QUECTEL ®
Build a Smarter World

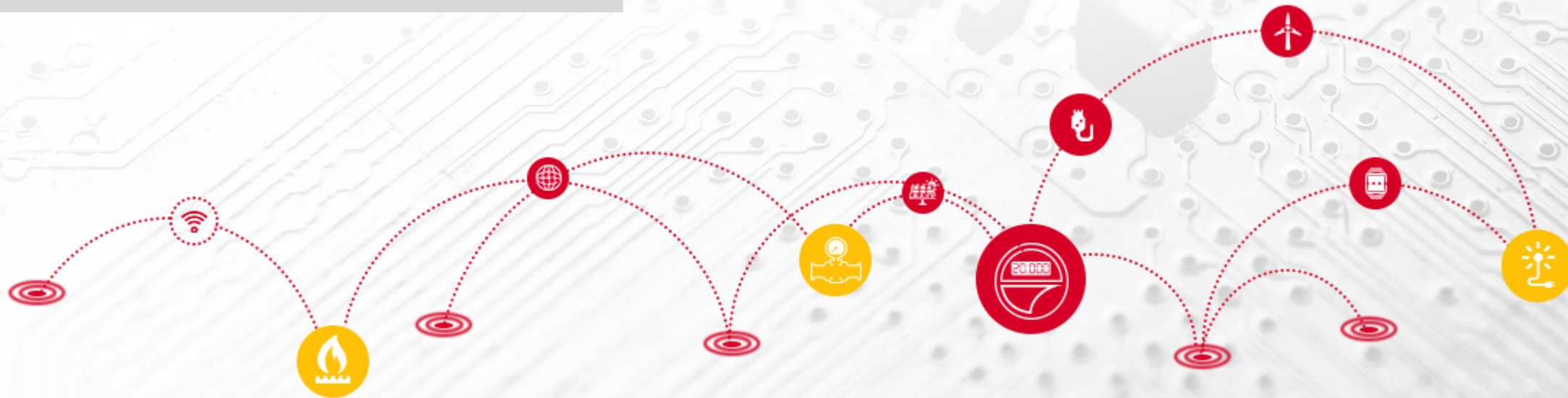# Quectel NB-IoT Module BC95&BC95-G&BC68

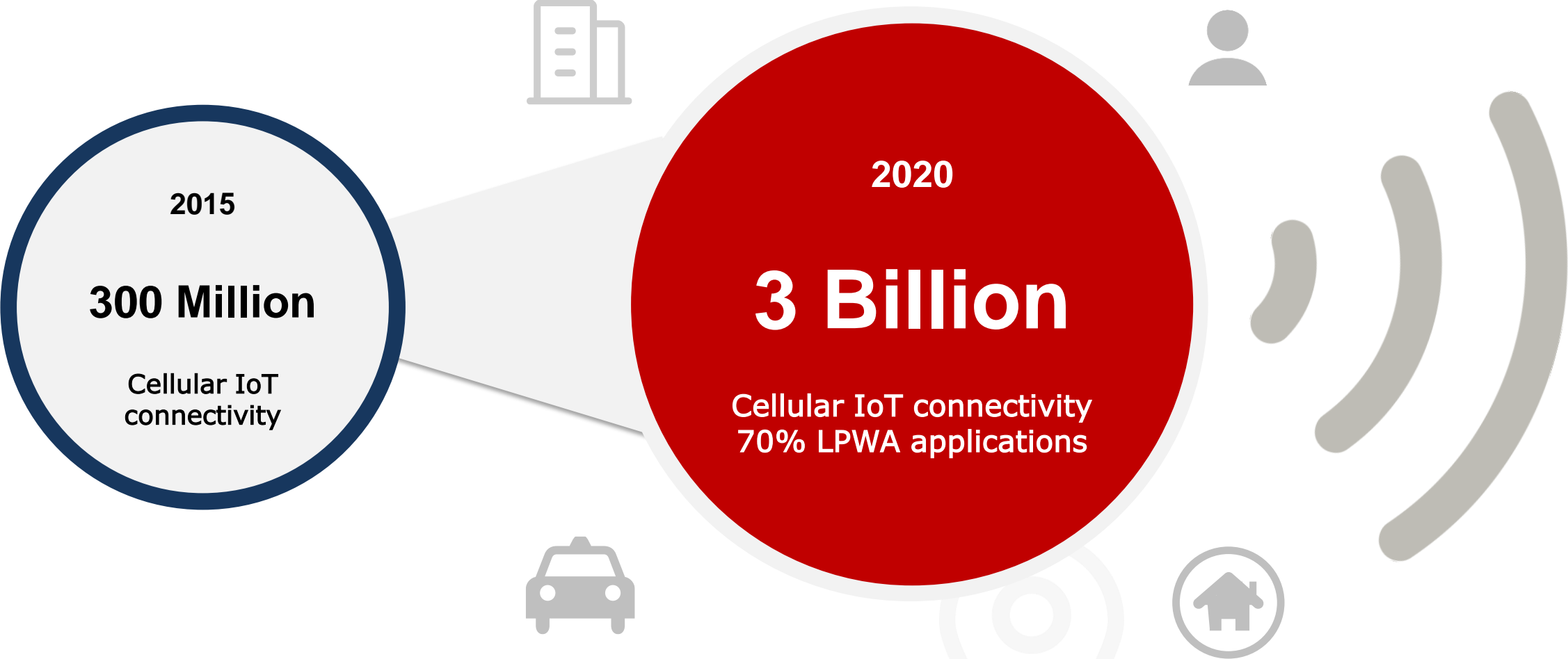## Product Overview

Jan., 2018

NB-IoT Technology

Product Overview

Technical Details

Applications

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IoT Connectivity Forecast

2015

300 Million

Cellular IoT connectivity

2020

3 Billion

Cellular IoT connectivity
70% LPWA applications

Application of Cellular Modules for IoT

Segment	Number of Connectivity by 2020	Requirement	Technology
• Camera • Video Display…	200 million	I >10Mbps	3G/4G/5G
• Smart Home • Wireless POS…	800 million	I ~1Mbps I Low Power Consumption	GSM/GPRS/CDMA LTE MTC (Rel. 12, Rel. 13)
• Sensor, Meter Reading • Asset Tracking • Smart Parking • Smart Agriculture…	2 billion	I Small Data Packet (<100kbps) I Deeper Coverage (20dB) I Low Power (10 Years) I Low Cost (<$5)	Zigbee/BT/Wi-Fi/ Sigfox/LoRa/ **NB-IoT…**

LPWA: Low Power Wide Area

Low-speed M2M modules will cover most applications in the future.

Comparison Between Different M2M Technologies

	Wi-Fi (802.11ah)	BT	Zigbee	LoRa	Sigfox	Legacy Cellular	NB-IoT
Spectrum	<1GHz	2.4G	2.4G/ 868MHz (EU)/ 915MHz (US)/	ISM bands 433MHz/868MHz/915MHz		2G bands	LTE & 2G bands
Data Rate	>100kbps	BLE: 2Mbps	20kbps @868M 250kbps @2.4G	0.3kbps~50kbps	100bps~600bps	<100kbps	<100kbps
Cost	Medium	Low	Low	Medium	Medium	Low	Medium → Low
Power Consumption	Medium	Low	Low	10 years battery life	10 years battery life	High	10 years battery life
Coverage (Range, Penetration)	Short, <100m			157dB	160dB	Long	164dB
User Setup	Hard			Easy		Easy	Easy
Standard	IEEE 802.11	IEEE 802.15.1	IEEE 802.15.4	Private		3GPP	3GPP

