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Wireless Application BU

- *Wireless IoT Solution*

LPLAN Solution – (*LPLAN – Low Power Local Area Network)
TRex (Transmission Range extendable)

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Background:

IoT (Internet of Things) is transforming human life styles through the connectivity of various computing devices and data transmission, and internet network. IoT makes the life style more convenient and better. It has many applicable scenarios such as physical monitoring wearable devices, environmental temperature / humidity sensors, indoor positioning system, smart home, retail, industry internet of things, immediate alarming, smart building, agriculture, medical care to realize smart city. ESMT is a rich professional design IC house and on leading position in the field and successfully develop IoT SOCs, modules and system boards of LPWAN and LPLAN in order to offer customers a complete solution.

Solution:

***LPWAN (LOW POWER WIDE AREA NETWORK)**

LPWAN is a wireless communication network with low-power consumption and long distance transmission. Through a relay base station and connect numerous devices, the data is transmitted with unlimited distance. ESMT provides SOCs authorized by **Sigfox** and modular products are applicable for various regions.

***LPLAN (LOW POWER LOCAL AREA NETWORK)**

LPLAN also uses UNLICENSED frequency band. Compared to the short transmission range of wireless protocols such as WI-FI, BLUETOOTH, and ZIGBEE, ESMT develops **TRex (Transmission Range extendable)** that the wireless communicated transmission range can be extended to several kilometers or across floors, thus applicable scenario is used to the private network in a local area. **TRex (Transmission Range extendable)** can also extend a local network to an external network through gateways.

TRex(LPLAN) – LPWAN vs. LPLAN

Comparison :LPWAN vs. LPLAN

Technology	NB-IoT	LoRa	Sigfox	TRex
Subscription Fees	High	No	Low	No
Coverage Range	Wide Area	Local Area	Wide Area	Local Area
Network	Public	Private	Public	Private
Cloud / Server	Operator	Private	Sigfox	Private
Signal Penetration	Poor	Better	Better	Better
Uplink Capability	Better	Poor	Better	Better
Downlink Capability	Better	Better	Poor	Better
Boot Time	Long	Short	Short	Short
Standby Power	High	Middle	Low	Low
Number of Nodes	250 ↑ ↑	250 ↓ ↓	250 ↑ ↑ ↑	250
Infrastructure	Operator	Private	Operator	Private
- Base Station	Yes	Yes	Yes	Yes
- Gateway	No	No	No	Yes
- Repeater	No	No	No	Yes

TRex(LPLAN) – Wireless SoC : XS8001-T

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Band :
915MHz / 868MHz / 780MHz / 470MHz /
433MHz / 315MHz / 230MHz

Data Rate & Modulation :
* 100bps / 600bps / 12.5Kbps / 25Kbps /
  100Kbps / 1Mbps
* GSK / BPSK

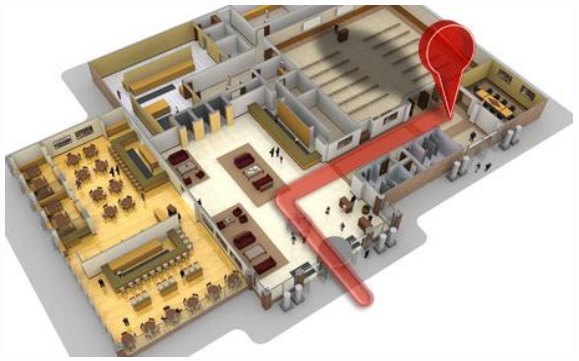
Power Consumption(Avg.) :
* TX : 60mA @ 14dBm(868MHz)
* TX : 130mA @ 22dBm(902MHz)
* <7uA @ Sleep

Others :
* Embedded +23dBm PA
* High Performance MCU - Andes N801

MCU :
* Andes N801-S Processor (32-Bit / 60MHz)
* 24KB RAM / 128KB Flash
* 10-Bit 250Kbps ADC * 4
* Peripherals : PWM * 2 / SPI * 2 / UART * 2 / GPIO / I2C
* AES-128
* Temperature Sensor
* Analog Comparator
* Battery Sensor
* Voltage Alarm
* AT-Command

