LPWA technology as a standard in LTE network

Microdis Seminar, Prague 13th of April 2018

Pasi Alajoki, Area Sales Manager, u-blox Espoo

Introduction to u-blox

u-blox at a glance

CHF 403.7 million

revenue in 2017

3 core markets served

automotive, industrial, consumer

16% of revenue

invested in R&D

6100 customers

in 66 countries worldwide

964 employees

about 67% in R&D

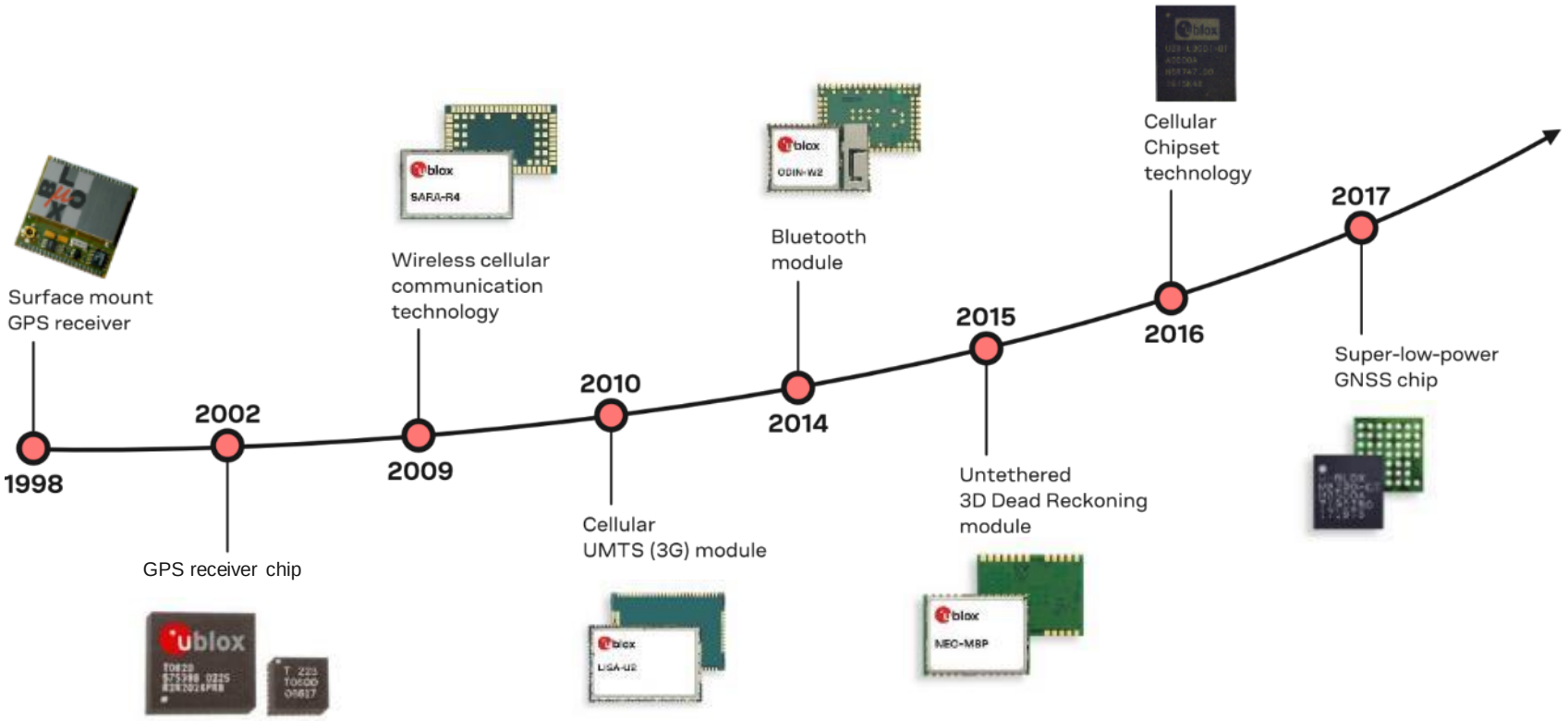
2007 SIX:UBXN

listed on the SIX since 2007

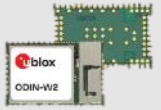
Innovation is our lifeblood

Strong innovations lead to the future

We have been first to market with many technology solutions.



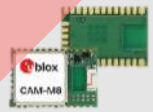
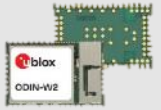
Unique combination of technology and product offerings

	Positioning	Cellular Communication	Short Range Communication
Integrated Circuits			
Modules	 		
Services and Solutions	CellLocate® (modem based positioning) AssistNow™ (world wide GNSS assistance service) GNSS Correction Data (for high precision)* FOTA (Firmware over the air) Lifetime Security		

*through Sapcorda, a JV with industry partners

The combination of our three core technologies offered in the form of chips and modules provides essential benefits to our customers.