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Extended Coverage

Long Battery Life

NB-IoT Advantages
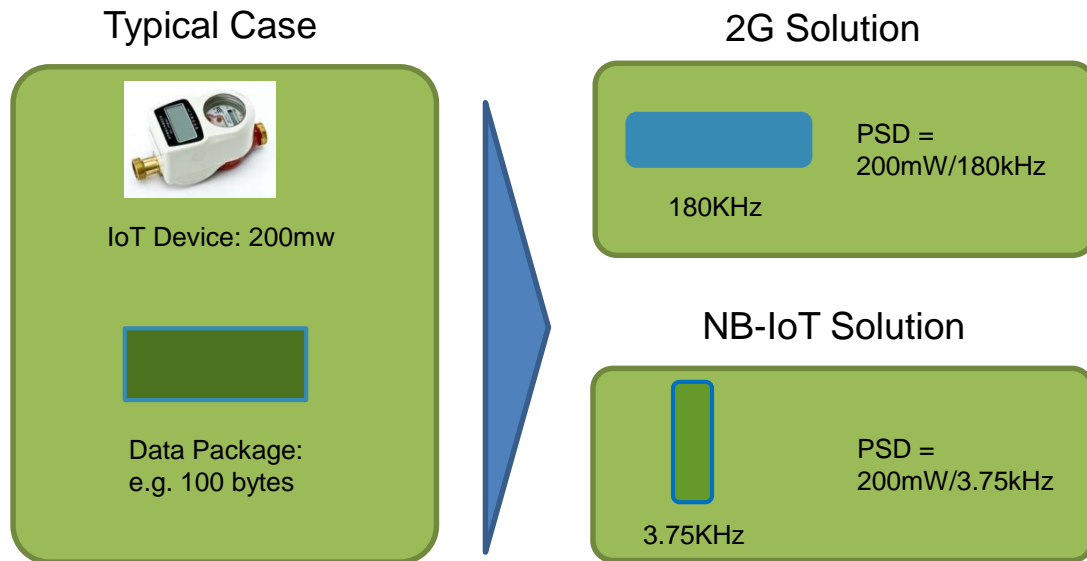
Licensed Spectrum

Massive Connectivity

Low Cost

NB-IoT Advantage – Extended Coverage

The target for the IoT connectivity link budget is an enhancement of **20dB**. This coverage enhancement would typically be equivalent to the signal penetrating a wall or floor, enabling deeper indoor coverage.

- **Uplink PSD Increased by 17dB**

  Typical Case

  IoT Device: 200mw

  Data Package:
  e.g. 100 bytes

  2G Solution

  PSD = 200mW/180kHz

  180KHz

  NB-IoT Solution

  PSD = 200mW/3.75kHz

  3.75KHz

  Note: The max Tx power of a GSM terminal can reach 33dBm and that of NB-IoT is about 23dBm, therefore the PSD of NB-IoT is 7dB more than GSM.
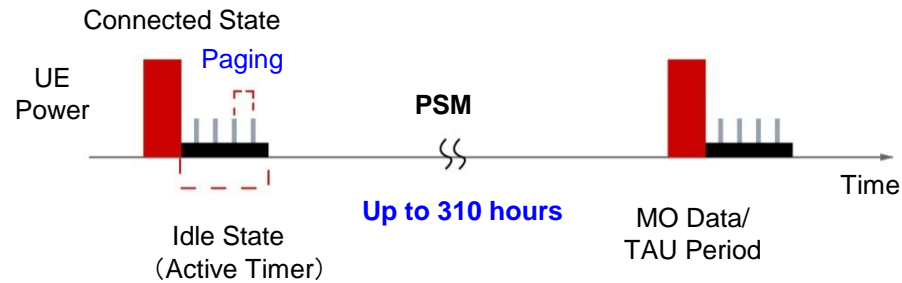
  PSD: Power Spectral Density

- **Repetition/Retransmission: 6dB~16dB**

  D1 D2

  Repetition

  D1 D1 D1 D2 D2 D2 D2

  Codec: 3dB~4dB

  2~16 Repetition:
  3dB~12dB

  D2 D2 D2 D2
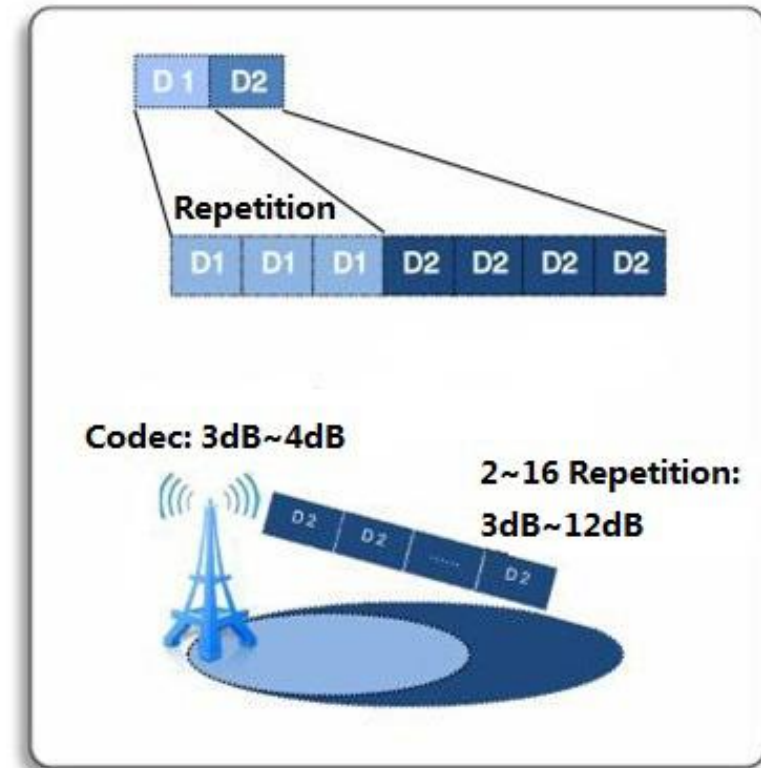
Released

NB-IoT Advantage – Long Battery Life

The industry aims to achieve a minimum of **10 years** of battery operation for simple daily connectivity with a small amount of data exchanged.

Power Saving Mode in 3GPP Release 12

- PSM (Power Saving Mode) and eDRX (Extended Discontinuous Reception) are the key technologies to extend the battery life in NB-IoT.

a) The terminal in PSM is still registered with network but the signals can not reach until it wakes up automatically. This kind of deep sleeping mode can conserve energy.

b) eDRX is a new feature released in 3GPP Rel. 13, which extends the sleep cycle of the terminal in idle mode to reduce the unnecessary start-up of the Rx units. It improves the reachability of downlink greatly compared with PSM.
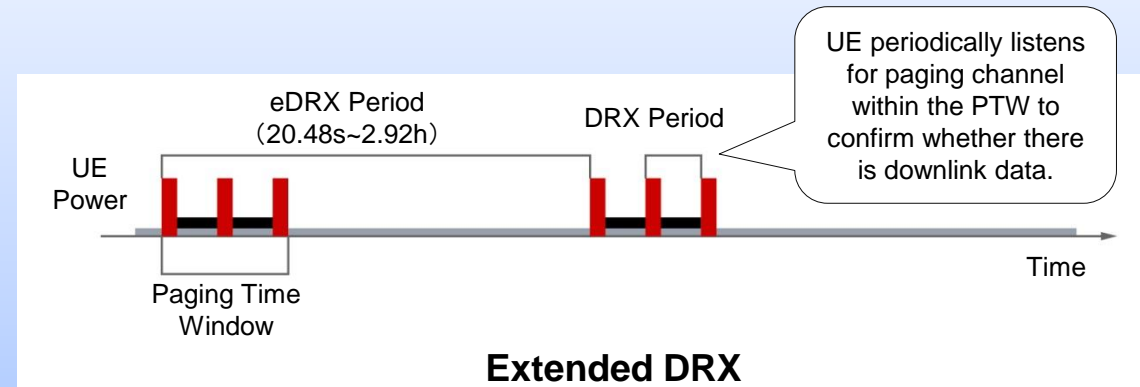
TAU: Tracking Area Update)

