datacentrix showcase 2017

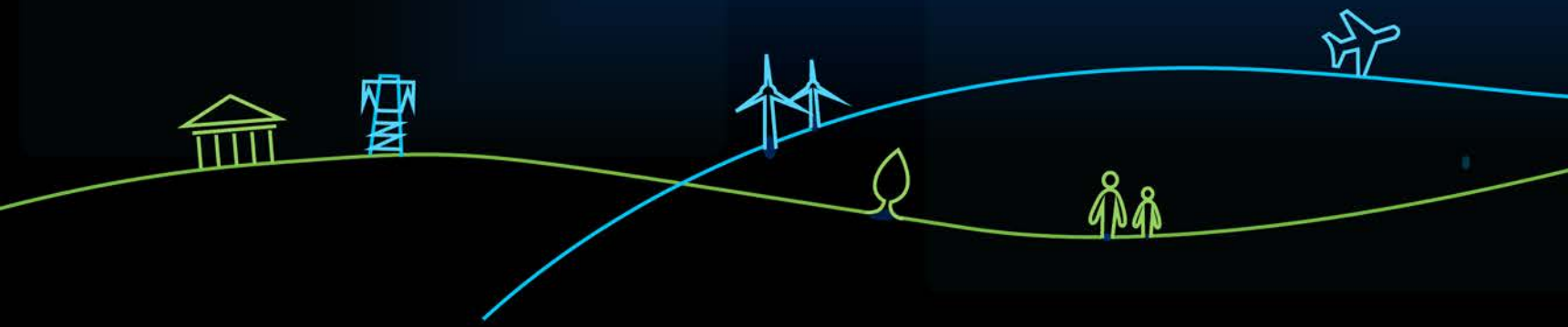
the reality of singularity

HUAWEI

Power IoT

DAVID RANDOLPH HOELSCHER

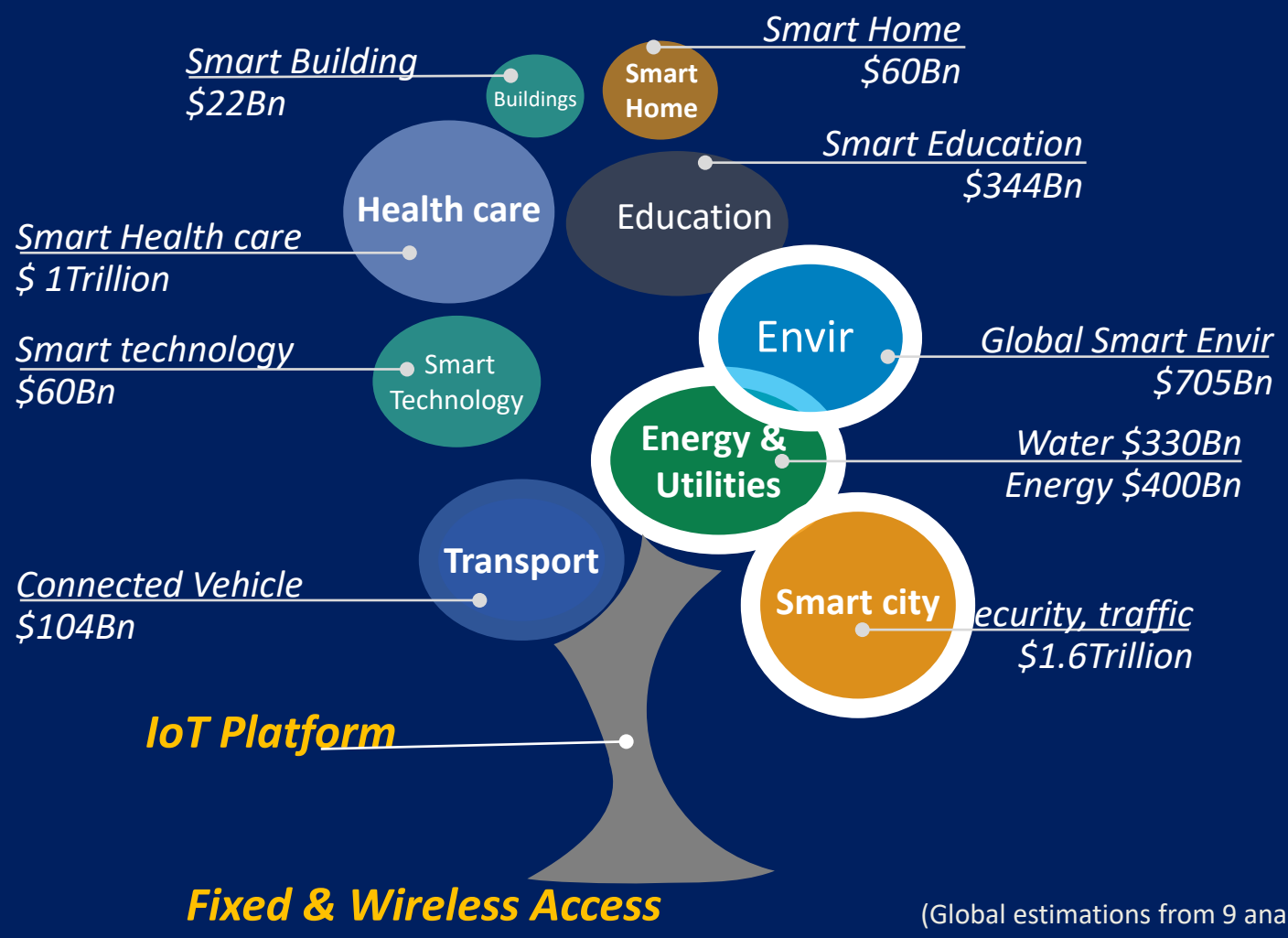
Director of IOT Marketing
Huawei Technologies