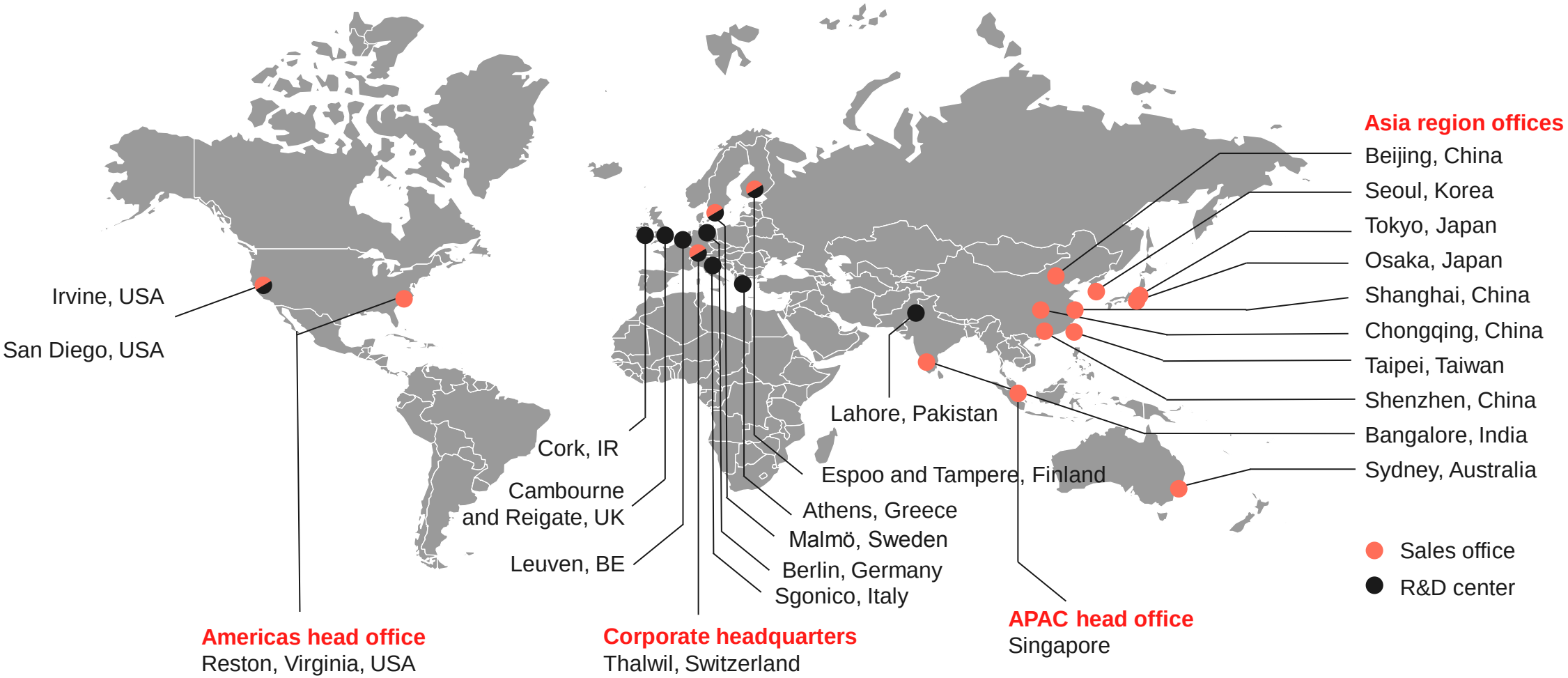
Unique combination of technology and product offerings

	Positioning	Cellular Communication	Short Range Communication
Integrated Circuits			
Modules	 		
Services and Solutions	CellLocate® (modem based positioning) AssistNow™ (world wide GNSS assistance service) GNSS Correction Data (for high precision)* FOTA (Firmware over the air) Lifetime Security		

*through Sapcorda, a JV with industry partners

- Strong synergies between the technologies
- Complete solutions
- Full owner of technology
- Maximum competence
- Solid product roadmaps
- Services on top of HW
- Improved functionality
- Lifetime support