UE: User Equipment

Rx: Receive

Tx: Transmit

- Simplified protocol
- Low power consumption
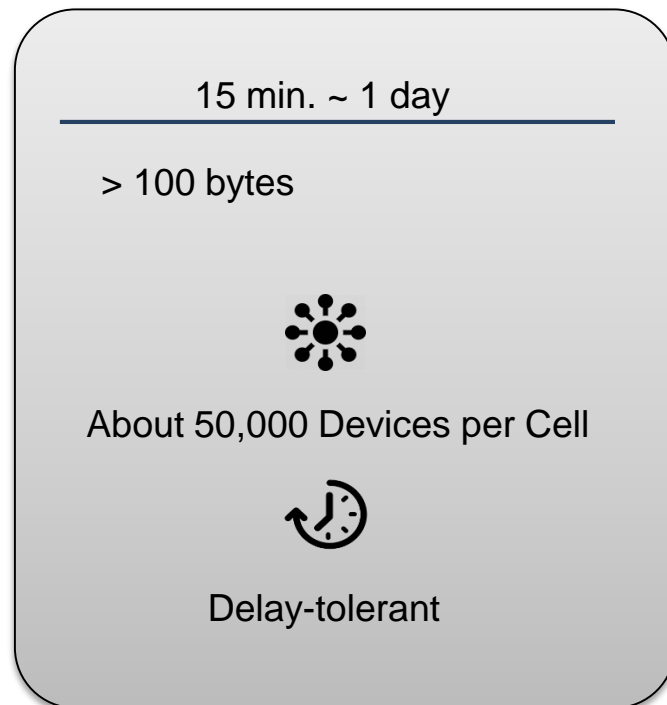- High PA efficiency
- Short Tx/Rx time

Extended DRX

NB-IoT Advantage – Massive Connectivity

It is ideal to have about **50,000** devices per cell; this is possible assuming that the household density is 1500 households per square meter, and there are 40 devices in every household.

Typical Model

15 min. ~ 1 day

> 100 bytes

About 50,000 Devices per Cell

Delay-tolerant

Special System Design for Massive Links

- **Narrowband Technology**

  Uplink equivalent power: 36 channels * 23dBm

- **Decrease Signal Interaction**

  Optimize the efficiency of frequency spectrum

- **Nodes Optimization**

  Independent congestion control
  Save terminal context

- **Core Net Optimization**

 Save registered information
  Download data cache

NB-IoT Advantage – Low Cost

Low Deployment Cost

Reusing LTE for NB-IoT takes advantage of existing technology as well as the installed system base. It is possible to reuse the same hardware and share spectrum by making NB-IoT compatible with LTE, without running into coexistence.
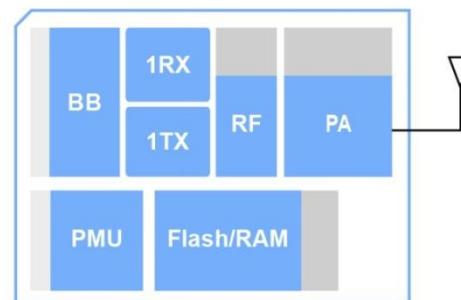
Low Device Cost

- Half duplex (HD) operation
- Single receiving antenna
- Decreased peak rate
- Reduced device bandwidth: as low as 180kHz in downlink and uplink
- Lessened memory requirements (500kByte)
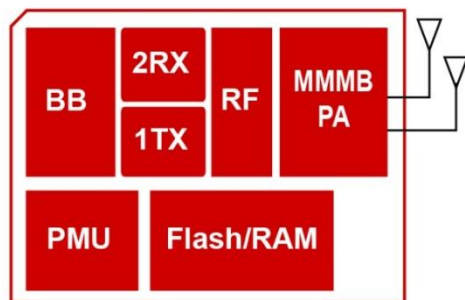
Cat 4
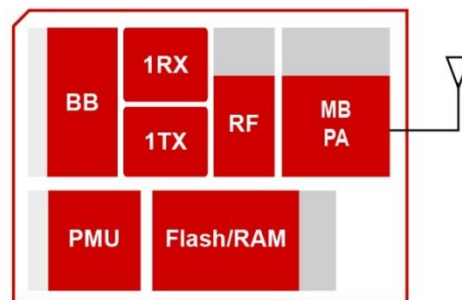
Cat 0

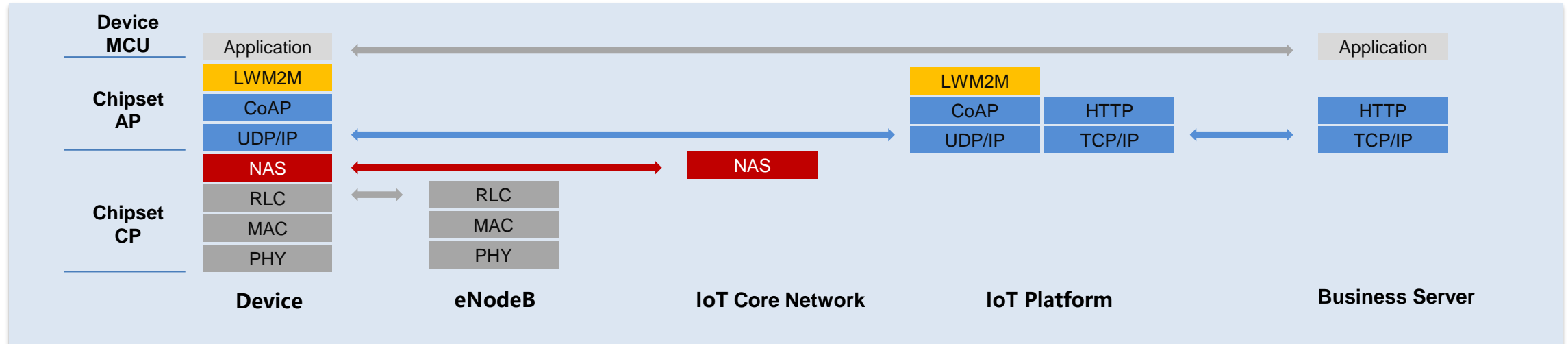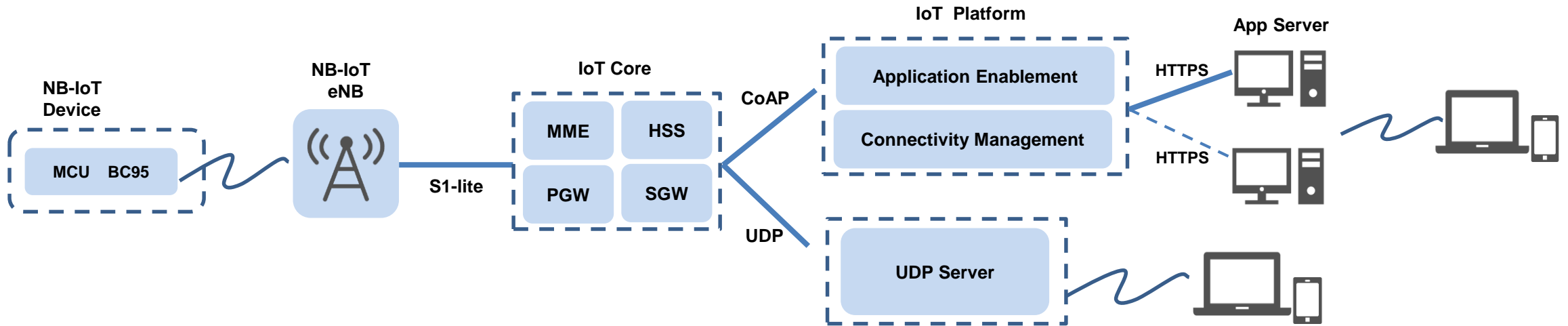Cat NB1 (NB-IoT)

MMMB: Multiple Mode Multiple Band

BB: Base Band

MB: Multiple Band

PMU: Power Management Unit

PA: Power Amplifier

NB-IoT Network Architecture

NB-IoT Device
MCU BC95

NB-IoT eNB

S1-lite

IoT Core
MME | HSS
PGW | SGW

CoAP

UDP

IoT Platform
Application Enablement
Connectivity Management

UDP Server

App Server

HTTPS

HTTPS

Device MCU
Application → Application

Chipset AP
LWM2M
CoAP
UDP/IP
NAS

LWM2M
CoAP | HTTP
UDP/IP | TCP/IP
NAS

HTTP
TCP/IP

Chipset CP
RLC
MAC
PHY

RLC
MAC
PHY

Device   **eNodeB**   **IoT Core Network**   **IoT Platform**   **Business Server**