LP
LOW POWER

TRex(LPLAN) – Scenario



Indoor Sensing

Local Area Monitoring

Mid. Range Automation

Low Power Consumption / Long Battery Life /
High Penetration / Long Range Transmission /
Low Construction Cost / Multi-Function Integration

Life +40%

TRex(LPLAN) – Diversified Network Architecture

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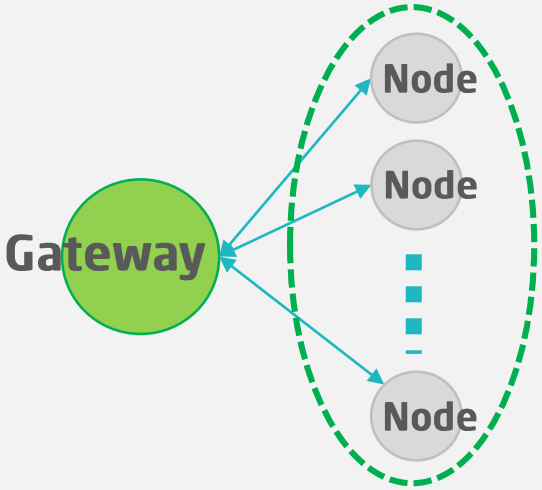
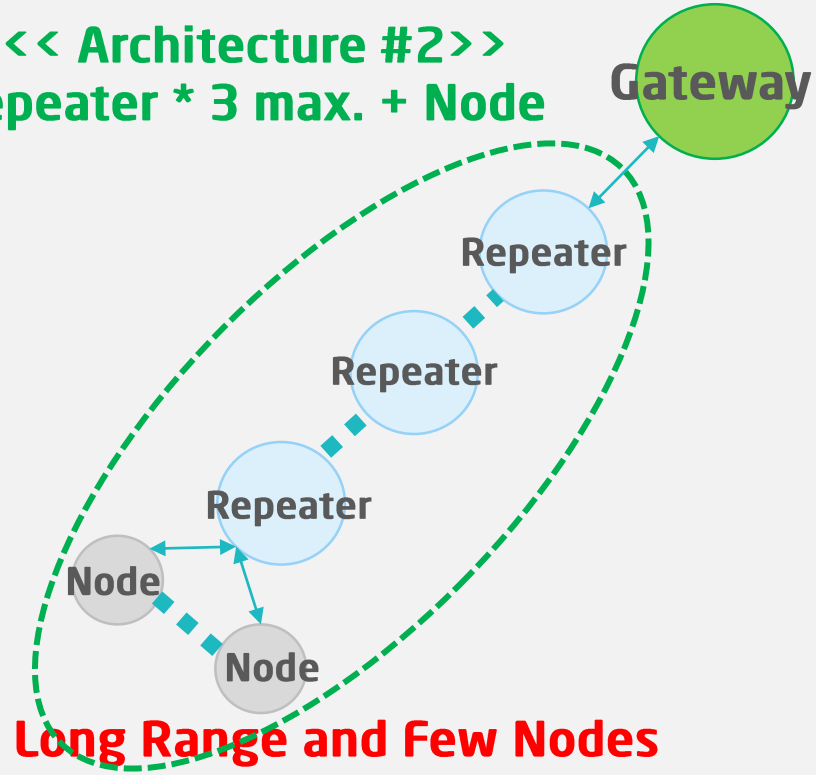
* Star or Tree + Star Topology Network
* Modular Network Architecture and Communication Protocol, Easy for Field Planning and Deployment
* Different field or Subsequent Expansion, Network Architecture Combine Arbitrarily

<<Architecture #1>>
Node * 254 max.