Content

- C-IoT Insight
- NB-IoT Industry update
- NB-IoT Use Cases Ecosystem

IoT connectivity A New look At Utility Opportunities



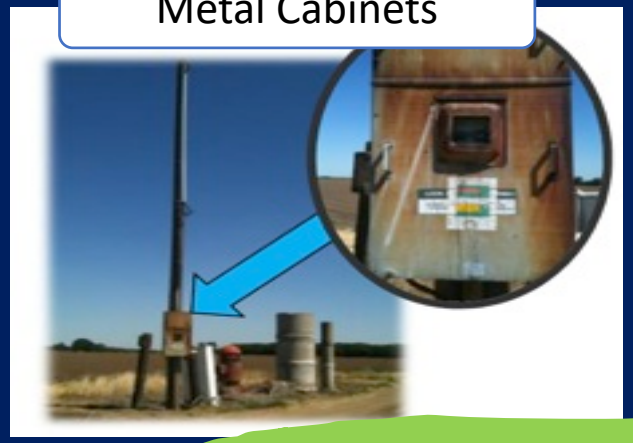
* Mc Kinsey Global Research 2015

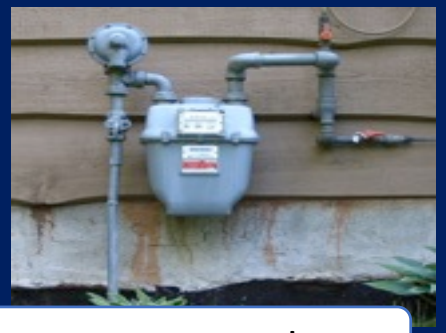
(Global estimations from 9 analytics agencies, eg. Ovum, GSMA, Gartner)