Module state machine

Connected

230mA @TX, 23dBm
50mA @RX

Wake up by external MCU
or internal timer

No data interaction within 20s(set by
the network), auto into Idle mode

Actively send data or receive data,
into connected mode

PSM

3~5 uA @PSM

Idle

2mA @DRX=1.28s

No data interaction within 10s(set by
the network), auto into PSM mode

LTE Cat NB1 (NB-IoT)

BC95

23.6mm x 19.9mm x 2.2mm
LTE Cat NB1

■ Single-mode LTE Cat NB1 (NB-IoT) Module

Module	BC95-B8	BC95-B5	BC95-B20	BC95-B28
LTE	B8 @LTE-FDD	B5 @LTE-FDD	B20 @LTE-FDD	B28 @LTE-FDD
Engineering Sample	Q1 2017	Q1 2017	Q1 2017	Q2 2017
Mass Production	Q2 2017	Q2 2017	Q2 2017	Q4 2017
Region	China, Europe	China	Europe	Australia
Certification	CCC, SRRC, CE, RCM, GCF, NAL*	CCC, SRRC, NAL*	CE, GCF	RCM

LTE Cat NB1 (NB-IoT)
BC95-G/BC68
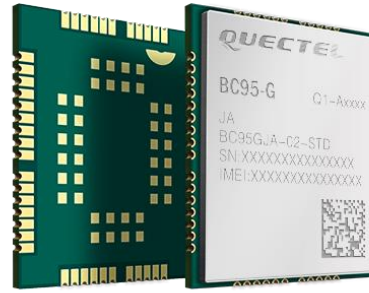
19.9mm x 23.6mm x 2.2mm
LTE Cat.NB1
Compatible with M95

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17.7mm x 15.8mm x 2.0mm
LTE Cat.NB1
Compatible with M66

■ **Single-mode multi-band LTE Cat NB1 (NB-IoT) Module**

| Module	BC95-G	BC68
LTE	B1/B3/B8/B5/B20/B28* @LTE-FDD	B1/B3/B8/B5/B20/B28* @LTE-FDD
Engineering Sample	Q4 2017	Q4 2017
Mass Production	Q1 2018	Q1 2018
Dimension	23.6mm x 19.9mm x 2.2mm	**17.7mm x 15.8mm x 2.0mm**
Region	Global	Global
Certification	CE*, GCF*, JATE*, TELEC*, KDDI*, KC*, Telefónica*, RCM*, ATEX*	CE*, GCF*, JATE*, TELEC*, KDDI*, KC*, Telefónica*, RCM*, ATEX*

NB-IoT Module Specifications

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Module	BC95	BC95-G/ BC68
Chip	Boudica 120	Boudica 150
Band	Single band BC95-B8: 900MHz BC95-B5: 850MH BC95-B20: 800MHz BC95-B28: 700MHz	Multi band B1/B3/B8/B5/B20/B28
LCC Package	23.6mm x 19.9mm x 2.2mm	BC95-G: 23.6mm x 19.9mm x 2.2mm BC68: 17.7mm x 15.8mm x 2.0mm
Data Rate — **Single Tone**	DL: 24kbps; UL: 15.625kbps	DL: 25.2kbps; UL: 15.625kbps
Data Rate — **Multi Tone**	/	DL: 25.2kbps; UL: 54kbps
Protocols	IPv4/IPv6*/UDP/CoAP/DTLS*/LwM2M/Non-IP	IPv4/IPv6/UDP/TCP/CoAP/DTLS/LwM2M/Non-IP/MQTT*
Power Consumption (Typical)	3.6uA @PSM 2mA @Idle mode, DRX=1.28s 220mA @23dBm (Band 8/5/20) 250mA @23dBm (Band 28) 80mA @12dBm (Band 8/5/20/28) 65mA @0dB (Band 8/5/20/28) 60mA @Rx	3.6uA @PSM 2mA @Idle Mode, DRX=1.28s 250mA @Tx, 23dBm (B1/B28*) 230mA @Tx, 23dBm (B3/B8/B5/B20), 80mA @Tx, 12dBm (B1/B3/B8/B5/B20/B28*) 65mA @Tx, 0dBm (B1/B3/B8/B5/B20/B28*) 50mA @Rx
Region	By region	Global

BC95/BC95-G Compatibility

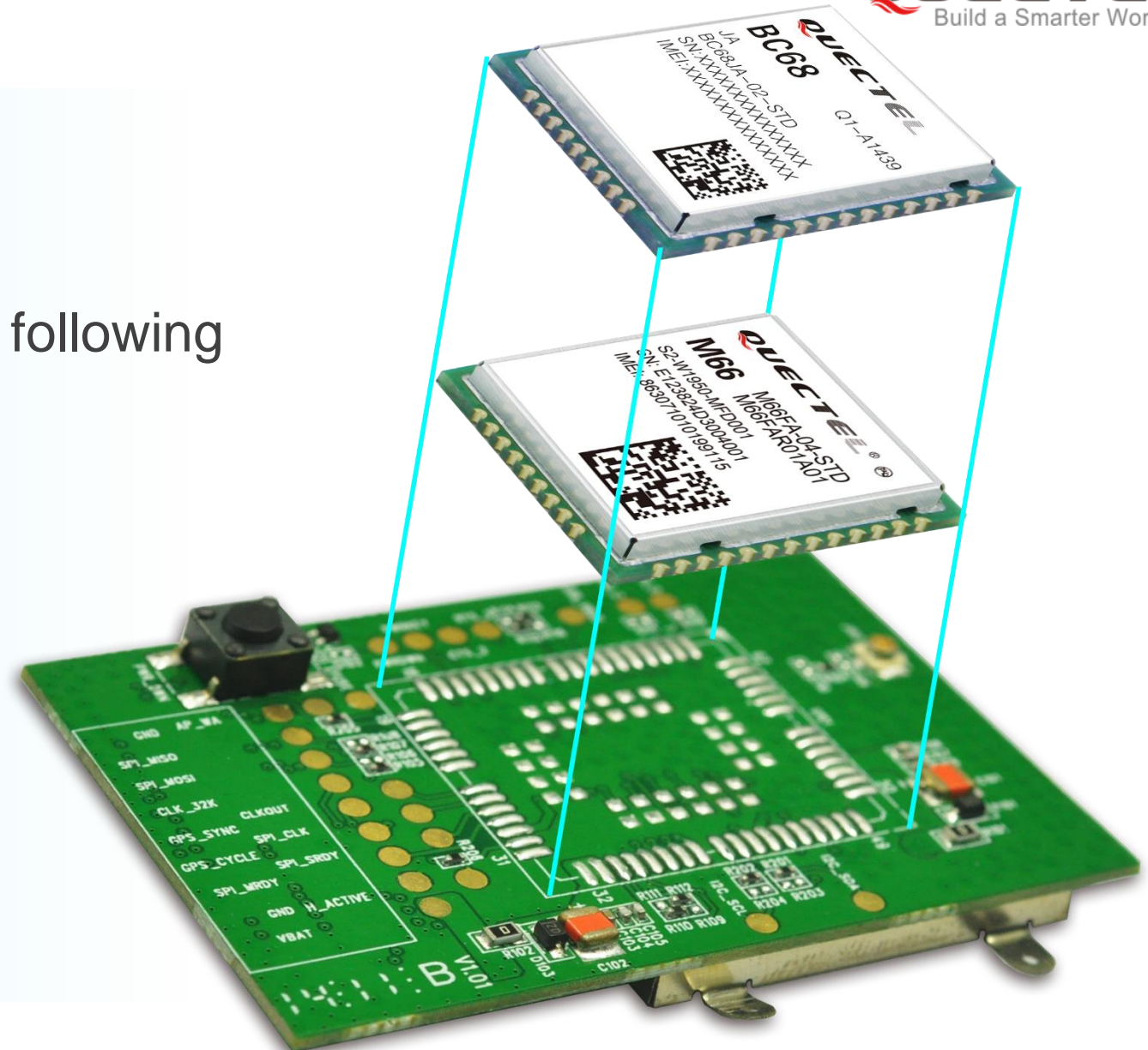BC95/BC95-G is compatible with the following Quectel 2G/3G/4G modules:

- GSM/GPRS M95 modules
- UMTS UG96 & UG95 modules
- LTE Cat 1 EG91 module
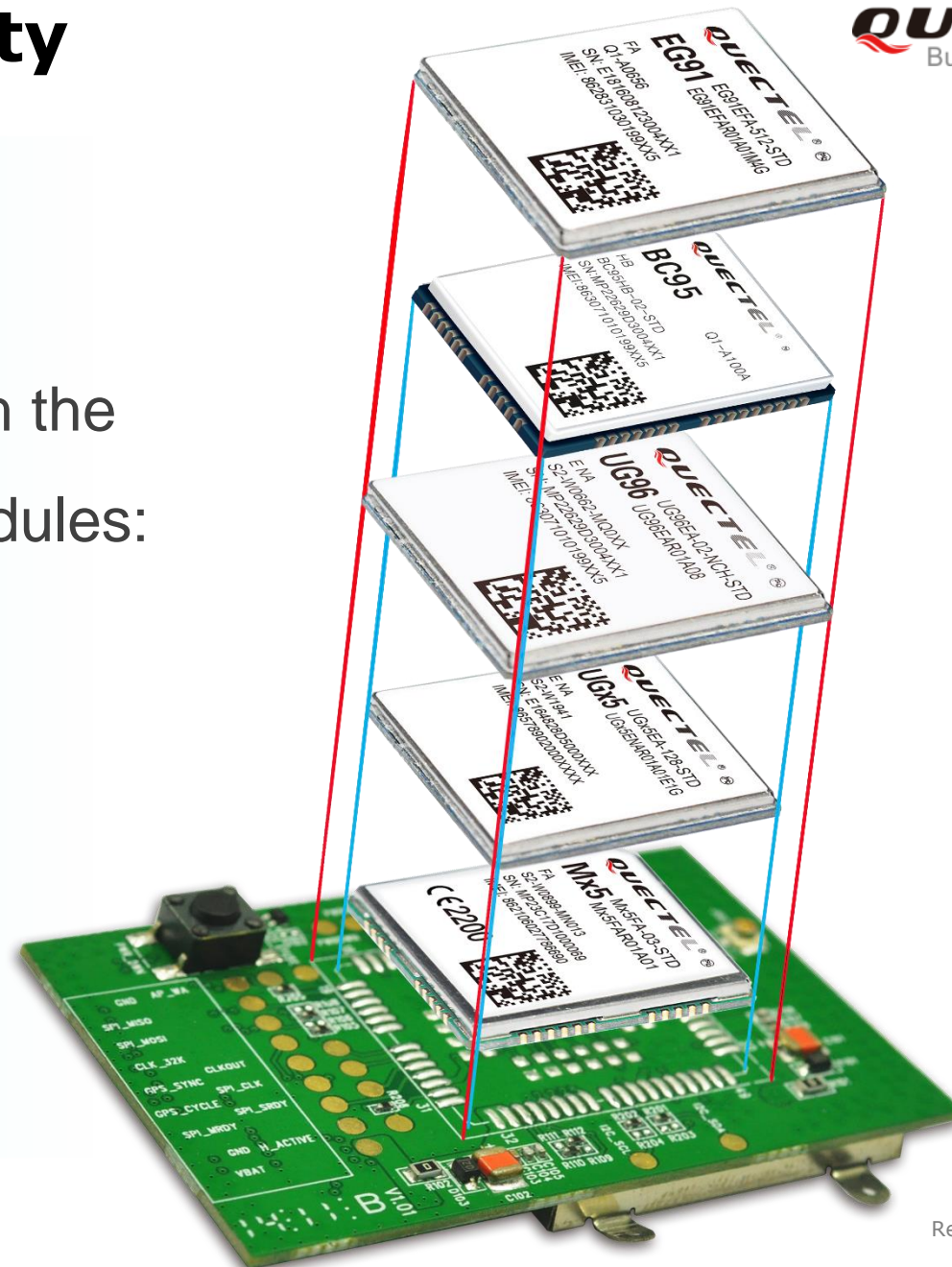
BC68 Compatibility

BC68 is compatible with the following

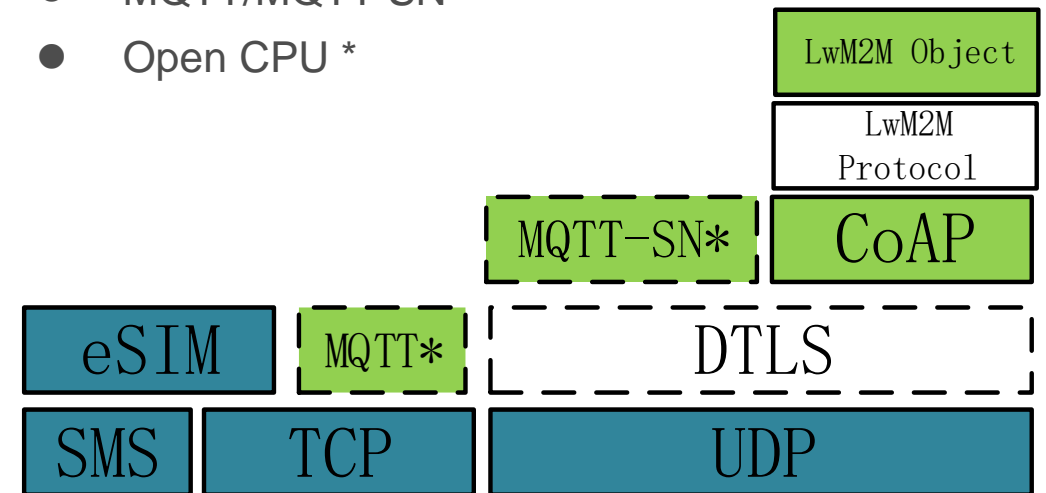Quectel 2G modules:

- GSM/GPRS M66 modules
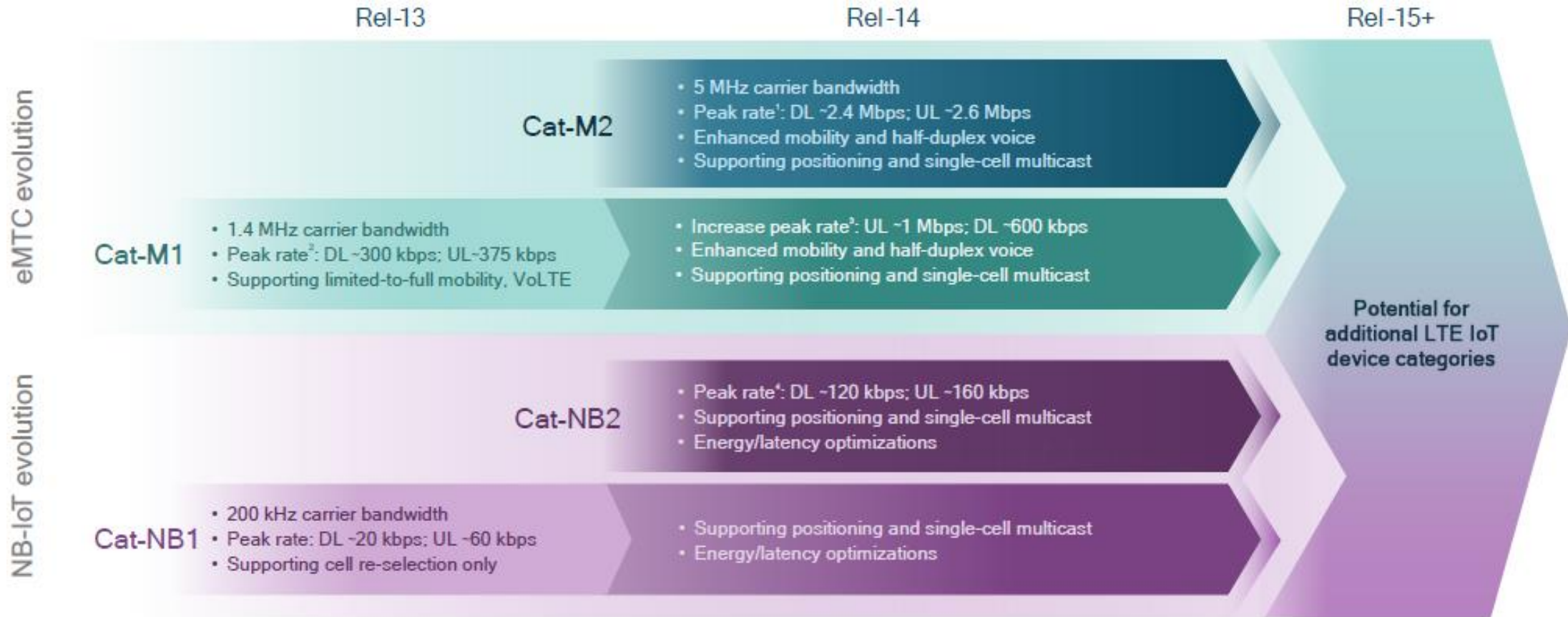
FW plan

BC95 (Free RTOS)