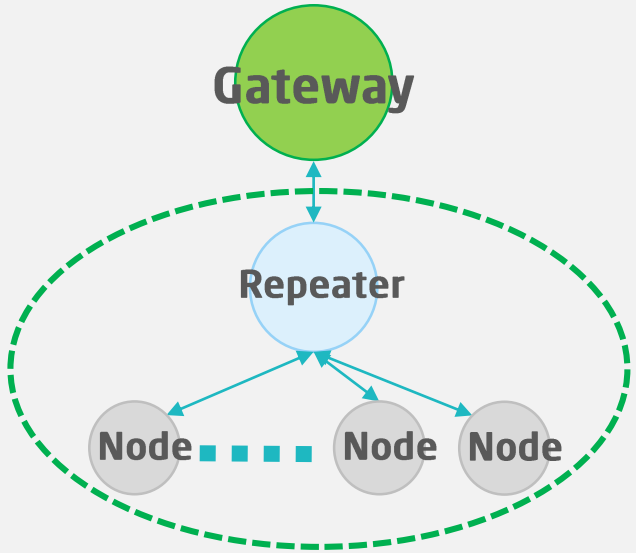
Small Area and Multi-Node

<< Architecture #2>>
Repeater * 3 max. + Node



Long Range and Few Nodes

<< Architecture #3>>
Repeater + Node



Extended Field Coverage

TRex(LPLAN) - Composable Hardware Design (Module/ Device / Repeater/ Gateway)

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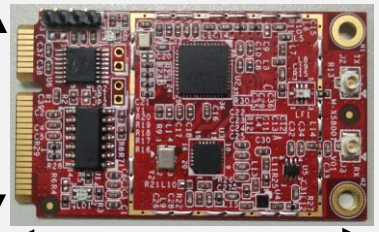
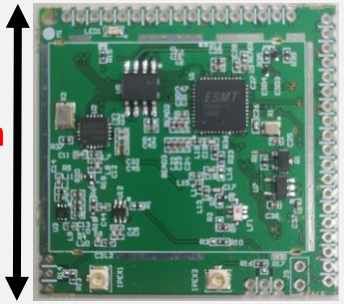
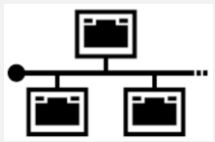
TRX Module (*Made by Artila)



TRX Module



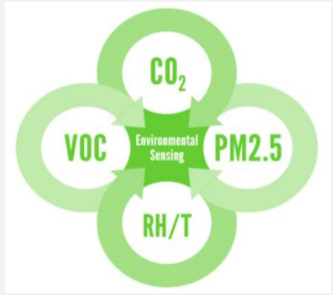
TX Module

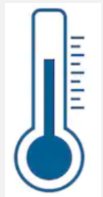


= Gateway or

(*Artila Matrix-750)

= Repeater





= Multi-Function Nodes

TRex(LPLAN) – Medical field Application Planning

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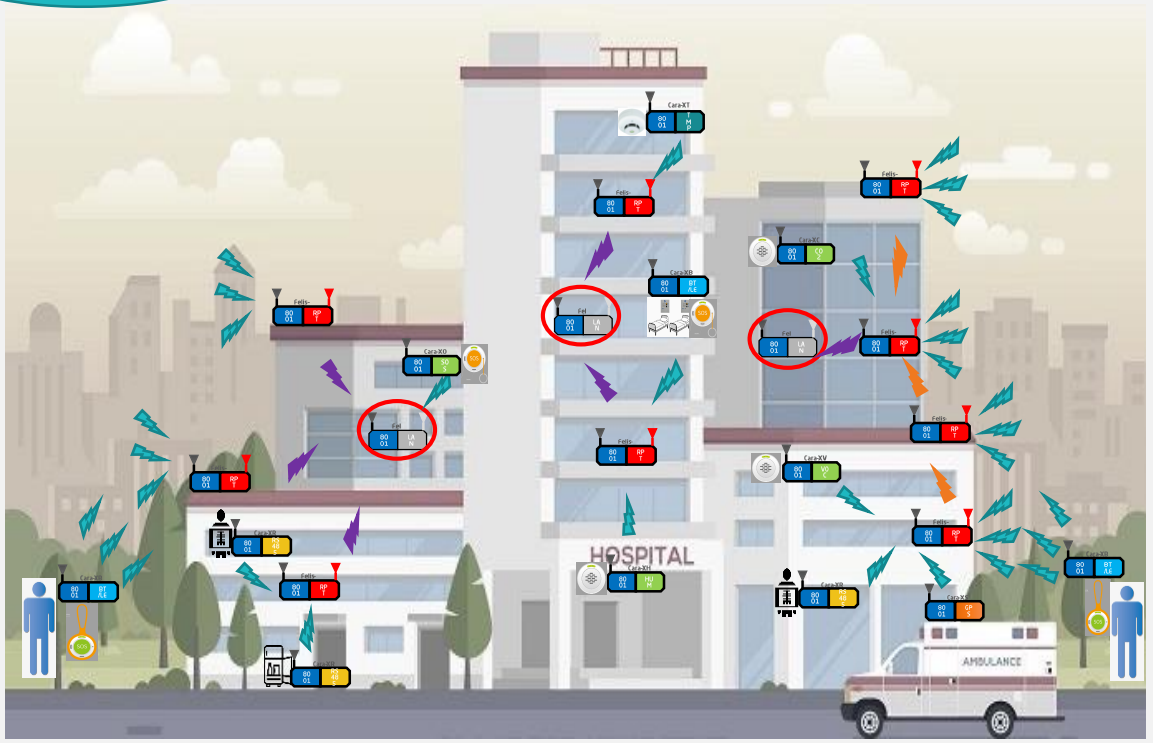
<<Advantage>>