Global presence
25 locations

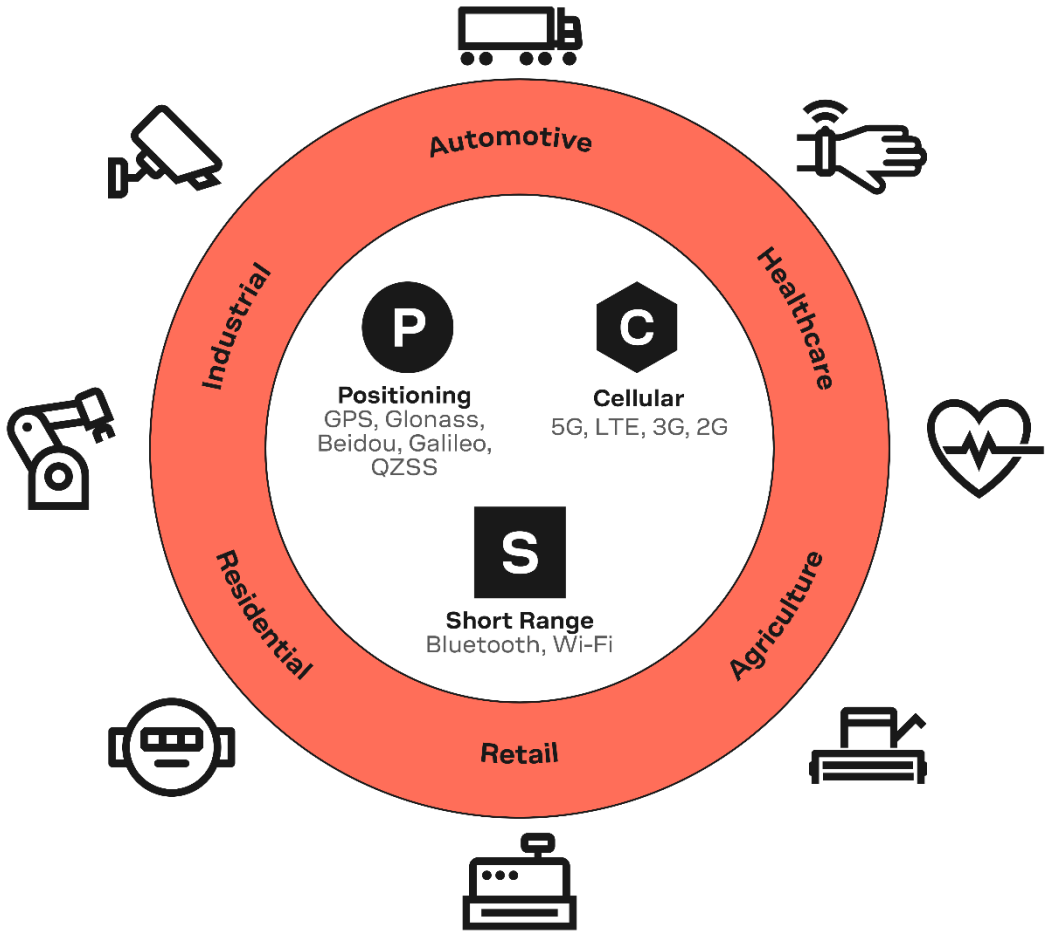


Americas head office
Reston, Virginia, USA

Corporate headquarters
Thalwil, Switzerland

APAC head office
Singapore

Enabling the Internet of Things (IoT)
u-blox at the core



Our three technologies – Positioning, Cellular, and Short Range – transform a wide range of products and devices into the Things of the IoT.

Innovation for competitive advantage

16% of sales invested in R&D

Our major R&D themes:

Autonomous driving

LTE connectivity

Smart modems

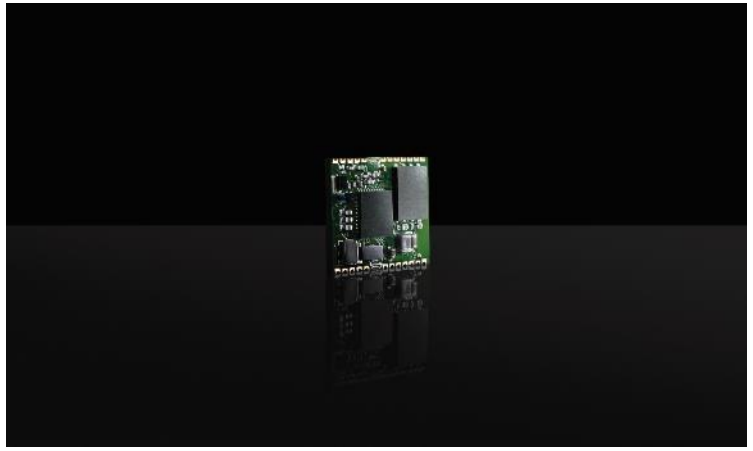
Security

Robustness

Size and cost reduction

Our promise

Competent technical support worldwide



Low risk through all phases of your design cycle

Quick time to market

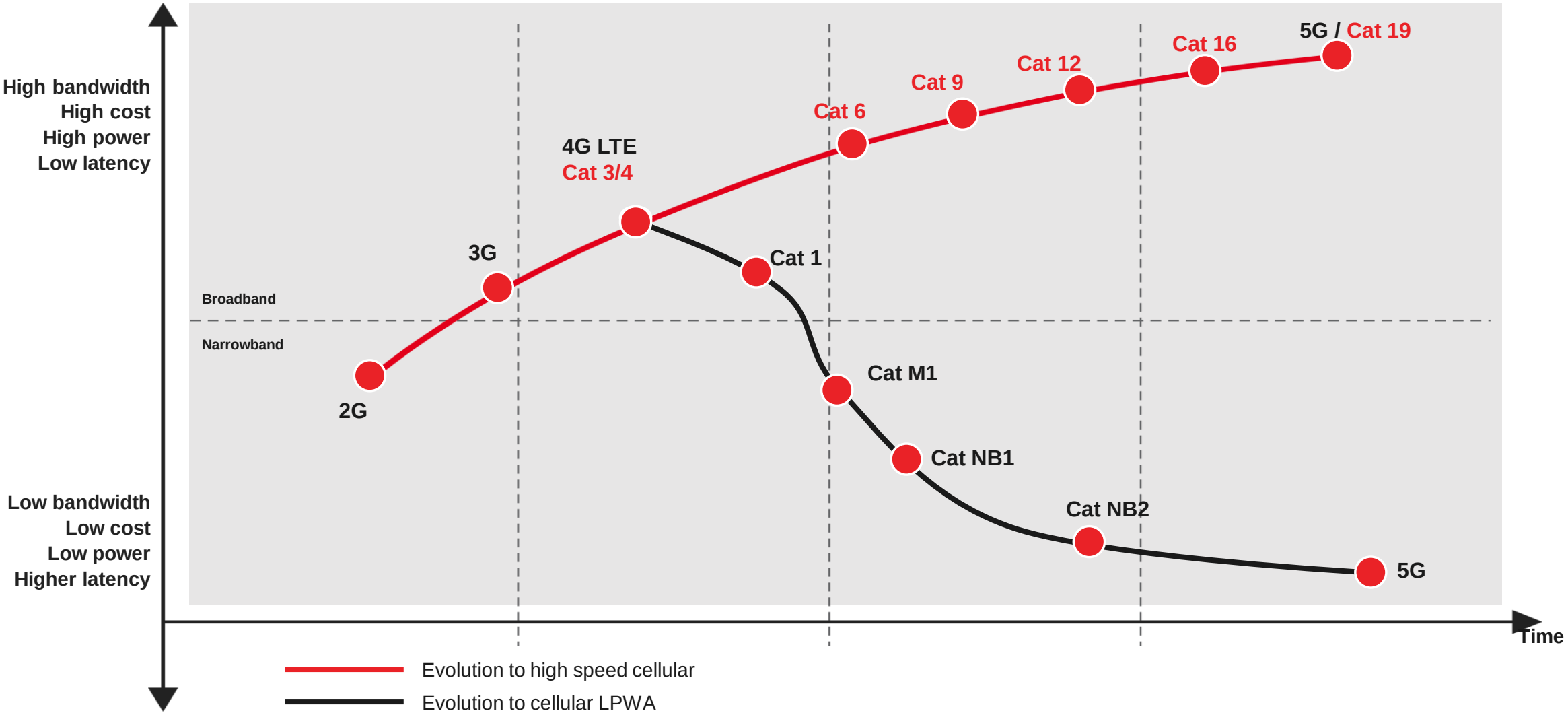
High quality

Outstanding performance

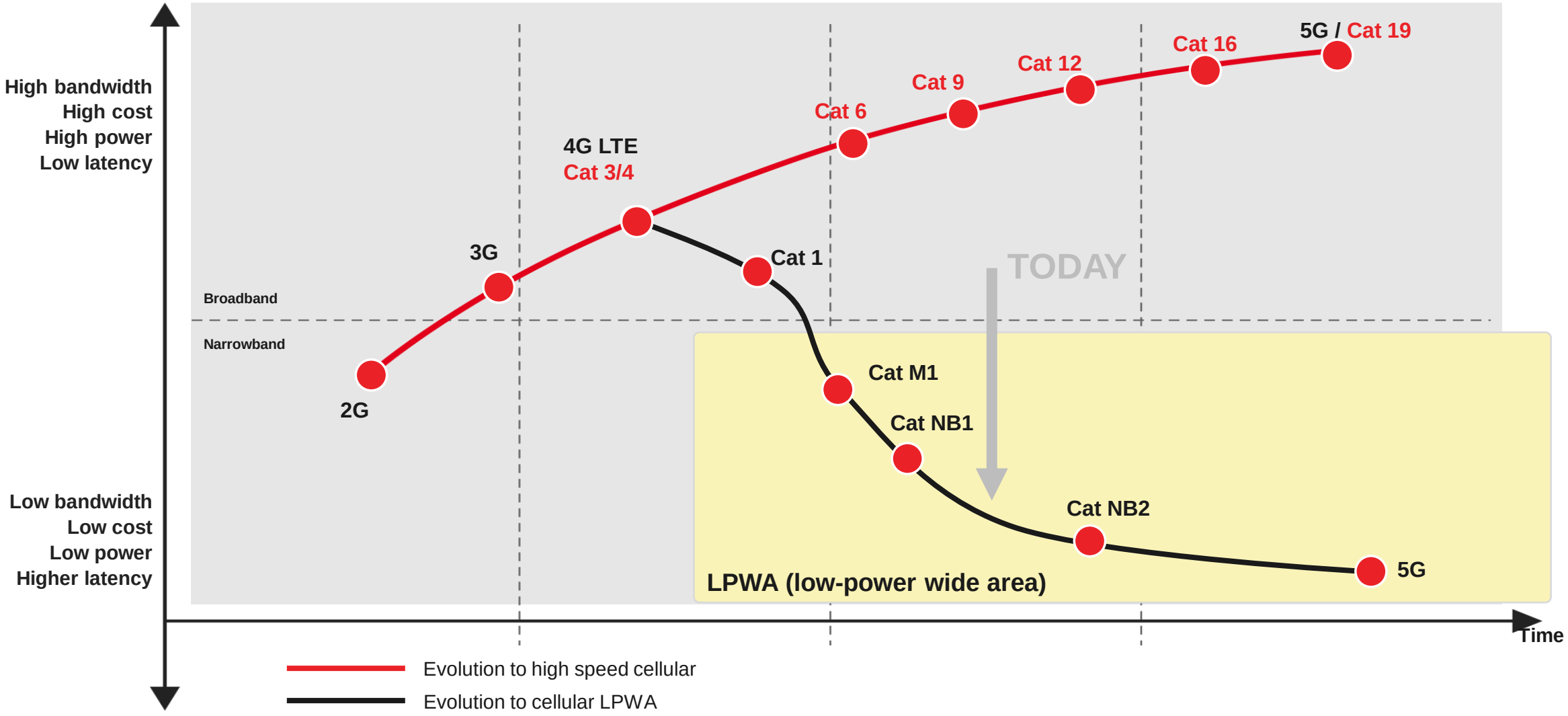
Security


LPWA Overview

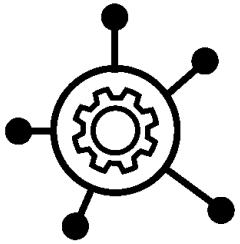
Global cellular technologies are evolving and multiplying…



…with a focus on LPWA technologies for the IoT