- Huawei platform: SDK+RDK+DFOTA (done)

    B5: for China Telecom auto register (done)

- B8: China Mobile OneNet

    schedule: Oct. Beta version

- Standard LwM2M

    schedule: Nov. Beta version

BC95-G/C68 (Lite OS)

- Huawei platform
- Standard LwM2M
- OneNet
- DFOTA
- DTLS/DTLS plus
- TCP/IP
- eSIM* (integrated in BC95-G)
- MQTT/MQTT-SN *
- Open CPU *

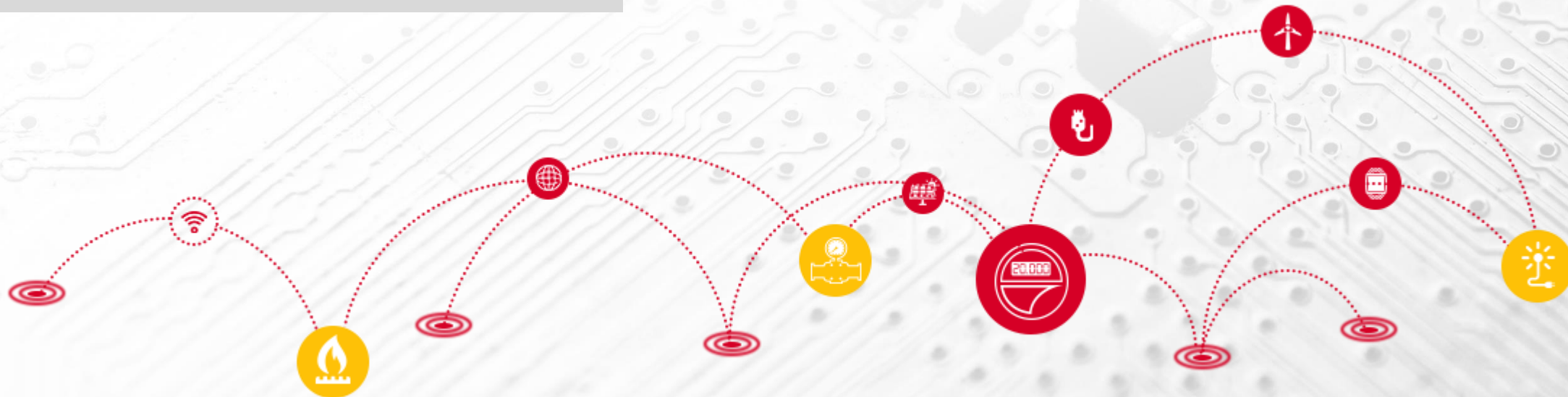| LwM2M Object |
| --- |

	LwM2M Protocol

MQTT-SN*	CoAP

eSIM	MQTT*	DTLS

SMS	TCP	UDP

NB-IoT evolution

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| | Rel-13 | Rel-14 | Rel-15+ |

eMTC evolution

Cat-M2
- 5 MHz carrier bandwidth
- Peak rate[1]: DL ~2.4 Mbps; UL ~2.6 Mbps
- Enhanced mobility and half-duplex voice
- Supporting positioning and single-cell multicast

Cat-M1
- 1.4 MHz carrier bandwidth
- Peak rate[2]: DL ~300 kbps; UL ~375 kbps
- Supporting limited-to-full mobility, VoLTE

- Increase peak rate[3]: UL ~1 Mbps; DL ~600 kbps
- Enhanced mobility and half-duplex voice
- Supporting positioning and single-cell multicast

NB-IoT evolution

Cat-NB2
- Peak rate[4]: DL ~120 kbps; UL ~160 kbps
- Supporting positioning and single-cell multicast
- Energy/latency optimizations

Cat-NB1
- 200 kHz carrier bandwidth
- Peak rate: DL ~20 kbps; UL ~60 kbps
- Supporting cell re-selection only

- Supporting positioning and single-cell multicast
- Energy/latency optimizations

Potential for additional LTE IoT device categories

Quectel 360-degree Support

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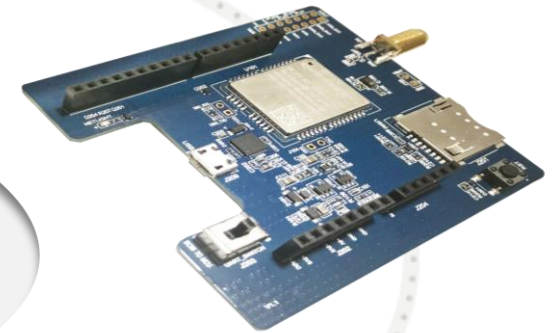Build a Smarter World

1. Design Concept

- Analyze Customer's Demands
- Recommend a Right Module for the Customer
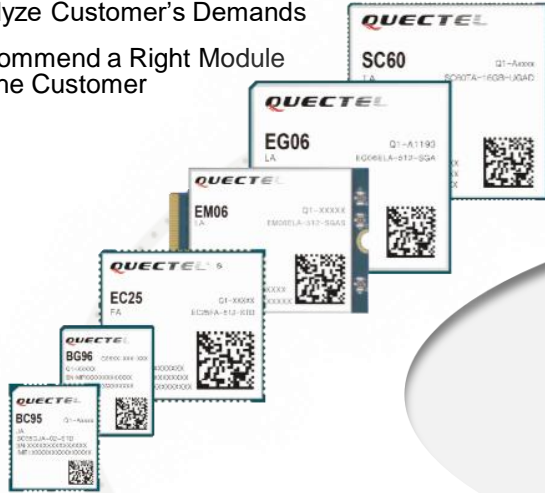
2. Design In

- Recommend Referenced hardware Designs
- Check Schematic and Layout
- Provide Software Design Support

www.quectel.com   86-21-54453668   On-site Support   support@quectel.com

3. Prototype

- Recommend Suppliers

5. Mass Production

- One-year Free Repair and Maintenance
- After-sales Service
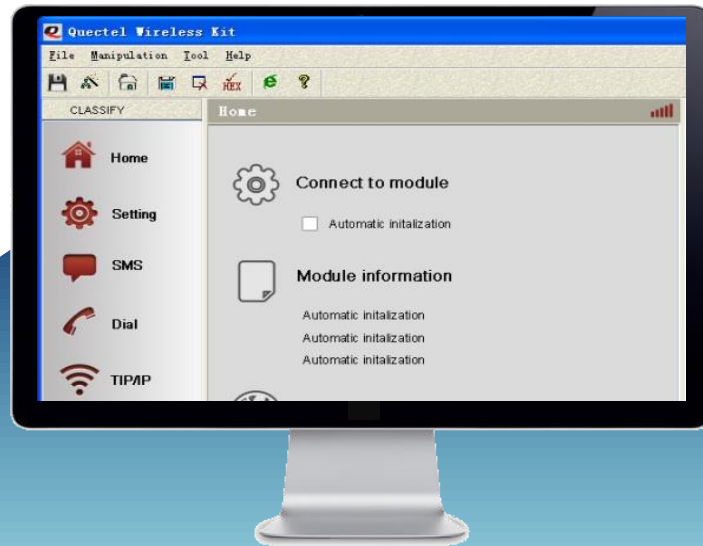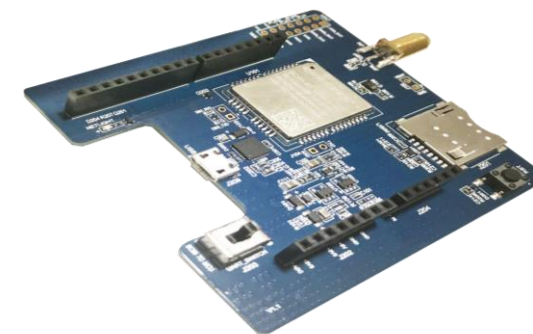
4. RF/EMC Test