* Best Signal Penetration
* Best Anti-Interference Ability
* Signal Fully Coverage w/o Dead Zone
  - Basement / Parking Lot
* Low Operating Costs
  - No Subscription Fee / Low Power Consumption

One RPT cover 3 Floors



<<Application>>

* Medical Equipment :
  Tracking / Abnormal Alarm / Reconfiguration/ Inventory
* Environmental Monitoring :
  Fire-Smoke Alarm / Temperature / Humidity / PM2.5 / CO2 / VOC / Electricity ...
* Inpatients :
  Emergency Call / Message Broadcasting / Indoor_Outdoor Tracking ...

TRex(LPLAN) – Medical field Application Planning : Lobby Example

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TRex(LPLAN) – Medical field Application Planning : Ward Example

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Patient Emergency Call and Locator

Fire/Smoke Detector

Repeater

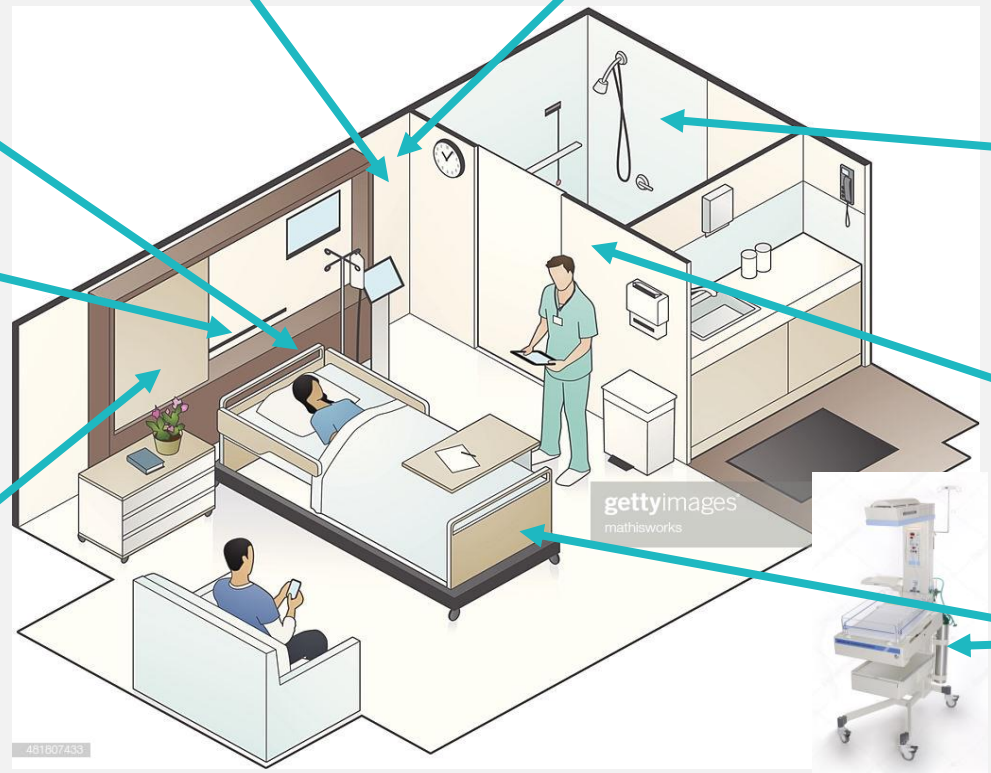
Nursing Call - Fixed Type

Nursing Call -Bathroom

Temperature Humidity Detector

CO2 Detector

Equipment Tracker



TRex(LPLAN) – Field Application : Power Saving (Temperature Detection)

