Narrowband-IoT

A Low Power Wide Area Network

December 2016


“To connect every machine...
to transform lives and businesses”

Vodafone: Powering the Internet of Things

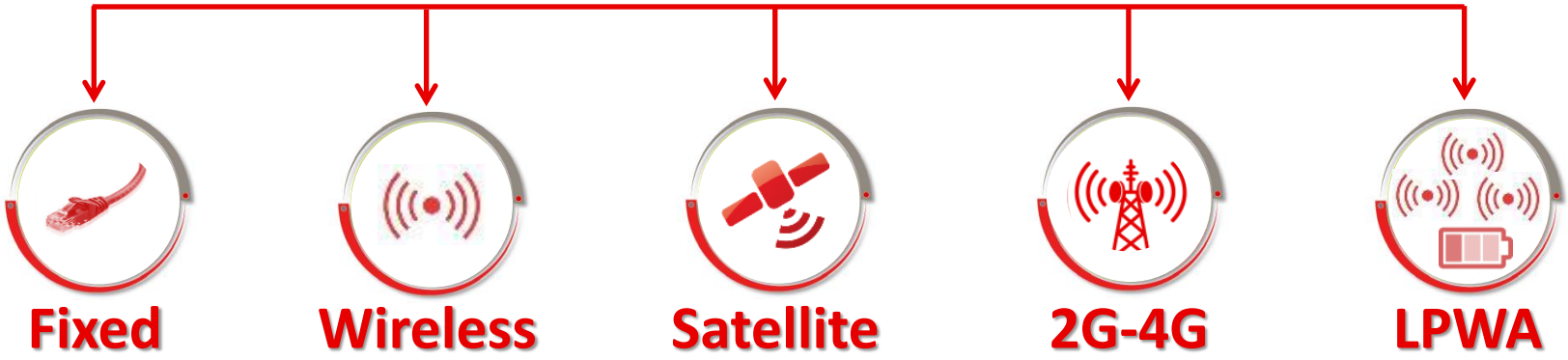
45.4m IoT Connections*

29% revenue growth YoY**

1,400 IoT professionals

136 million MB of data supplied each month

The IoT demands a wide range of connectivity solutions



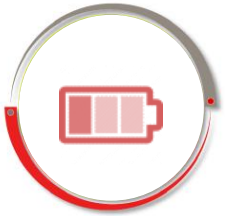
*Q2 FY 16/17 – 30th Sept 2016
** Year end 15/16 31st March 2016

C1 – Public

What is LPWA?

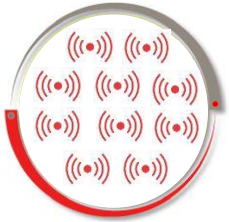
LPWA

Low Power Wide Area wireless network technology is specifically for connecting devices with low bandwidth requirements, using low power whilst providing increased penetration. Many millions of devices will be connected via LPWA.

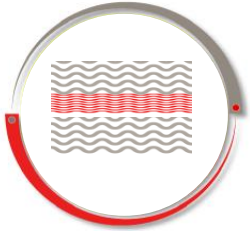


10+ Years Battery Life

Deep Penetration



Mass Deployment



Low Bandwidth

Device Cost

What applications are suited to LPWA?

Gas metering

Large homogenous market measured in millions
Battery life and propogation is critical
Large number of potential meter manufacturers

Water metering

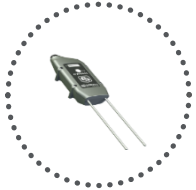
Large homogenous market measured in millions
Battery life and propagation is critical
Large number of potential meter manufacturers

Liquid and pressurised fuels

Large homogenous market measured in millions
Asset is currently un monitored & losses are high
Battery life is critical

Smart Bins

Growing market with good business case
Battery life and network coverage is critical
Complements our hi end connected bins



Environmental Monitoring

Latent market waiting for a low power solution
Battery life and network coverage is critical
Fragmented channel to market in low volumes

Smoke and fire alarms

Massive market measured in hundreds of millions
Battery life and ability to test device is critical
High volume B2C play

Parking monitoring

Market measured in hundreds of thousands
Battery life and low install cost are critical
Low data throughput

Alarms and event detectors

Market measured in hundreds of thousands
Battery life is ultra critical
Very low data throughput on check and trigger

What are the technology options for LPWA?

	Unlicensed Services (e.g. Sigfox, LoRa)	Licensed Service (e.g. NB-IoT)
Leverages existing network	🔴	🟢
Extended Battery Life	🟢	🟢
Deep Indoor Coverage	🟢	🟢
SIM security for the IoT	🔴	🟢
Experienced Network Support	🔴	🟢
Standards Based (non-proprietary)	🔴	🟢
Bandwidth Available	🟡	🟢
2 Way Communication	🟡	🟢
Low Device Cost	🟢	🟢

How does Narrowband-IoT fit into Vodafone's offering?

2G → 4G

- ☑ Sophisticated devices
- ☑ High performance
- ☑ Fast data rate

NB-IoT

- ☑ Low bandwidth
- ☑ Deep coverage
- ☑ Long battery life
- ☑ Low cost devices

NB-IoT is complementary to Vodafone's IoT services, providing different connectivity for different use cases.