Why LPWA?
The Challenge - IoT Apps in Difficult RF Environments

Indoors

Metal Cabinets





Battery Powered

Wide Coverage Area

Remote Locations

Underground

C-IoT is designed to provide wide WAN coverage

100K
Connections/cell

20dB
Deeper coverage

10 years
Low power

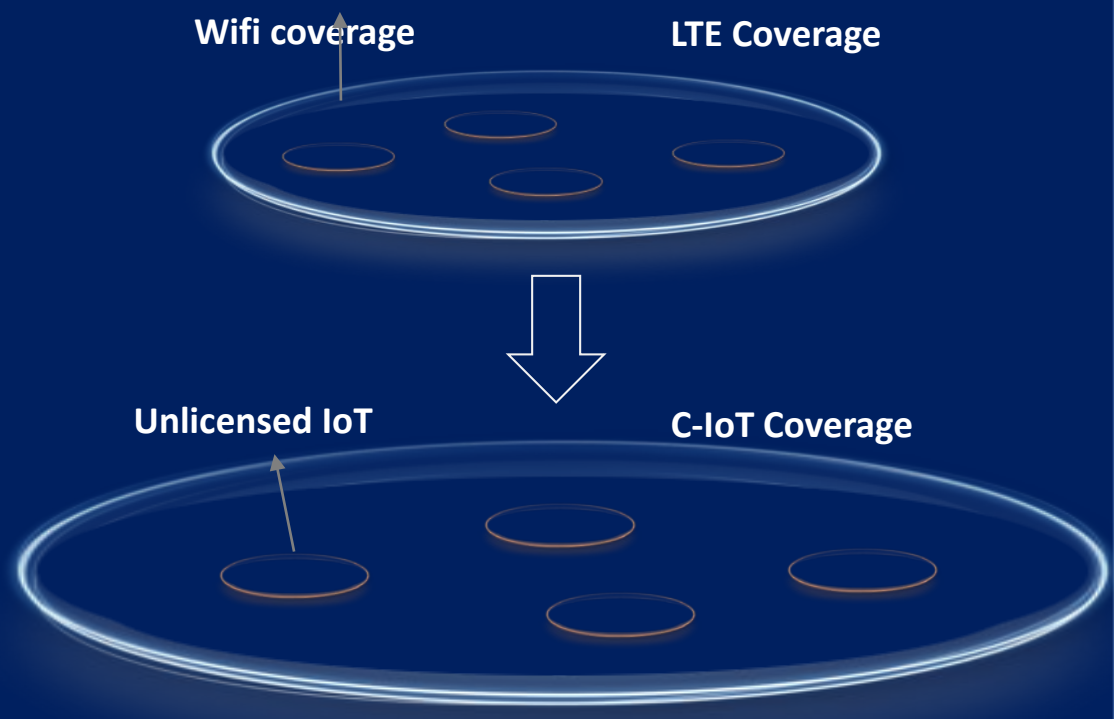
C-IoT

Re-use existing Cellular network Hardware + Spectrum

Carrier-grade Reliability

3GPP 4G-Like Security

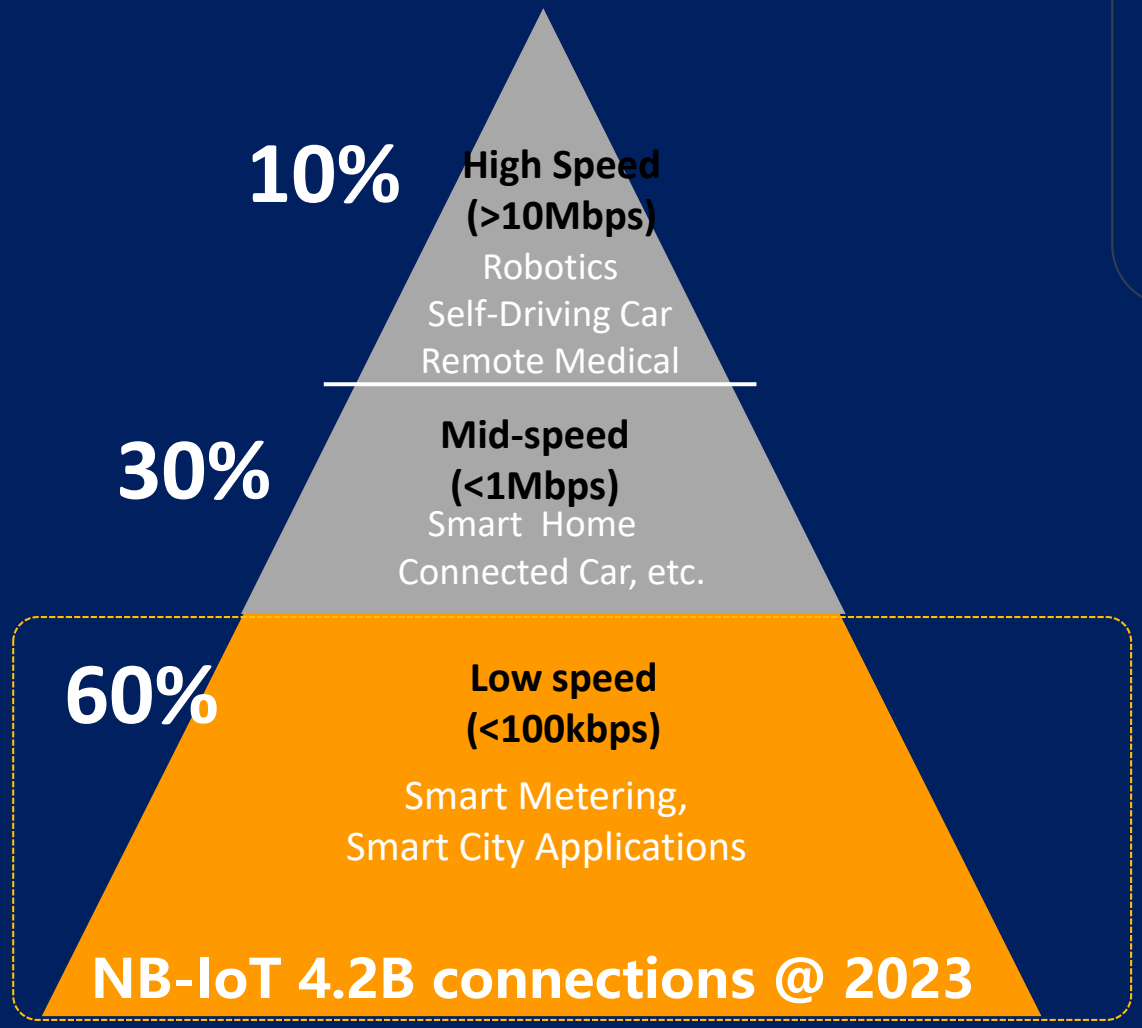
Roaming



- Unlicensed technology is for local coverage
- C-IoT is for wide coverage

NB-IoT: the best addressing the LPWA market

- ❑ *Wide Coverage:* *100x4G*
- ❑ *High Quality* *Licensed Spectrum*
- ❑ *Massive Connection:* *100k/cell*
- ❑ *Cost effective -- CAPEX* *Infrastructure reuse*
- ❑ *Cost effective -- OPEX* *~ 10 yrs battery*
- ❑ *Cost effective -- Terminal* *$5 module*



Global Cellular IoT connections

	Connection (M) 2016	Connection (M) 2020	Market ($100M) 2020
Meter	320	1,300	1 8 3
Parking	3.4	24	73
Tracing	18	210	39
Agriculture	35	150	27
Lighting	24	190	24
Monitoring	4.3	31	18
Livestock	7.3	64	12

NB-IoT -- LTE technology with 200KHz System Bandwidth

Downlink
OFDMA

15KHz *12 = 180KHz

Peak Rate: ≈ 200Kbps

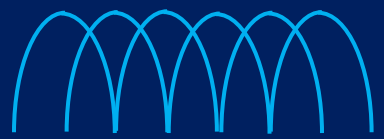
Uplink
SC FDMA

singletone

15KHz

Peak Rate: ≈ 22.4Kbps

multitone



15K *12 = 180KHz

Peak Rate: ≈ 200 Kbps

- Narrow band match small package IoT service model
- Accommodate large number IoT traffic model terminal
- Fit in-band scenario

NB-IoT -- Deep Coverage: Main Features

1. Power Spectrum Density Boosting

Typical Case

IoT Device:200mw

Data Package
(e.g100 byte)