- Offer Laboratory

Quick Start

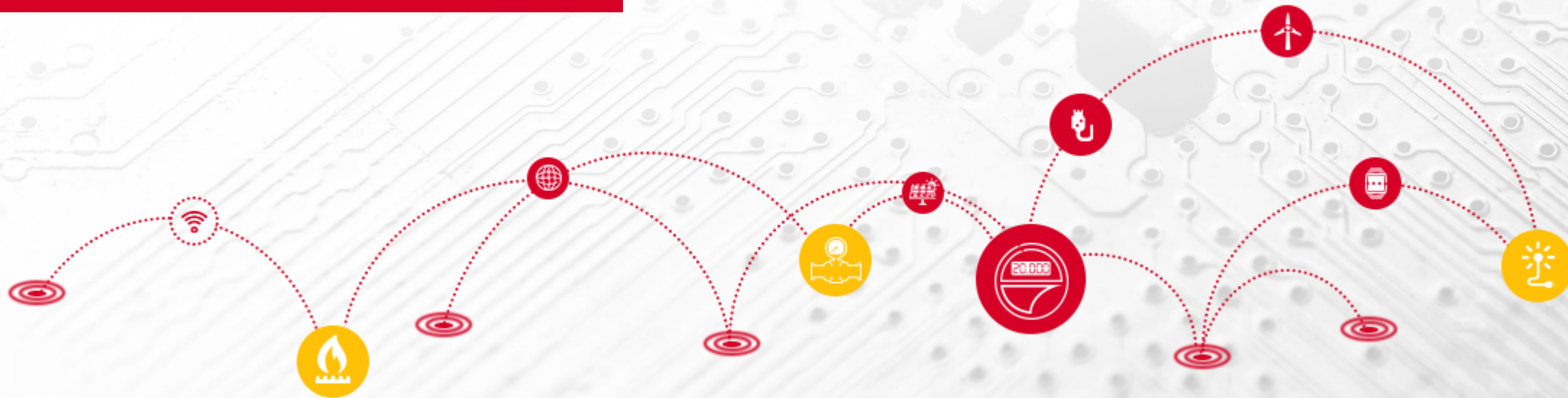**EVB Kit**

TE-B (Arduino Interface)

Quectel offers a GUI tool named **QNavigator**. It can help customers quickly test Quectel module's functionality.

NB-IoT Technology

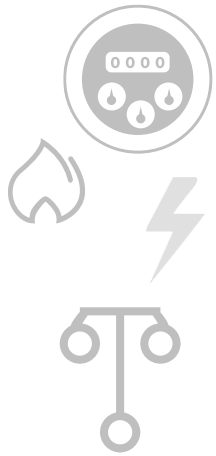Product Overview

Technical Details

Applications

NB-IoT Application Market

Public Utilities

- Water/Gas Metering
- Parking
- Fire Hydrant
- Smoke Alarm
- Street Lighting
- Trash Bin

Personal Life

- Asset Tracking
- Electronics
- Person/Pet Tracking

Quectel

NB-IoT Module

Industry & Agriculture

- Gas Detector
- Soil PH/Optical Sensor
- Machine Alarm
- Irrigation Controller

Smart Home

- Intelligent Door Lock
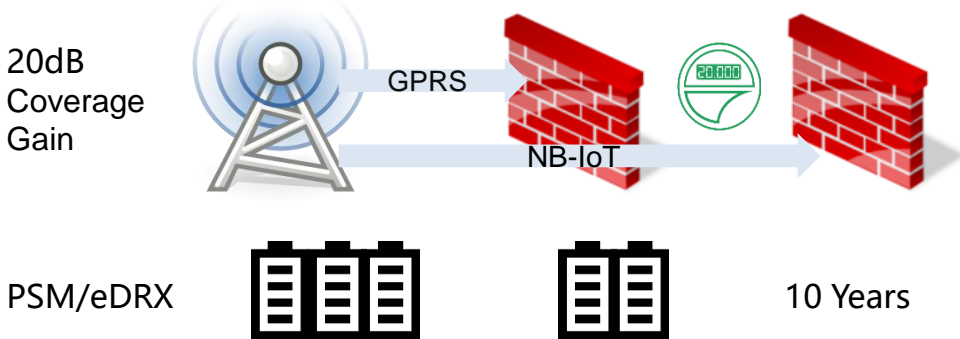- Intelligent Control

Smart Metering

The most suitable solution for water meters

20dB Coverage Gain

GPRS

NB-IoT

PSM/eDRX

10 Years

- ▪ Battery driven
- ▪ Daily water data collection
- ▪ Automatically detect leaks, bursts, tampering and temperature

Smart Metering power consumption

1. The current consumption in the first day is：770uAH+619.2uAH+484.8uAH+3.3uA*24H= 1953.2uAH

2. The current consumption in the left 364 days is:（619.2uAH+484.8uAH+3.3uA*24H）*364= 430684.8uAH

3. So the total consumption in a year is: 1953.2uAH + 430684.8uAH = 432.638mAH

If want the device continuously work for 10 years, it need a battery at least: 432.638mAH *10 = about 4.33AH

Coverage Level	RSRP Value	Power →Sending 200B→PSM				TAU Process		Remark							EDRX cycle time	
		Power on→PSM		PSM→Aattach→sending 200B→Idle(eDRX)→PSM		PSM→TAU→Idle(eDRX)→PSM		typical current consumption in different state							cycle time	active time
		Time (s)	Energy (uAh)	Time (s)	Energy (uAh)	Time (s)	Energy (uAh)	Tx (mA)	Tx-MAX (mA)	Rx (mA)	Idle (mA)	PSM (uA)	Tx 200B Only (uAh)			
0	-93.9	46	398	144	310	121.14	91.8	186.5	200	54.8	5.8	3.3	3.075			
1	-129	63	770	151	619.2	132.76	484.8	194.1	200	55.5	5.8	3.3	19.913 retransmit		40.96s	120s
2	-137	92	1900	162	1252.6	137.8	860.1	195.3	200	57.2	5.8	3.3	64.453 retransmit			

