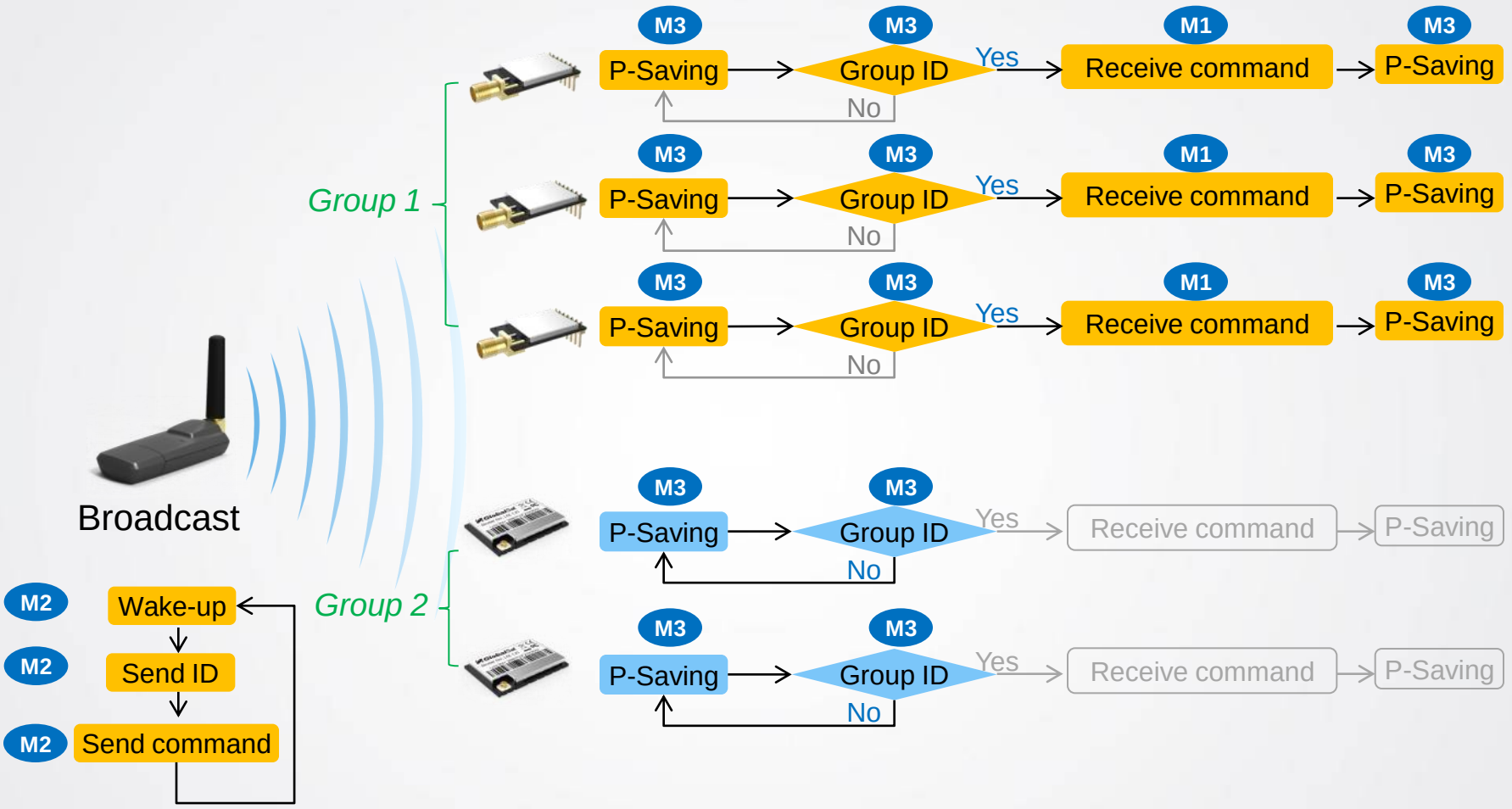
Gateway
@ base

Security tracking

Individual record
@ polling

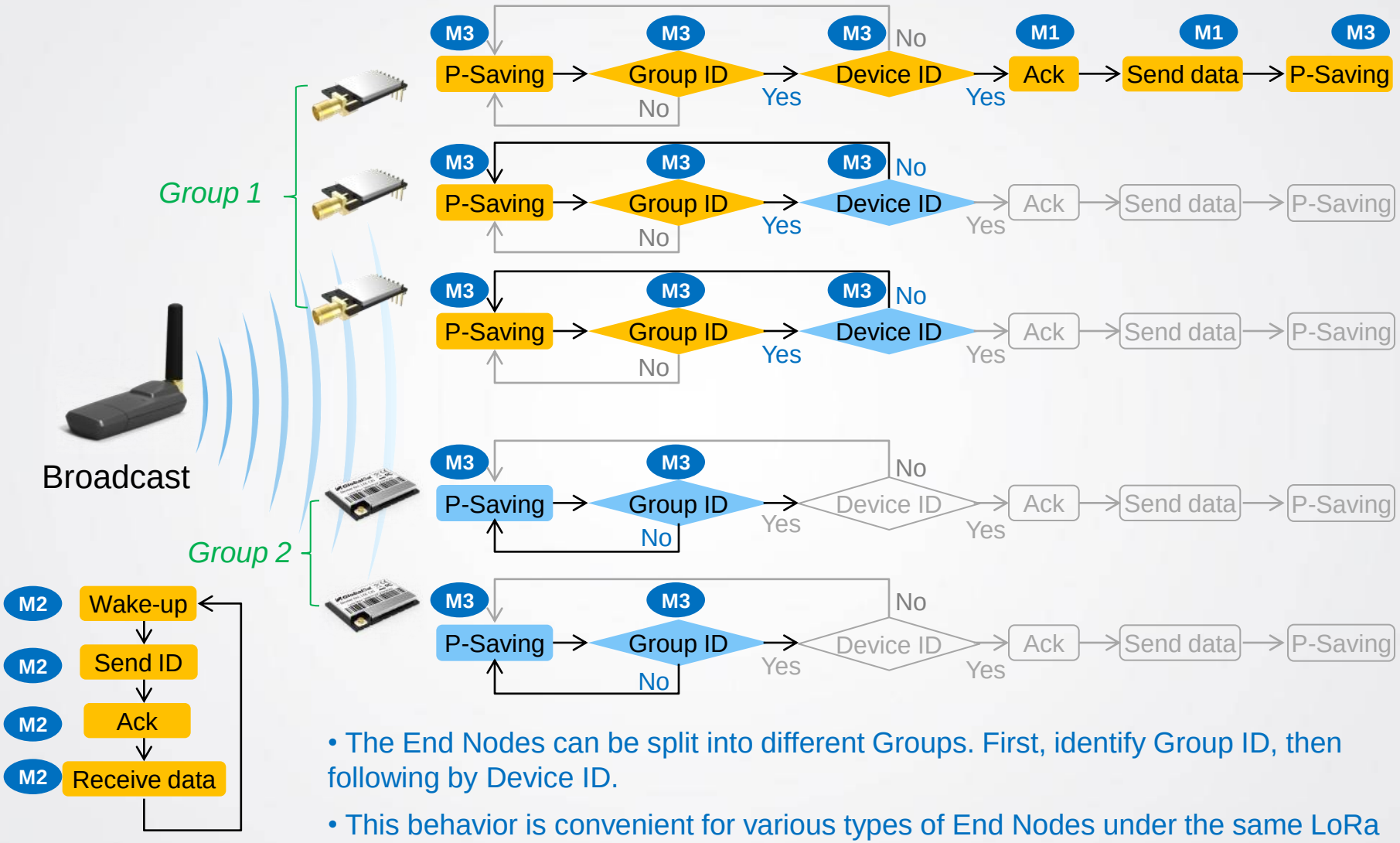