The cellular IoT promise:
Benefits of LTE Cat M1 and NB-IoT (LTE Cat NB1)



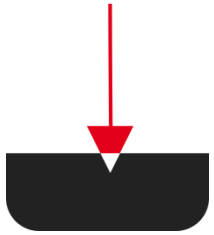
Large ecosystem

3GPP Release 13

Module certified in all major markets

Low power

Optimized for long battery life (in excess of 10 years depending on operating conditions)



Extended range

Enhanced coverage of 15-21dB* in buildings and basements (and underground with NB1)

Limited performance

M1 peak rates up to 375 kb/s DL / UL

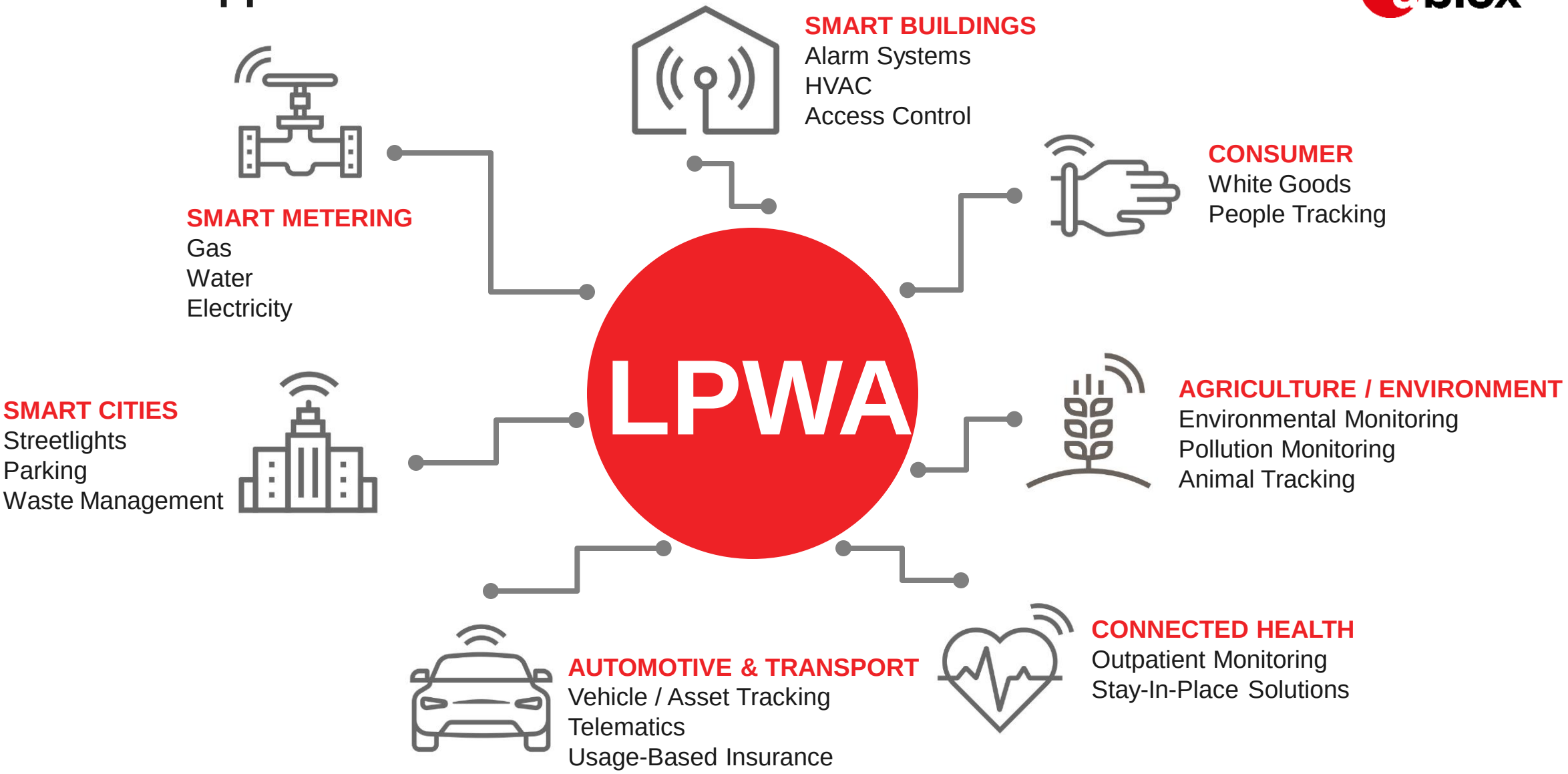
NB1 peak rates up to 27.2kb/s DL / 62.5 kb/s UL