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Humidity/Temp. Meter

TRex(LPLAN) - Field Application : Air-Flow Detection

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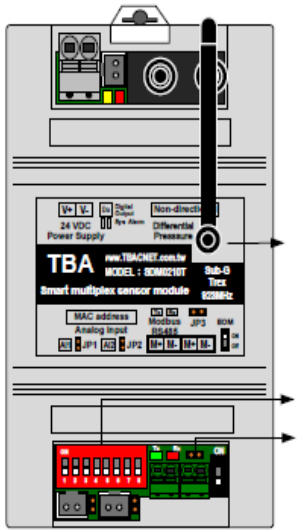

Feature：

- **MCU**→32 bit (MCU)，128K Flash，16K SRAM memory.
- **RS485**→MODBUS RTU RS485 RTU.
- **Wireless**→Sub-G，923 MHz，TRex.
- **Sensor**→high accuracy sensor. Include **differential pressure、vibration、temperature、humidity.**
- **Analog Input**→Dry contact or thermistor.
- **Digital Output**→5VDC hot switch output.
- **Compact**→sensing-calculation-monitor-communication-clouds。
- **Quick installation**→compact, Save construction time.

TRex(LPLAN) – Backed Dashboard : RSSI Signal & Battery

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TRex(LPLAN) – LoRa vs. TRex

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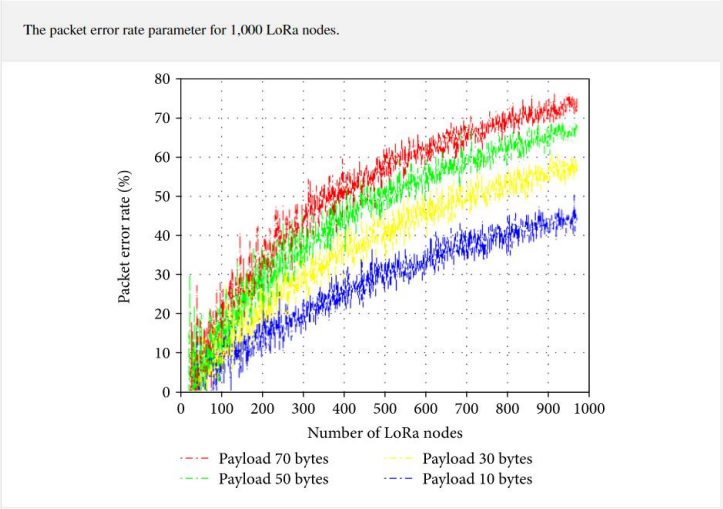
	TRex	LoRaWAN
RF Chip Solution	ESMT / Taiwan	Semtech / USA
Protocol License Fee	NO	YES
Protocol Customization	YES	NO
Technical Support	ESMT	Module Maker / S.I
Network Type	Local Area Network	Wide Area Network
Network Topology	Star or Tree + Star	Star
Support Frequency	915MHz/868MHz/780MHz/630MHz/510MHz/470MHz/433MHz/400MHz/230MHz	915MHz/868MHz/433MHz
RF Chip Type＊1	RF SoC (Transceiver + MCU 2-in-1)	Transceiver Only
TX Power＊2	+17dBm max.	+20dBm max.
Transmission Range	800m (Data Rate:50Kbps)	15Km (Data Rate:0.3Kbps)
Data Rate＊3	100Kbps typ.	50Kbps max.
RX Sensitivity＊4	-126dBm (Data Rate:0.5Kbps)	-137dBm (Data Rate:0.3Kbps)
Anti-Interference＊5	Hopping	CSS
Encryption Protocol	AES-128	AES-128
Up/Down-Link	High Data Rate/Middle Range/Low PER	Low Data Rate/Long Range/High PER
Nodes vs. PER＊6	50 Nodes / 1% max. (Uplink Period:30s/Payload:80 bytes)	100 Nodes / 20% min. (Uplink Period:120s/Payload:70 bytes) ＊7
Repeater	YES	NO
Range Extendable	YES	NO
Node Expansion Cost	LOW	HIGH
Device Battery Life	TRex > 2 * LoRaWAN	