2G/3G/LTE Solution

Average Power=
200mW/180kHz

180 KHz

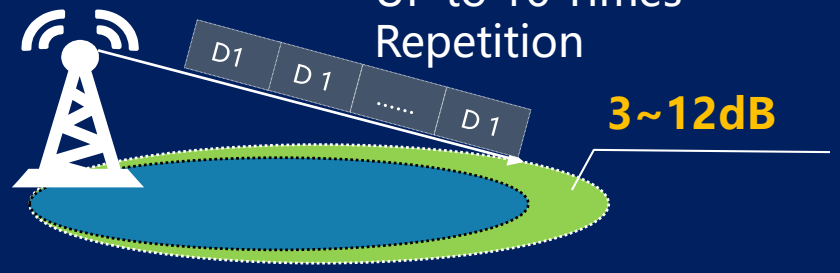
36 times/17dB

NB IoT Solution

Average Power=
200mW/3.75kHz

3.75 KHz

2. Repetition

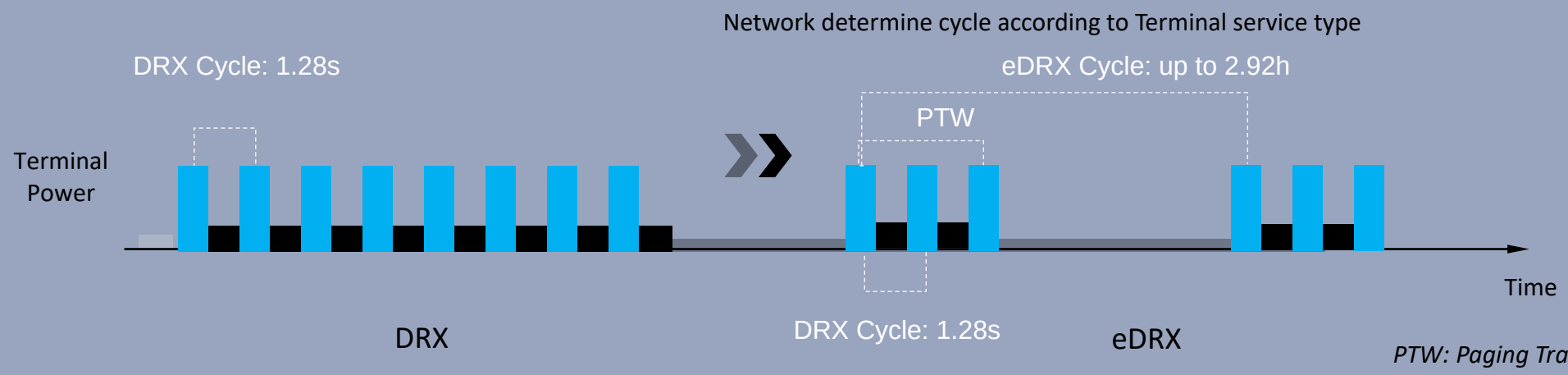


3. UL Receive Diversity

Energy Saving: PSM + eDRX

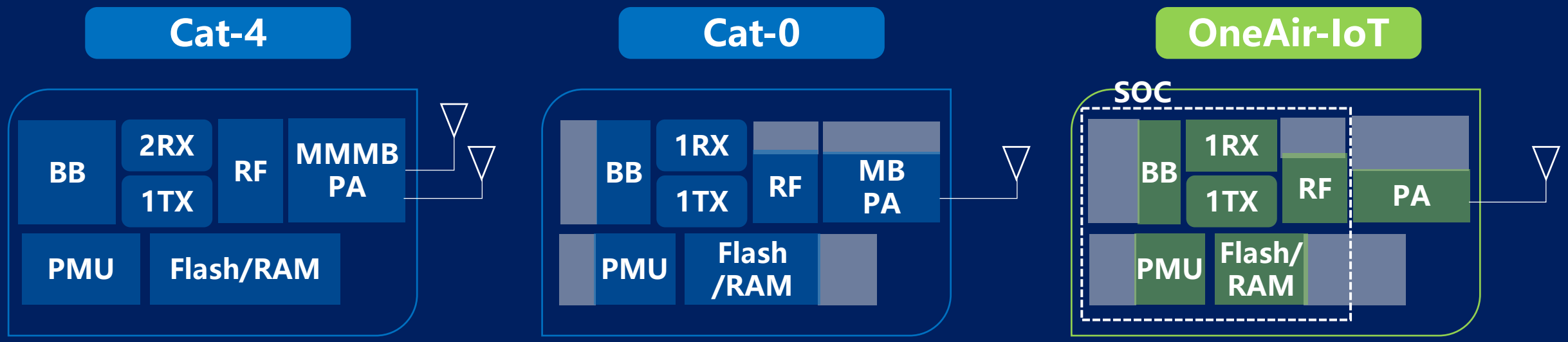
PSM(Power Saving Mode)

eDRX(Extended DRX)



PTW: Paging Transmission Window

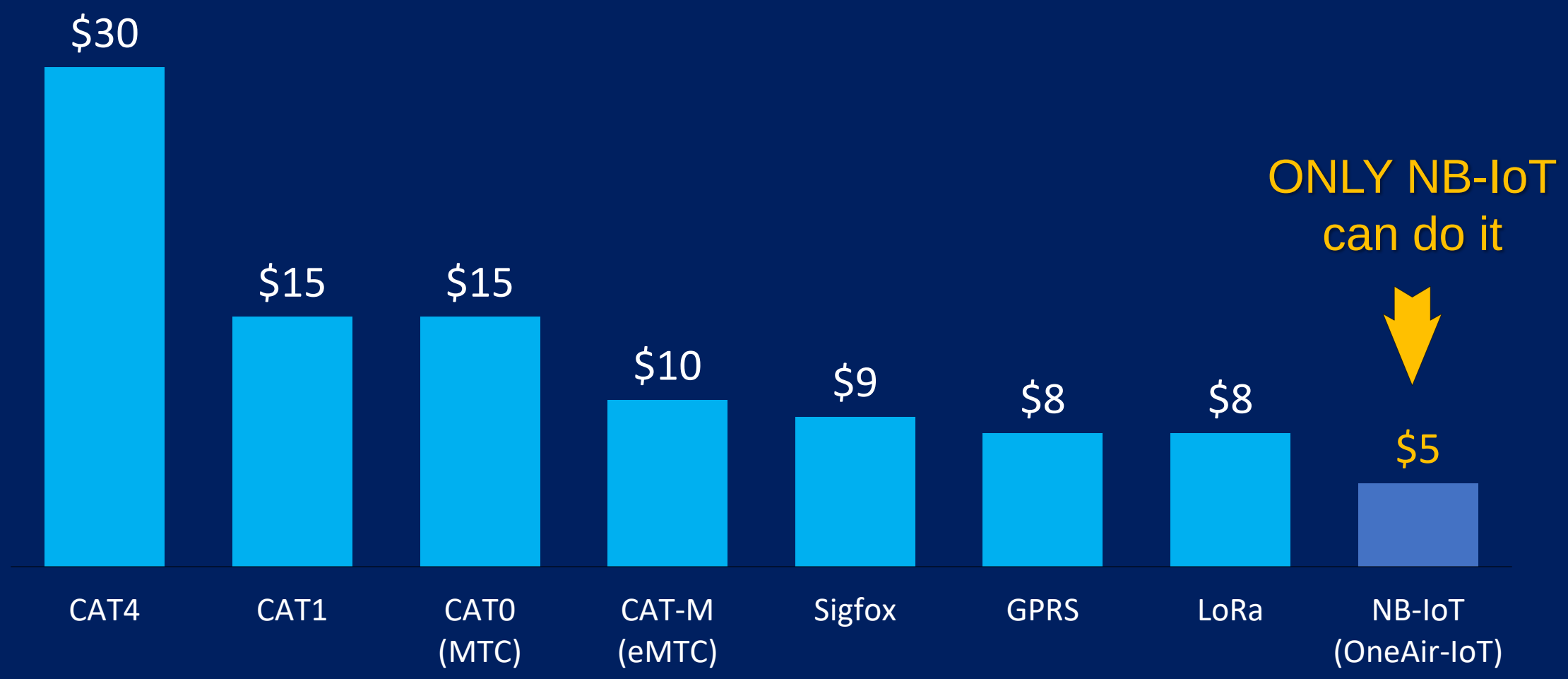
NB-IoT -- Low Cost: Chipset/Module



MMMB: Multi-Mode, Multi-Band PA
MB: Multi-Band
BB: Baseband
PMU: Power Management Unit
PA: Power Amplifier
SOC: System on Chip

- SOC Solution
- Half Duplex RF/Single Antenna /Reduced Memory
- Narrow Band/UL Single-Carrier Modulation
- Simplified Process

5 USD Module is Competitive for LPWA Market



R14: Positioning to simplify device requirement

NB-IoT Tracking Technologies Overview:

GPS + NB-IoT (Connectivity)

NB-IoT (OTDOA)

- Device cost: ~50USD
- Accuracy: 10m
- Latency:30s
- Power consumption:

0.3mAh/Report

- Device cost: ~40USD
- OTDOA: 30~50m
- Latency:10s
- Power consumption:

0.2mAh/Report

NB-IoT Tracker

BaaS Business Model:

Kids tracking (GizmoPal)