Help button
@ trigger

Use of M.O.S.T. – Group Command



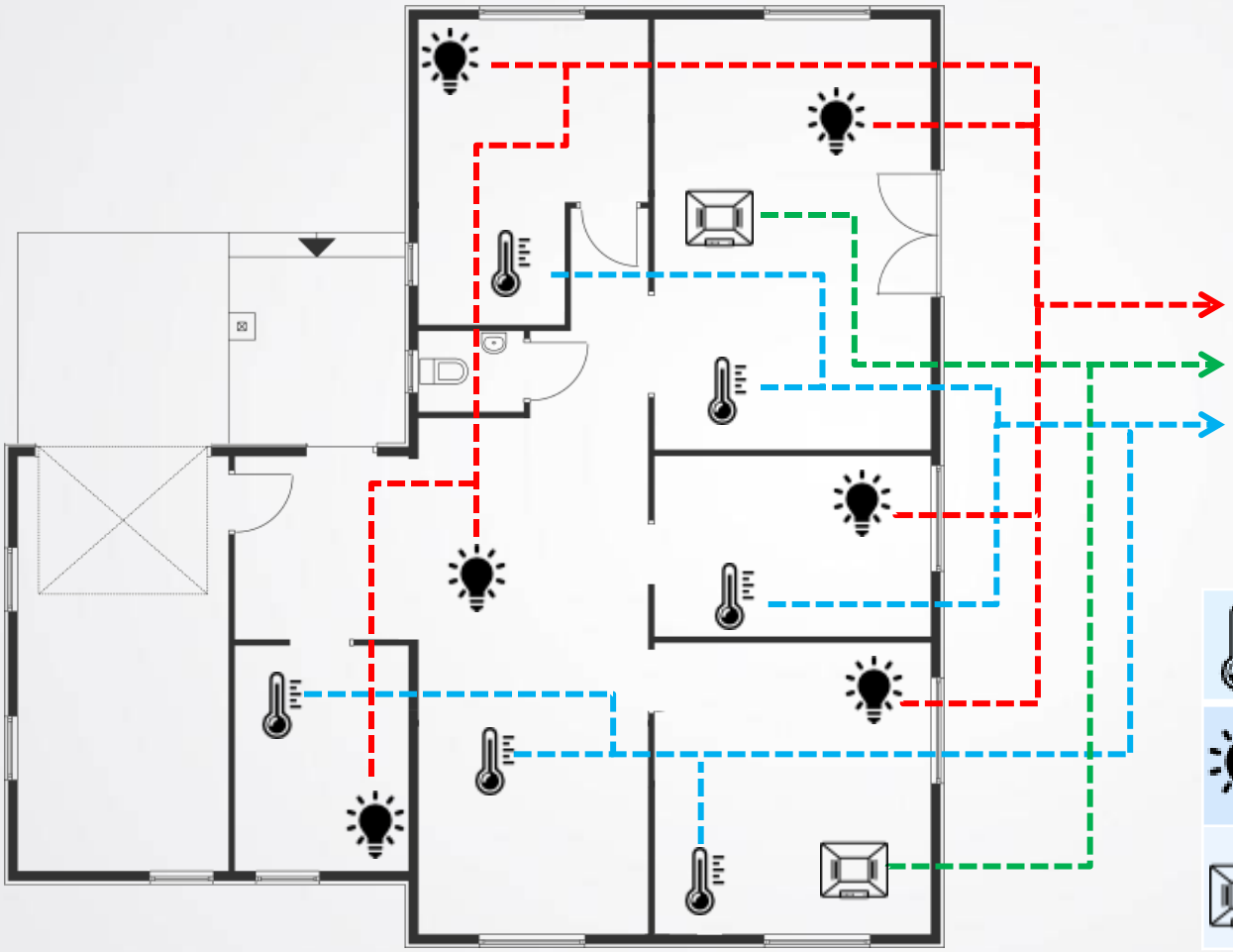
• User can group End Nodes into several groups, so only Nodes in the same Group will respond to the call, no need to identify individual Device ID.