Reduced complexity

NB-IoT supports narrowband operation and reduced system complexity

*as compared to GSM, 15dB enhanced coverage with Cat M1, 21 dB with Cat NB1

Markets & Applications



Technology comparison

Feature	2G (GSM / GPRS)	Cat M1 (Full duplex)	Cat M1 (Half duplex)	Cat NB1 (NB-IoT)
Application focus	Mobile connectivity / M2M	Mobile connectivity / M2M		M2M
Radio Spectrum	200 kHz 3GPP Licensed [1]	1.4 MHz 3GPP Licensed [1]		180 kHz 3GPP Licensed [1]
Guaranteed Quality of Service (QoS)	Yes	Yes		Yes
Responsiveness	milliseconds => seconds	milliseconds	milliseconds => seconds	seconds => minutes
Roaming	Global	Global		Global
Peak Data Rate	Up to 85.6 kb/s (DL) Up to 42.8 kb/s (UL)	1 Mb/s (DL/UL)	375kb/s (DL/UL)	27.2 / 62.5 kb/s (DL/UL)
FOTA	No	Yes		Yes
Range / MCL [6]	Above ground / 139.4 / 144 dB [2]	Basement / 155.7 dB		Underground / 164 dB [3]
Mobility	Vehicular (300kmh) (full handover)	Vehicular (300kmh) (full handover) [4]		Vehicular (100kmh) (no handover)
Voice Support	Yes (GSM)	Yes (incl. VoLTE) [5]		No
Battery life	5-10yrs	5-10yrs		10yrs+
Cost (Module or eBoM)	$	$$	$	$

Notes:

1. 3GPP Licensed spectrum in 450MHz and 700MHz – 3.5GHz
2. GSM has MCL (maximum coupling loss) of 139.4 dB, GPRS of 144 dB
3. NB-IoT uses Single-Tone signalling in the UL to ensure reliable operation to the cell-edge
4. MNO support initially only in Idle Mode, will support Connected Mode in future FW rel.
5. Future FW release