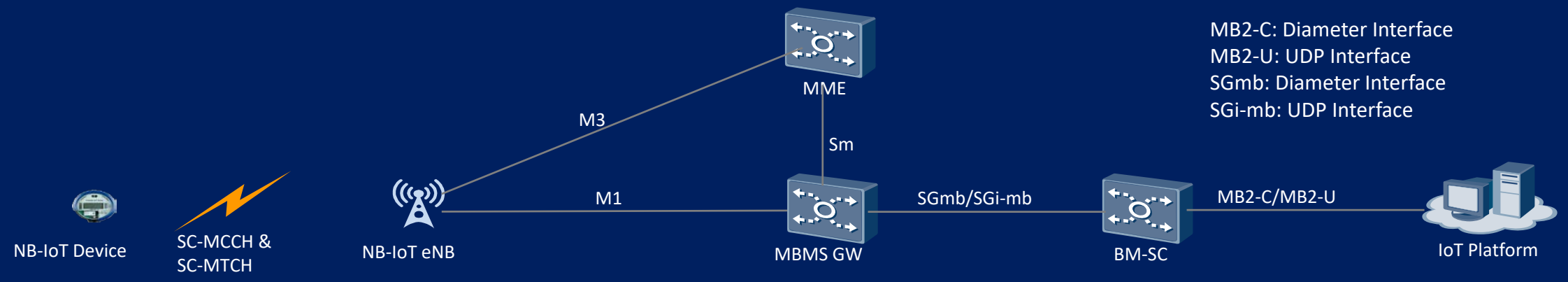
Monthly service fee: 5USD

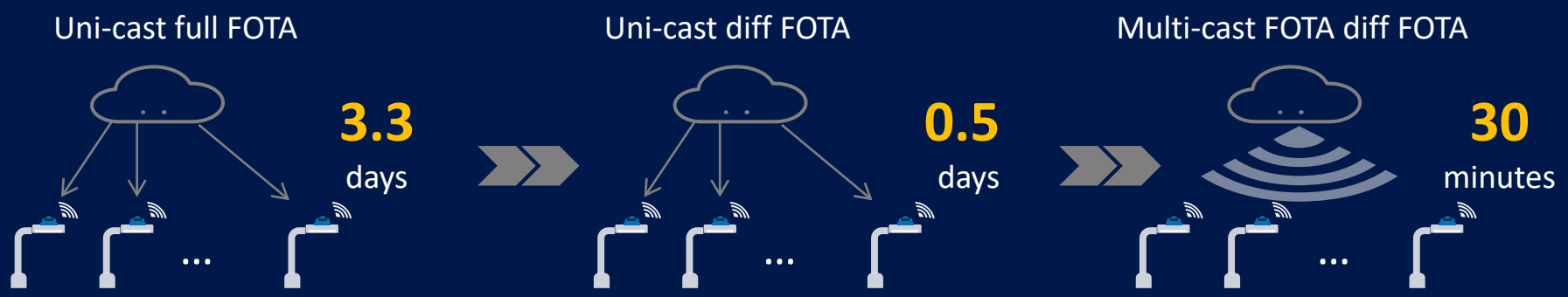
Kids tracking (Filip2 Tracker)

Monthly fee:

USD10 for voice and data

R14: Multicast to improve network performance



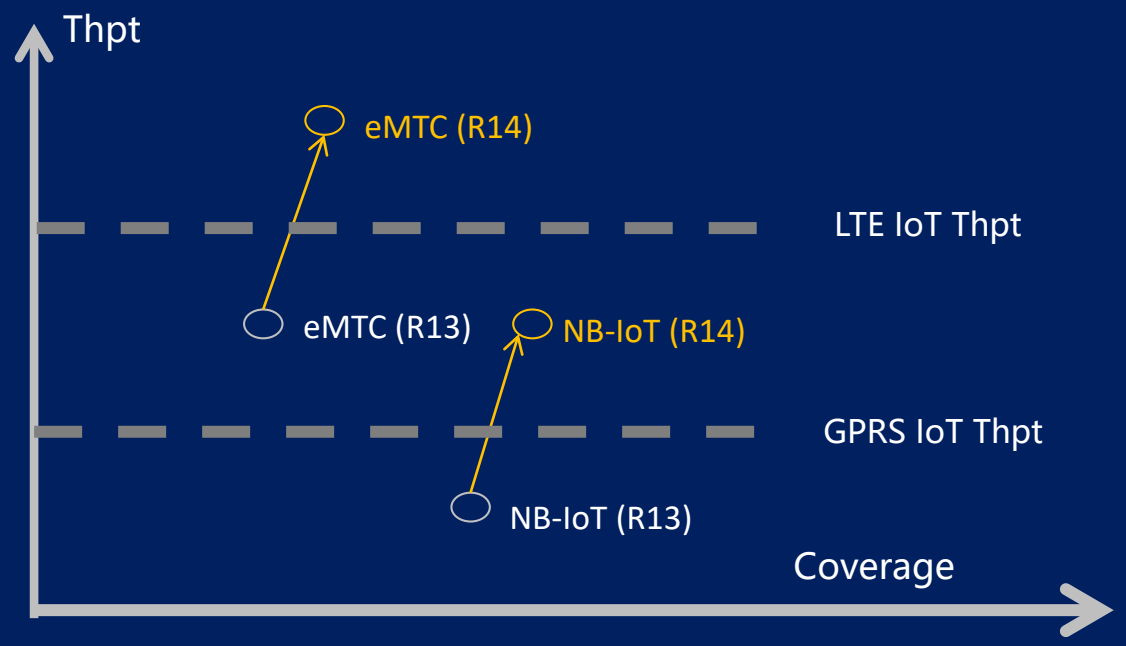


Dependency:

- Need chipset support broadcasting
- Need add MBMS GW & BM-SC

Assumption: 100 device, full package: 750KB, diff package: 100KB

R14: Throughput evolution: NB-IoT to replace GPRS
eMTC to replace CAT-1 and 3G M2M



	2016	2017	2018	2019
OBD				
POS	GPRS			
Pet tracking				
Logistic tracking			NB-IoT	
Smart parking				
Street light				
Smart metering				