Smart Home

Smoke Detect Alarm

Smart Lock

Home Appliances

- NB-IoT intelligence lock
- Smoke detect alarm
- NB-IoT white goods
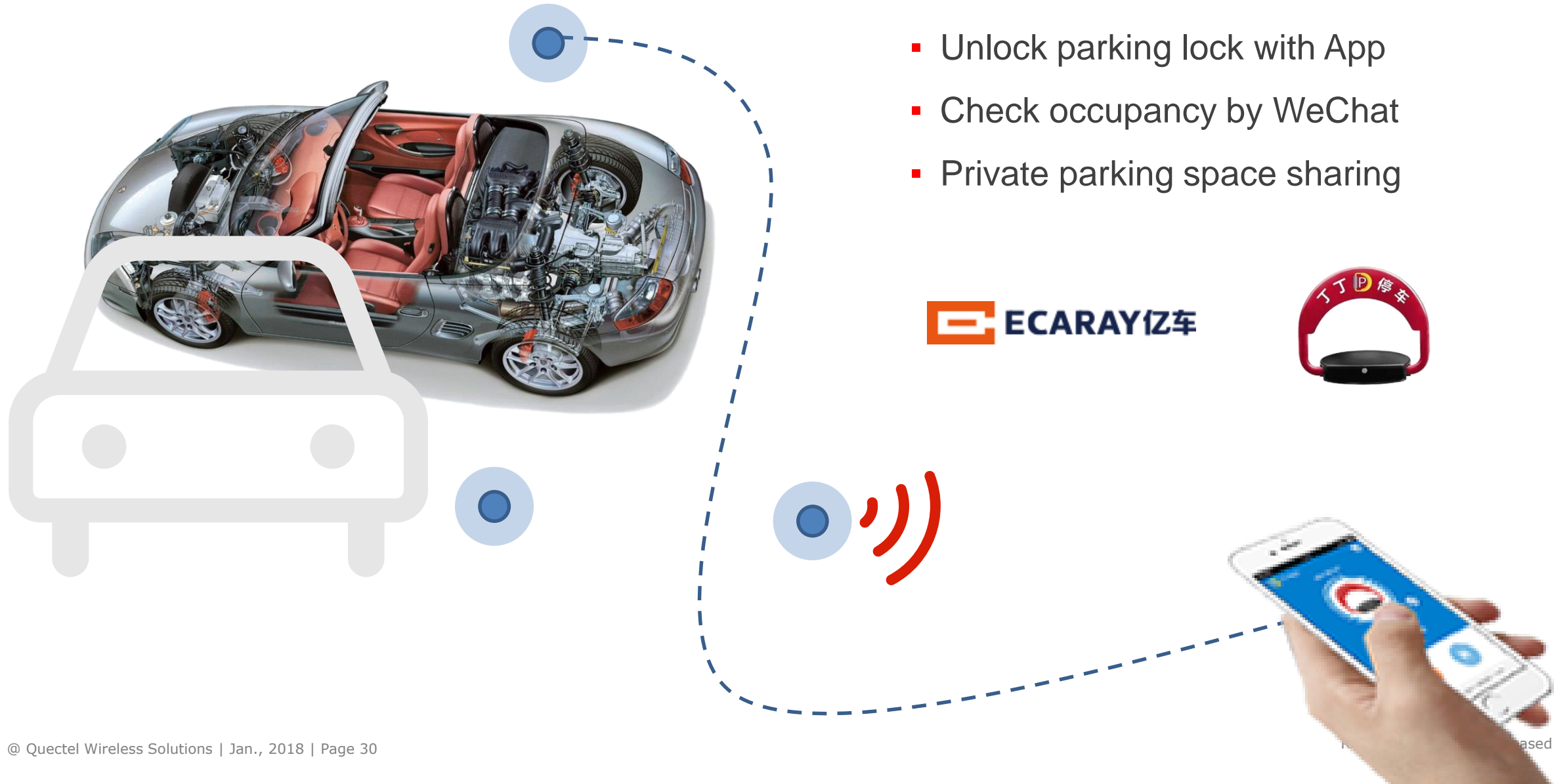- More safety, more convenient, plug in and connect to the platform

分享云

Haier
一个世界一个家

HOTHiNK 昊想智能

Street Lighting

- Real time data feeds directly to the operation center

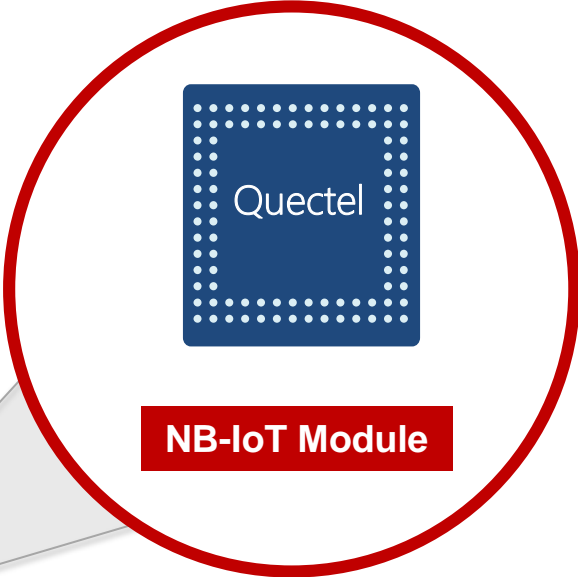- Manual brightening of lighting when required

- Energy efficiency improving

泰华智慧

比弦物联
bettershine

Parking

- Unlock parking lock with App

- Check occupancy by WeChat

- Private parking space sharing

Bike Sharing

NB-IoT Module

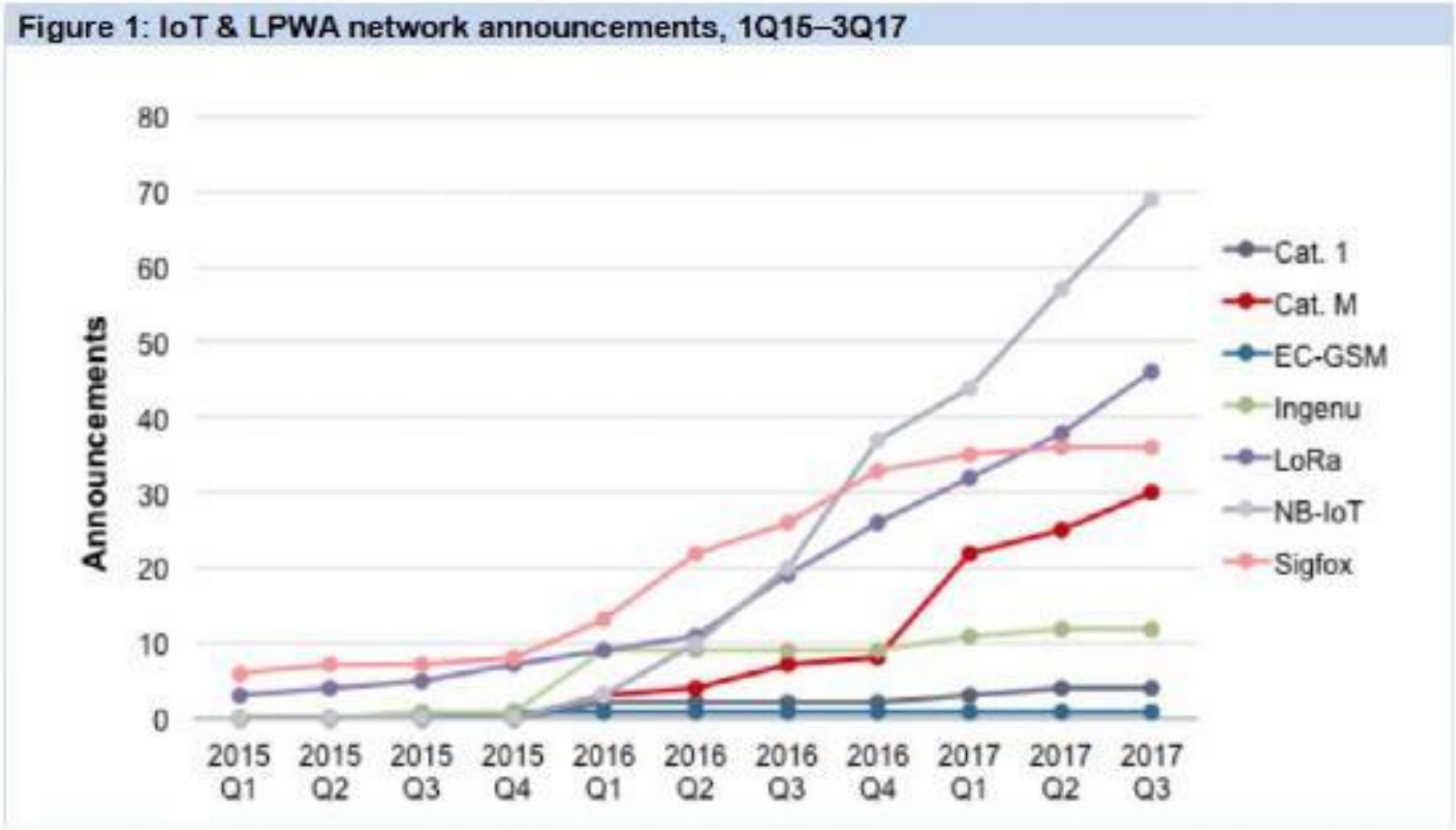ıs: Released

Animal Testing

- Monitor health and safety of the cattle
- Improve milk yield and in time cow breeding

AOTOSO 银川奥特信息技术股份公司

Operators Involved in NB-IoT

Operator LPWA deployment plan

Figure 1: IoT & LPWA network announcements, 1Q15–3Q17

Legend: Cat. 1, Cat. M, EC-GSM, Ingenu, LoRa, NB-IoT, Sigfox

Source: Ovum IoT & LPWA Network Deployment Tracker, 3Q17. Note: Announcements include planned, trial, and live deployments.

Thank you!

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Website: **www.quectel.com**