Use of M.O.S.T. – Grouping + Polling



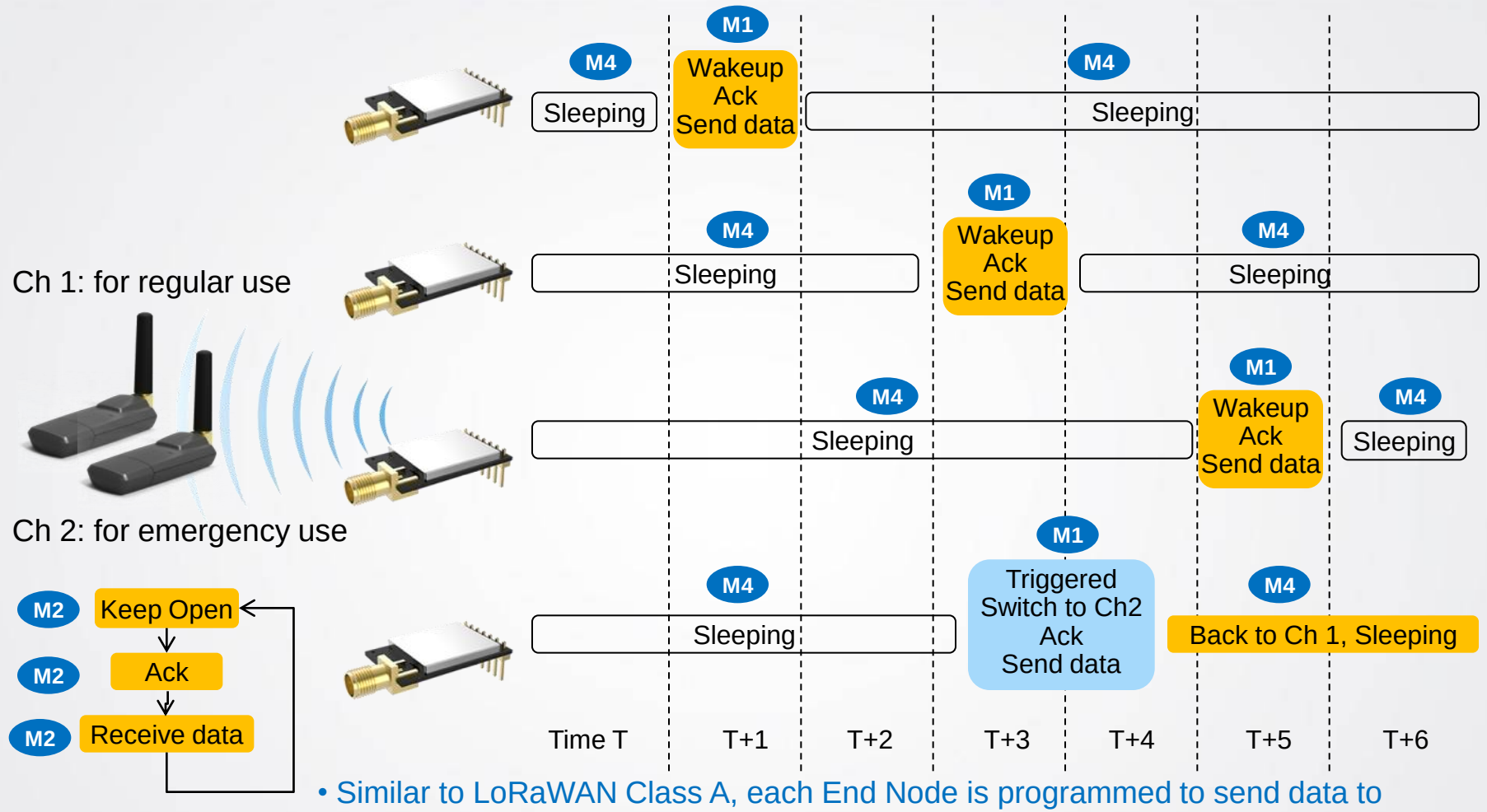
- The End Nodes can be split into different Groups. First, identify Group ID, then following by Device ID.
- This behavior is convenient for various types of End Nodes under the same LoRa umbrella.

Grouping & 2-tier Mgt Scenario



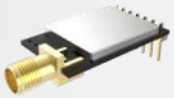
	Group 1:Temperature sensor
	Group 2: Lighting control
	Group 3: Smoke alert

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

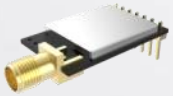


- Similar to LoRaWAN Class A, each End Node is programmed to send data to Gateway at different time slot and only be activated at the designated time and remains idle otherwise, tremendous saving of power.
- In case of Alert at End Node, jump to Ch 2 to send alert signal back to Gateway to avoid channel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