DL: 80kbps
UL: 106kbps

DL: 21.25kbps
UL: 15.62kbps

NB-IoT/eMTC Standard's evolution path to 5G

NB-IoT

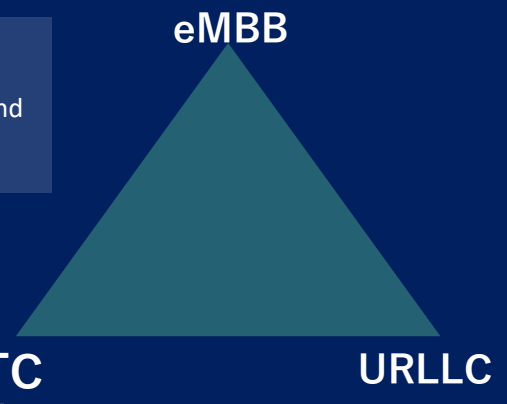
Rel-14	Rel-15
• Positioning E-CID OTDOA • SC-PTM • 14dBm output power • Peak throughput improvement (DL 114kbps/UL 142.5kbps)	• TDD NB-IoT • RRM measurement, latency improvement • **NPRACH enhancement** • **Differ group QoS**

eMTC

Rel-14	Rel-15
• Positioning OTDOA • SC-PTM • VoLTE coverage improvement (5dB) • 5MHz/20MHz bandwidth (UL 3Mbps/7Mbps DL 4Mbps/27Mbps)	• Capacity improvement: Sub-PRB eMTC (45KHz) • **64QAM** • Low UE output power

Technology:

NR LTE to cover high band and low band

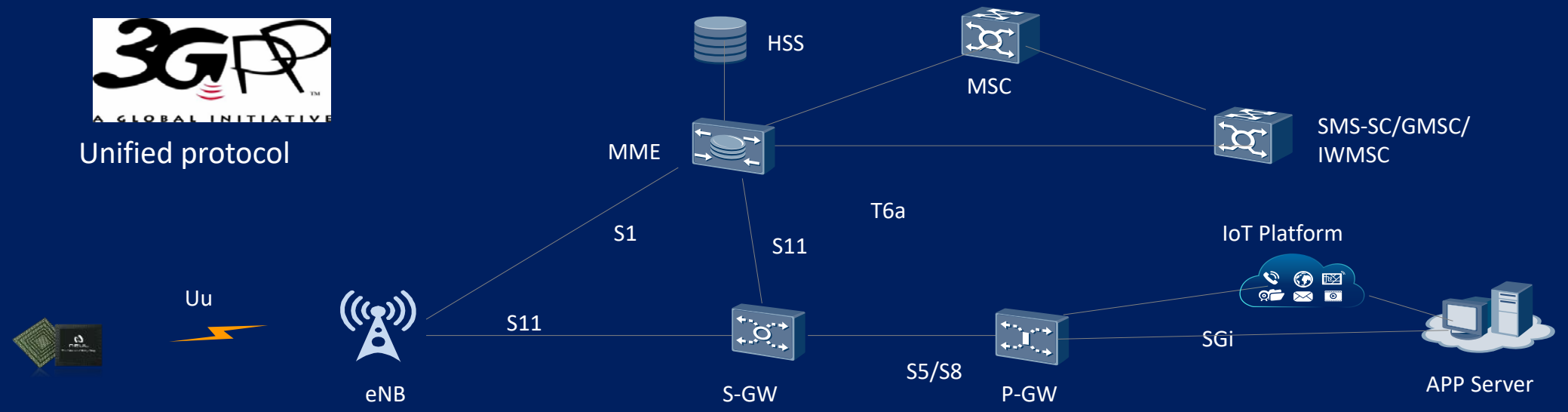


Technology:

NB-IoT,

- mMTC NR will not be considered until R17;
- NB-IoT will be used to cover 5G mMTC use case before R17

Industry Testing to Guarantee Inter-vendor operability



IODT → MVI → Commercial

Test between vendors

Test in operator's lab

Verification in commercial network

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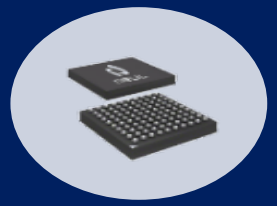
Huawei Chipset and Network are Commercially Available



2016.Q4 — Boudica 120 ES

2017.Q1 — Boudica 120 CS

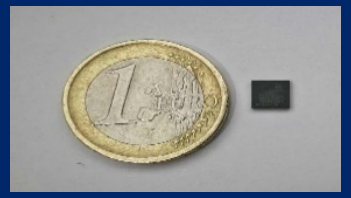
2017.Q2

2017.Q3

2017.Q4 — Boudica 150 CS

High Integration

- SOC: BB +RF +PMU + AP/SP/CP + eFlash + SRAM
- Three ARM Cores: AP+CP+SP



Boudica 120 (3GPP R13)

- Bands: 5/8/20/28
- DL 21.2Kbps / UL 15.6Kbps
- PSM / eDRX / cDRX
- Coverage Level Selection
- Paging
- 20dB Coverage Gain
- SMS, IP / Non-IP
- Single Tone
- Application for 3rd party integration (2017 Q2) (TUP/CoAP/FOTA/LWM2M/DTLS/TCP/eSIM)

Boudica 150 (3GPP R13&R14)

- Bands: 5/8/20/28/3/1
- DL 80Kbps / UL106Kbps
- Positioning (OTDOA)*
- Multicast (SC-PTM) *
- Data over user-plan*
- Single Tone / Multi-tone
- AP Open for 3rd party

* Planning Feature

NB-IoT: SRAN12.0 GA — SRAN12.1 GA — Global Commercialization

eMTC: SRAN12.1 trial — SRAN12.1 GA — Project Starts with Mature Chipset

Module Readiness for NB-IoT Device Integration

NB-IoT Module readiness in 2016

Ublox:SARA-N2
NB-IoT

Quectel:BC95
NB-IoT

NB-IoT module received
Global Certification Forum certification

More chipsets and modules will be ready in 2017

MDM 9206

XMM 7315

Monarch

Deutsche Telekom rollout NB-IoT: 8 countries in Europe in 2017

Commercial plan:

NB-IoT rollout across Europe in 8 countries in 2017

Germany: commercial launch in 2017Q2

Netherland: Nationwide coverage in 2017

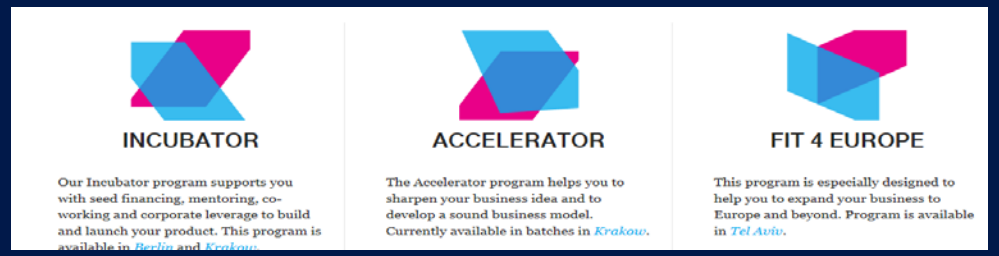
Use cases:

Smart building:

- Heat consumption
- Water consumption
- Intelligent smoke alarms

Parking

Develop ecosystem through NB-IoT Prototyping Hub

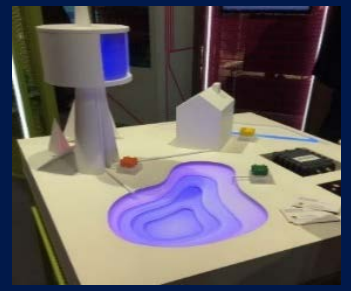


Support plan for startups:

Demo Kit → Lab trial → Field trial → Roll out

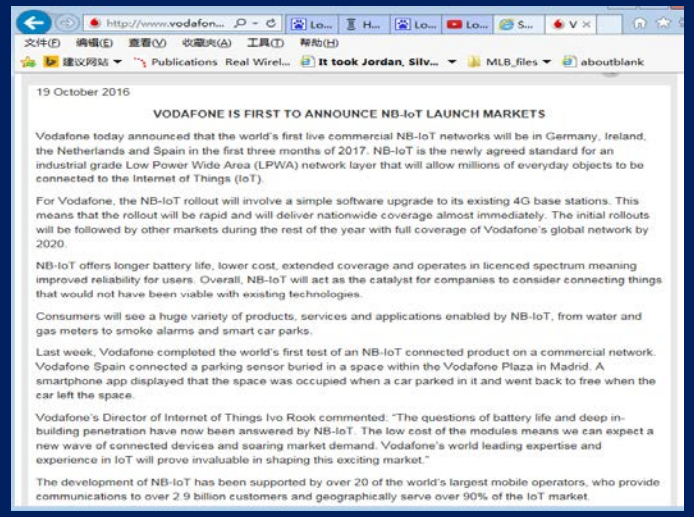
Examples of use case innovation through prototyping hub:

Bee hive monitoring



Smart water management

Vodafone announced the commercialization of NB-IoT



19 October 2016

VODAFONE IS FIRST TO ANNOUNCE NB-IoT LAUNCH MARKETS

Vodafone today announced that the world's first live commercial NB-IoT networks will be in Germany, Ireland, the Netherlands and Spain in the first three months of 2017. NB-IoT is the newly agreed standard for an industrial grade Low Power Wide Area (LPWA) network layer that will allow millions of everyday objects to be connected to the Internet of Things (IoT).

For Vodafone, the NB-IoT rollout will involve a simple software upgrade to its existing 4G base stations. This means that the rollout will be rapid and will deliver nationwide coverage almost immediately. The initial rollouts will be followed by other markets during the rest of the year with full coverage of Vodafone's global network by 2020.

NB-IoT offers longer battery life, lower cost, extended coverage and operates in licenced spectrum meaning improved reliability for users. Overall, NB-IoT will act as the catalyst for companies to consider connecting things that would not have been viable with existing technologies.

Consumers will see a huge variety of products, services and applications enabled by NB-IoT, from water and gas meters to smoke alarms and smart car parks.

Last week, Vodafone completed the world's first test of an NB-IoT connected product on a commercial network. Vodafone Spain connected a parking sensor buried in a space within the Vodafone Plaza in Madrid. A smartphone app displayed that the space was occupied when a car parked in it and went back to free when the car left the space.

Vodafone's Director of Internet of Things Ivo Rook commented: "The questions of battery life and deep in-building penetration have now been answered by NB-IoT. The low cost of the modules means we can expect a new wave of connected devices and soaring market demand. Vodafone's world leading expertise and experience in IoT will prove invaluable in shaping this exciting market."

The development of NB-IoT has been supported by over 20 of the world's largest mobile operators, who provide communications to over 2.9 billion customers and geographically serve over 90% of the IoT market.

Who we are | What we do | Investors | Media | Career

The future in our hands with the commercial launch of NB-IoT in Vodafone Spain

23 Jan 2017 by Santiago Tenorio, Vodafone Group Head of Network Strategy & Architecture @VodafoneGroup

Welc... | What... | Tech... | Commercial launch of NB-IoT in Vodafone Spain

Vodafone's first commercially available Narrowband Internet of Things (NB-IoT) network is now operational in Spain. This network will soon have the capability to connect more than 100 million new devices to the internet of things.

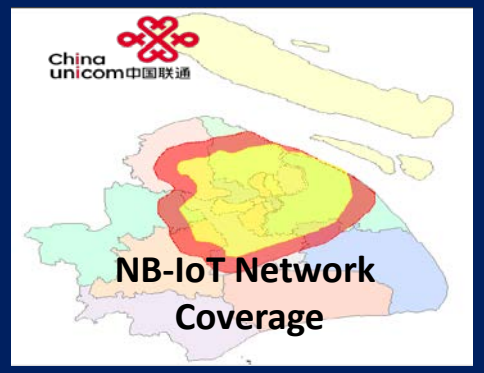
- 4 countries in Europe (Germany, Ireland, Netherlands and Spain) will commercially launch NB-IoT in 2017.

- Announced the commercialization of NB-IoT on 23rd Jan 17
- **1000** sites activated NB-IoT in Spain by the end of march 2017
- Took just a few hours to deploy NB-IoT with software upgrade in Valencia

- Madrid, Valencia, Barcelona are covered, Plan to cover 6 cities in 2017H1

China Unicom: 800+ Sites Activated NB-IoT in Shanghai

Shanghai Unicom:



- **800+** base stations covered Shanghai in 2016Q4

- Pre-commercial announced

Network readiness accelerates the development of vertical customers

Parking operator

Smart Parking

Gas Utility

Smart Gas Meter

Fire center

Smart Fire Protection

11 use cases ready

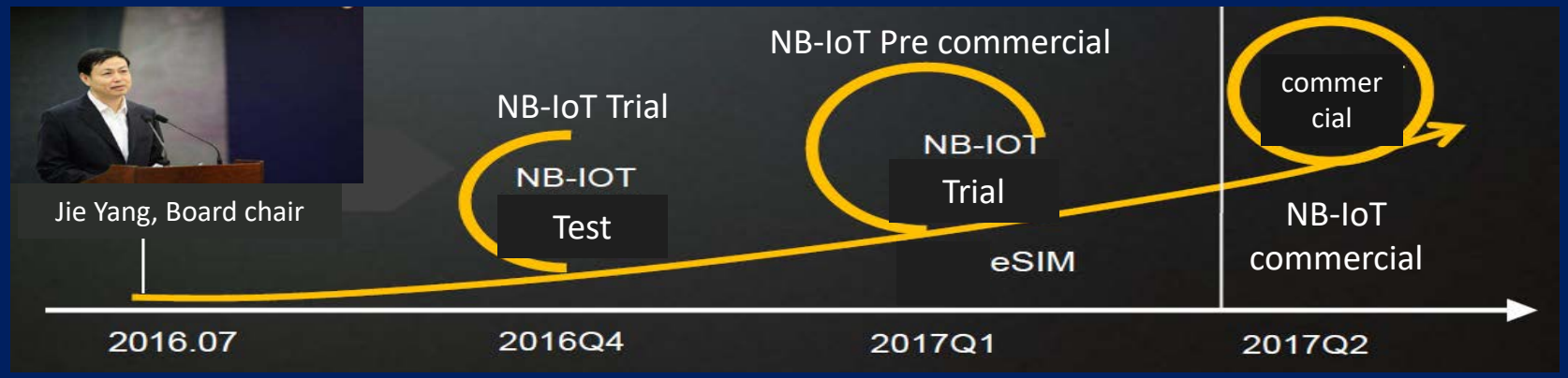
Street light

Door lock

Tracker

Pipe monitor

China Telecom: NB-IoT Nationwide Coverage in 2017H1



- 2017H1, NB-IoT will be enabled in L850 to achieve national wide coverage

Use cases

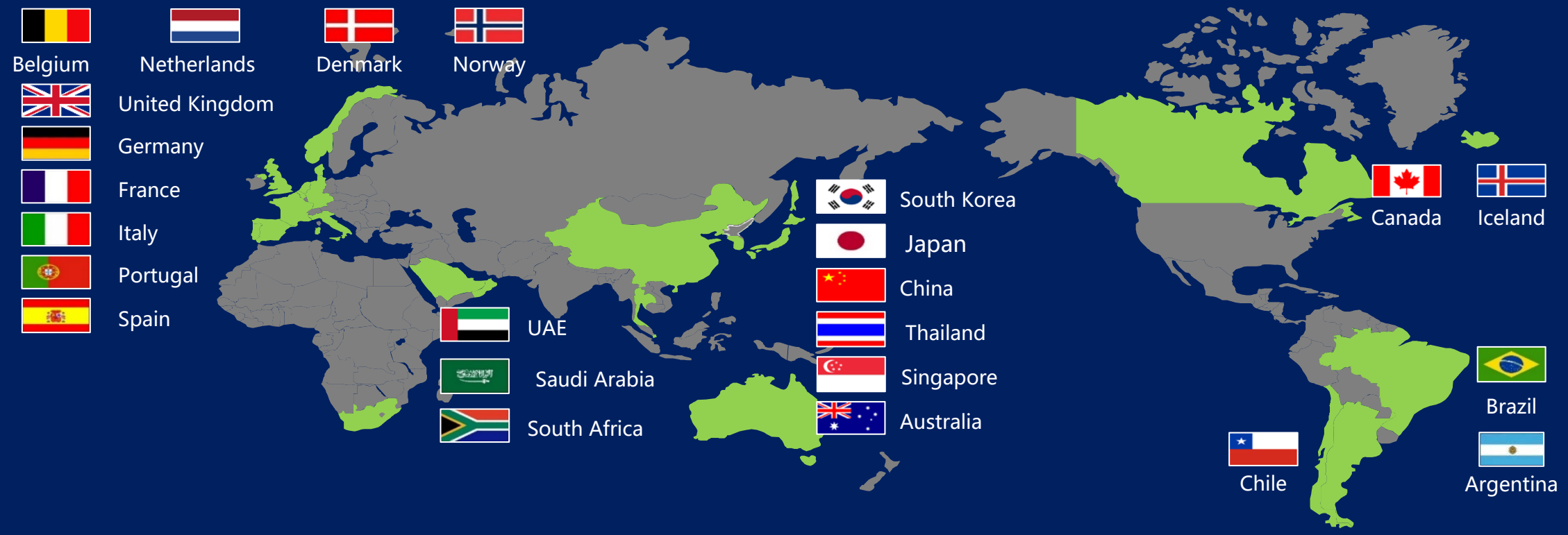
Share bicycle

- 100 NB-IoT bicycles test in Beijing University in Q2 2017
- 100K bicycles in Beijing city by September 2017
- China Telecom to provide NB-IoT coverage in whole Beijing by June 2017

- Mar 22 2017, Shenzhen water utility announced commercialization;
- 1200 meters (phase 1) running in live network;

Huawei will Deploy 30+ NB-IoT Commercial Networks in 20+ Countries in 2017

Representing 32% of Global Population & 10% of Countries



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Huawei Global NB-IoT Open Labs Accelerates Industry Development

- Openness Empower Vertical Industry
- Innovation Foster Applications

Global NB-IoT Open Labs

NB-IoT Ecosystem is Taking Off

40+ partners from 20+ industries

Smart Water

Kamstrup, 三川智慧 SANCHUAN, xinyuan, 汇中 HUIZHONG, NWM, 智润科技, VEOLIA

Smart Gas

Pietro Fiorentini, PRMT, GoldCard, 威星仪表

Smart Grid

JANZ, HOLLEY, TATUNG, 威胜集团 Wasion Group

Smart Parking

InnoTek, ANGLE, Q, infocomm, smartparking

Asset Tracking

ASCENT, accent systems

Smart Agriculture

Pessl, EDYN

Smart Lighting

PHILIPS, AOP

Smoke Detector

HOTHiNK, GTI 光通国际

Air Quality Monitoring

iRex, 汉王 Hanvon, Hanwei

Pet Tracking

Oviphone, nereo

Bicycle Sharing

ofo

White Goods

Midea

Healthcare

Electronic Manufacturing Service

宏电 Hongdian

eLTE-IoT Based on ISM Band

Meets Regional ISM Requirements

China

- 470 MHz to 510 MHz
- EIRP: 17 dBm/50 mW

USA

- 902 MHz to 928 MHz
- EIRP: 36 dBm (> 50 channels)
  30 dBm (< 50 channels)

Europe

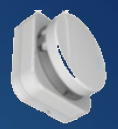
- 863 MHz to 870 MHz
- ERP: 14dBm

For use with Industrial IoT devices

meters

Control equipment

Trackers



Sensors