LTE communications technologies

	High Performance 4G	Basic 4G	LPWA	LPWA: Full Capability
	Cat 3/4	Cat 1	Cat M	NB-IoT
E2E Support	TODAY	TODAY	H1/2017	H1/2017
DL/UL Rates	150Mbps/50Mbps	10Mbps/5Mbps	Up to 1000kbps	3 to 100kbps
Sector Capacity	>200k	>200k	>50k	>200k
Coverage	-4dB GSM	-4dB GSM	+11dB GSM	+20dB GSM
Battery	1 years today > 10 years from H2/2016*	1 years today > 10 years from H2/2016*	> 10 years	> 15 years
Module Cost**	30€-80€ (today) < 40€ (2017)	~30€ (today) <20€ (2017)	<15€ (2017)	<10€ (2017)
Network Upgrade	Supported Today	Supported Today	SW + Some HW Upgrades	SW + Some HW Upgrades
Security	High	High	High	High

* Earliest date for Power Saving Mode core upgrade and new devices
** New Module RFI planed when market deemed to be more stable

NB-IoT (Cat-NB1) and LTE-M (Cat-M1) are suitable for different use cases

LTE-M (Cat-M1) Target Application Characteristics:

- Real-time voice requirement
- Instantaneous and frequent messaging requirement
- Throughput in the range of (800kbps in good conditions)
- Does not require +20dB extra coverage
- Does not require 10 year battery life

NB-IoT (Cat –NB1) Application Characteristics :

- No real-time voice required
- Infrequent periodic messaging (few messages per day)
- Low throughput requirement (<200kbps)
- Requires +20dB extra coverage
- Long battery life (up to 10 years)

C1 – Public

Global support for the NB-IoT standard

- Global forum on NB-IoT created by GSMA
- NB-IoT Open Labs opening across the world, supported by:
  - Vodafone (Open Already)
  - China Mobile,
  - Etisalat,
  - China Unicom
  - Telecom Italia
  - LG Uplus,
- 3GPP Global Standard on NB-IoT Agreed June 2016

GSMA WELCOMES MOBILE INDUSTRY AGREEMENT ON TECHNOLOGY STANDARDS FOR GLOBAL LOW POWER WIDE AREA MARKET

http://www.gsma.com/newsroom/press-release/gsma-welcomes-mobile-industry-agreement-on-technology-standards/

Global standard agreed and supported by GSMA body and members.
Worldwide adoption now accelerating

NB-IoT support continues to grow

How is Vodafone Deploying Narrowband IoT?

From Vodafone 2016 Result Announcement:

'We will start this year by introducing a new technology called Narrow Band IoT. That basically means that, if you take our existing 4G network, we do a software upgrade in about 85% of our installed base that enables this new technology.'

- Johan Wibergh, CTO

We will begin our roll out in 2017 and our goal is to enable all 4G sites with NB-IoT by 2020

Where can I see Narrowband-IoT in action?

Click to follow link

We are running NB-IoT pilots around the world

UK

- Vodafone's Open Lab created for live network tests, demos and pilots.

Turkey

- NB-IoT smart parking demoed in Istanbul

Spain

- World's first pre-standards NB-IoT message sent over a live commercial network
- Tested in real water meter locations provided by Aguas de Valencia

GRUPO AGUAS DE VALENCIA

Australia

- Testing with South East Water across their sewer pressure monitoring system

South East Water

More Information Available on Request

Vodafone completes the world's first trial of standardised NB-IoT on a live commercial network

- On the 19th Sept in Madrid, engineers from Vodafone & Huawei completed the first over-the-air connection on a live network using standardised NB-IoT.
- The commercial trial used a live 4G base station, using the 800 MHz licenced spectrum frequency band to successfully send messaging.

telecompaper:::

Vodafone, Huawei complete first commercial trial of NB-IoT

Wednesday 21 September 2016 | 09:53 CET | News

Vodafone all set for early 2017 NB-IoT launch — MOBILE WORLD LIVE

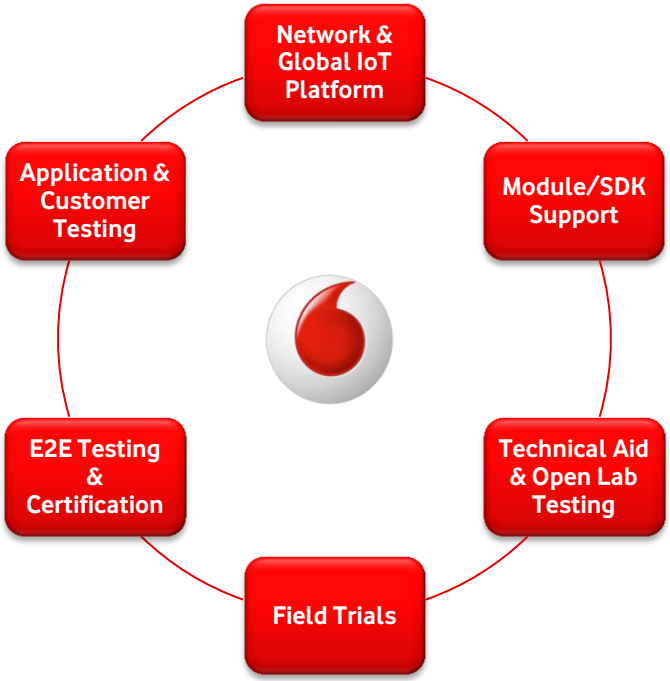
Vodafone IoT @VodafoneIoT — Follow

World's first standard Narrow Band #IoT over-the-air connection made today on Vodafone's live network in Spain: vdfn.biz/Eu4X

Source: http://www.vodafone.com/content/index/what/technology-blog.html

What's next ?

- Continued standards implementation
- Ecosystem creation, product development, certification and trials
- Customer trials and application development
- End to end service testing



Today we are actively engaging with our customers to see how NB-IoT can benefit their business

How do I find out more?

Engage with Vodafone Team

Join the NB-IoT Forum for access to latest updates

Follow us on twitter @vodafoneiot

Thank you