Note :

* 1 : RF SoC: To Integrat both of RF transceiver and the microcontroller in single chip. No additional microcontroller is needed. It will effectively reduces the size of the motherboard and production cost.
* 2 : Greater TX power mean longer transmission distance, but it is also accompanied by the disadvantage of more power consumption.
* 3 : Faster data rate will short transmission time which can save device power consumption, but transmission range will also be shortened.
* 4 : Smaller RX sensitivity(negative) mean longer signal received range.
* 5 : Both TRex and LoRaWAN operate in the public ISM Sub-GHz band. There are many interference and not easy to track. Therefore, frequency hopping and spread spectrum are commonly used for anti-interference technologies.
* 6 : PER = Packet Error Rate, the unit is percentage (%), the smaller the value is better, which means the lower the probability of data loss during transmission. Any communication system will have a problem of packet loss rate in actual application , PER cannot be zero.
* 7 : Source of thesis information
  https://www.hindawi.com/journals/js/2019/3502987/



TRex(LPLAN) – Conclusion

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Complete Communication System :

* Innovative Low Power Local Area Network (LPLAN) Protocol
* Flexible and Modular Network Application Architecture
* Best Signal Penetration and Anti-Interference Ability
* Simple and Free Combination Hardware Design

Various Application Scenarios :

* Indoor: Environmental Detection / Monitoring
* Local Area: Smart Hospital / Factory / Building
* Mid. Range: Pasture Management / Forest monitoring / Aquaculture

Diversified Product Application :

Indoor_Outdoor Tracking / Emergency System / Equipment Management System / Parking Management System / Fire Alarm / Smoke Detector / Anti-Theft System / Temperature and Humidity Detection / Air Quality Index / Water Quality Detection ...

Roadmap :
Sphynx XS9000 series

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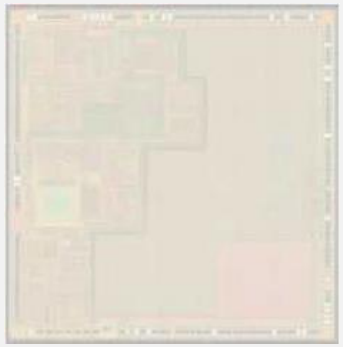
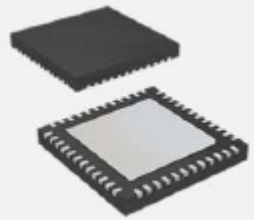
High Performance ISM Wireless SoC

- Short Range: BLE5.x(Beacon)
- Long Range : Sigfox, Weightless-P, Wi-Sun , Proprietary UNB
- ARM Cortex-M3 80MHz with 48KB SRAM + 128/256KB Flash
- Worldwide ISM Band : 2.4GHz & Sub-1GHz (230MHZ, 315MHz, 433MHz, 470MHz, 510MHz, 630MHz, 780MHz, 868MHz, 915MHz)
- Modulation Scheme : OOK, ASK, BPSK, (4)(G)FSK,(G)MSK , oQPSK, DSSS-oQPSK
- Baud Rate :
  - * Ultra NarrowBand : 100bps, 600bps, 1kbps (BPSK)
  - * NarrowBand: 12.5kbps (BPSK, GFSK, GMSK, oQPSK)
  - * Wideband :100kbps, 200kbps, 250kbps , 500kbps , 1M, 2M (GFSK, GMSK, oQPSK)
- Integrated +23dBm PA (Sub-1GHz) & 4dBm (2.4GHz)
- External LNA and PA Support
- AoA(Angle of Arrival) Support
- 12-bit ADC * 4 & Current Generator 6-bit
- Various Peripherals : GPIO / SPI*2 / UART*3 / I2C / PWN*6
- Rx < 8mA ; Tx < 30mA @ 14dBm ; Sleep < 2uA
- AES128/256 & SM1/2/3/4
- QFN48





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