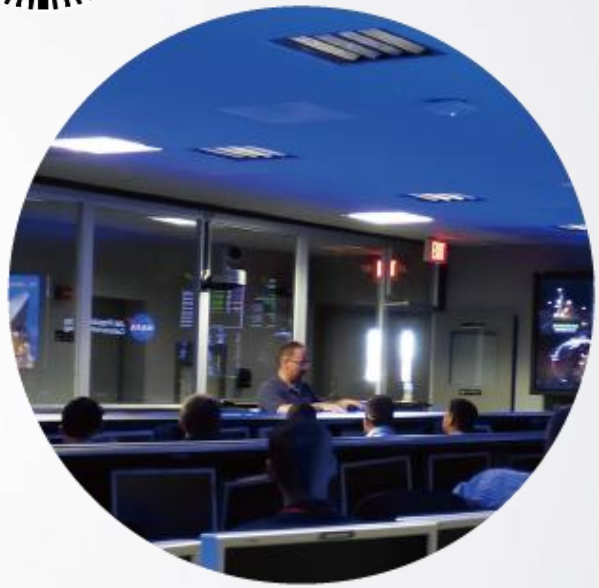
Active Mode Scenario



Electricity meter



Gas meter



Control Center

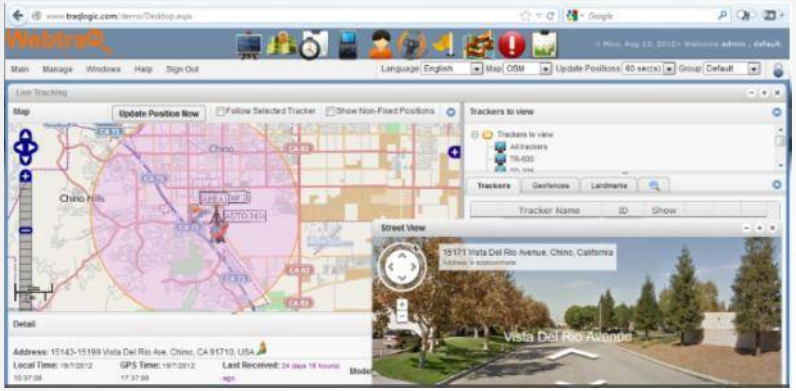
M.O.S.T. Configurations

- 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

Application

Application for LoRaWAN and M.O.S.T.

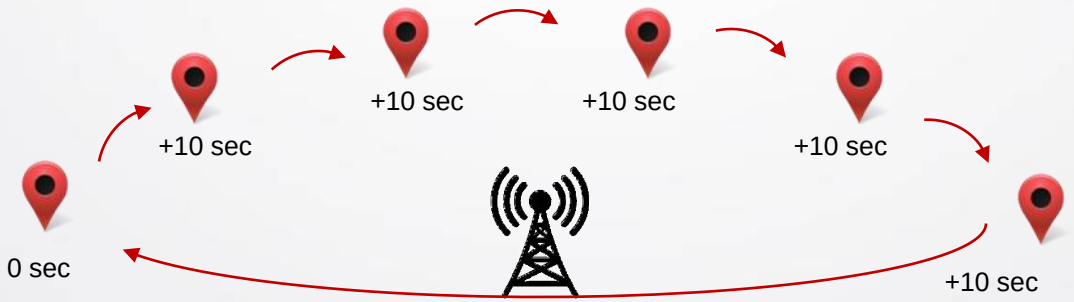


WebTraq	EzFinder
Commercial tracking platform	SMB/Personal tracking platform
•Multiple tracking setup	
•Maps, street view, landmark	
•Geo-fencing, various alerts	
•Support LoRa & GSM trackers on same platform	
•Multi-layer management	•Simplified mgt and report layer
•Comprehensive report	•Fit in personal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

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

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.

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

- LoRa Gateway EVB
  - 2x LoRa RF channels
  - Built-in LAN & WiFi
  - 1x mPCIe slot, 1x USB port
  - HDMI output
- LoRa Shield for MOST
  - Support Arduino and LinkIt ONE platform
- Arduino Uno
- Temp/humidity sensor & LED kit
- MOST-Link SW Package and Cloud Platform

• Gateway EVB

• LoRa Shield

• Arduino Uno

• SW Package

• Sensor Kits

- *also available: LoRa Shield for LoRaWAN*

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Thank You!