Supports use cases unique to LTE Cat M1

u-blox SARA-R4 & SARA-N series modules

Product Roadmap – SMD Modules Form-Factor

SARA

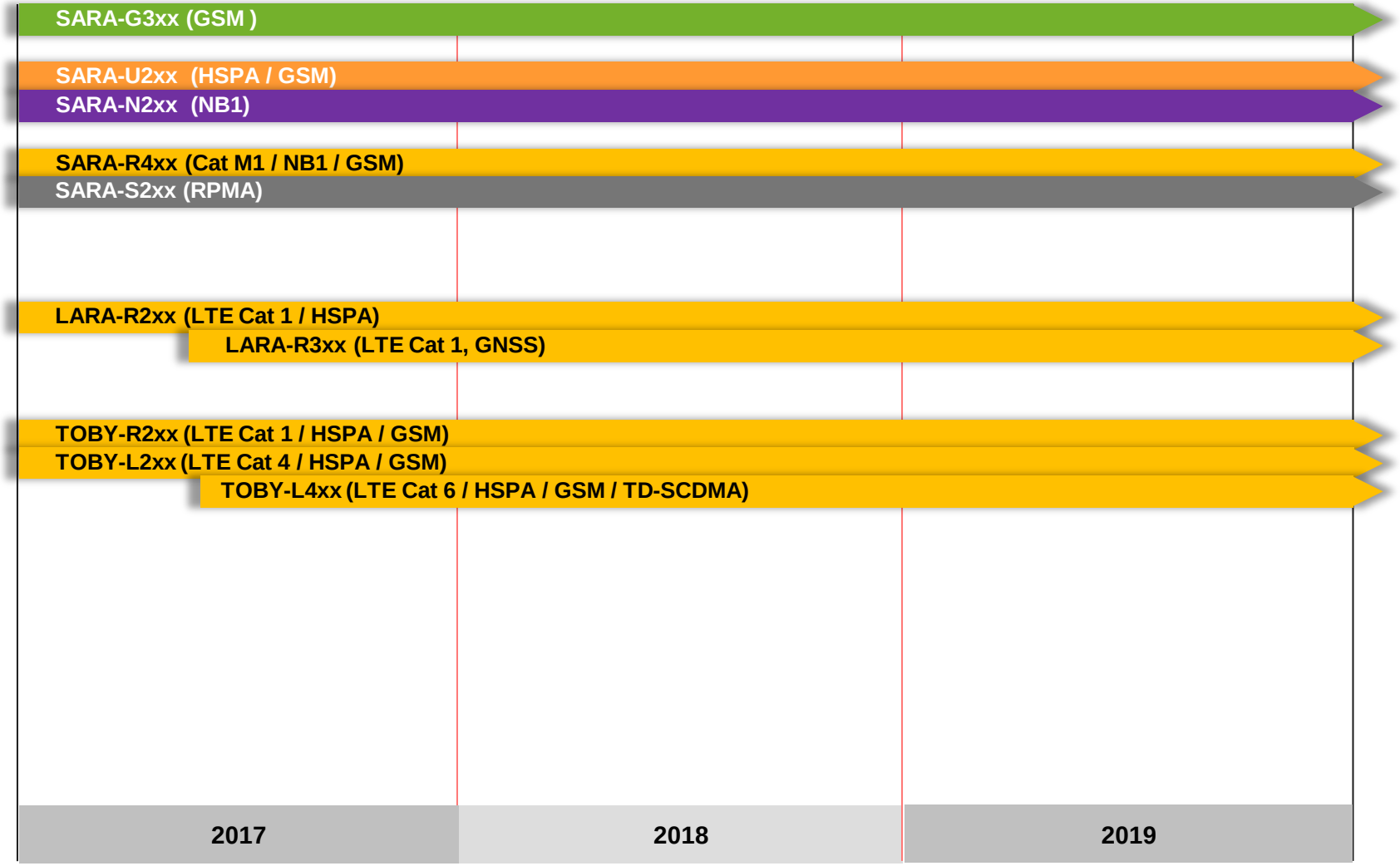
16.0 x 26.0 mm

LARA

24.0 x 26.0 mm

TOBY

24.8 x 35.6 mm



LTE Cat M1

- **Geography:** North America (2017), EMEA (2017), APAC (2017/2018)
- **Key Operators:** Verizon, ATT, T-Mobile, Telus, Telstra, Optus, Bouygues, Orange, Swisscom, NTT DoCoMo, Softbank, KDDI
- **Segments:** Insurance, Vehicle & Asset Tracking, Smart City & MAC, Wearables (Trackers)
- **Applications:** Usage-based insurance, fleet management, crash notifications, stolen vehicle recovery, vehicle diagnostics

Data rate:
375 kb/s DL/UL (half Duplex) [1]

Spectrum:
1.4 MHz Licensed

Latency:
ms - Sec

Battery Life:
5-10 Yrs

Range:
Basement (155.7 dB MCL)[2]

Quality of Service

Voice[3]

FOTA

Mobility
Full handover

[1] 1 Mb/s UL/DL (Full Duplex)

[2] Maximum Coupling Loss, as compared to GSM 139.4 dB MCL

[3] Future FW release

[4] MNO support initially only in Idle Mode, will support Connected Mode in future FW release

SARA-R4/N4 Series modules overview

Module	Form Factor	Bands				3GPP Rel.			Functions						Grade
		LTE FDD	LTE Category	HSPA+	GSM/GPRS quad band		Power Save Mode	eDRX	Voice	HTTPS, FTPS, TLS	TCP/UDP, FTP, HTTP	Ext. GNSS interface Assistnow client	CellLocate	Host Interfaces	
SARA-R404M	LGA	13	M1			R13	●				●			USB, UART	Professional
SARA-R410M[2]	LGA	2, 4, 5, 12	M1			R13	●			●	●			USB, UART	Professional
SARA-R410M[2]	LGA	Configurable	M1, NB1			R13	●	●	(1)	●	●	●	(1)	USB, UART	Professional
SARA-R412M	LGA	Configurable	M1, NB1		●	R13	●	●	(1)	●	●	●	(1)	USB, UART	Professional
SARA-N410	LGA	Configurable	NB1			R13	●	●		●	●	●	(1)	USB, UART	Professional

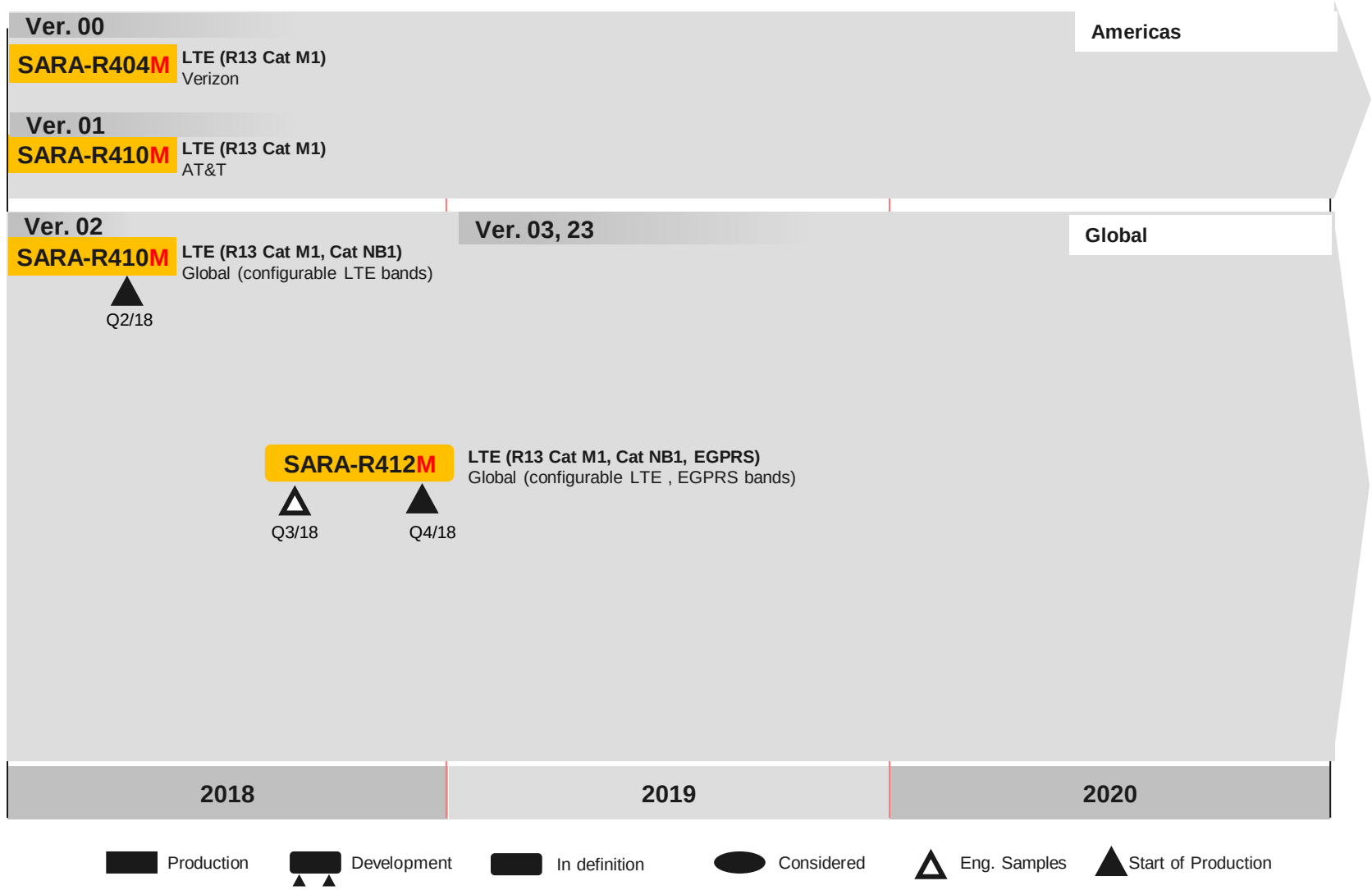
(1): Subsequent firmware version
(2): ver. 01B: AT&T variant (2,4,5,12), LTE Cat M1 only
ver. 02B: Global (configurable LTE bands) variant, LTE Cat M1 and NB-IoT

Product Roadmap

LTE Cat M1, NB1 and EGPRS modules

SARA

16.0 x 26.0 mm



NB-IoT (LTE Cat NB1)

- **Geography**: EMEA (2017), APAC (2017/18), Americas (2017/18)
- **Key Operators**: Vodafone, DT, TIM, TDC, Telenor, Telefonica, Swisscom, China Mobile, China Unicom, China Telecom, LGU+, Telus, TIM Brazil, Telstra, AT&T, Verizon, T-Mobile, Megafon
- **Segments**: Smart Metering, Smart City & MAC, Wearables (Trackers)
- **Applications**: Utility meters, street lighting, parking systems, waste management, HVAC, access control, white goods, people / animal tracking, land / pollution / precipitation monitoring

Data rate:
27.2 / 62.5 kb/s (DL/UL)

Spectrum:
180 kHz Licensed

Latency:
Seconds

Battery Life:
10+ Yrs

Range:
Underground (164 dB MCL)[1]

Quality of Service

Voice

FOTA

Mobility
Limited (No Handover)

[1] Maximum Coupling Loss, as compared to GSM 139.4 dB MCL

SARA-N Series modules overview

Module	Form Factor	Bands				3GPP Rel.	Functions										Grade
		IoT NB	LTE Cat	LEGACY	GSM/GPRS/EDGE		Power Save Mode	eDRX	Voice	UDP	TCP	HTTP, FTP	CoAP / DTLS	LWM2M	Ext. GNSS interface Assistnow client CellLocate	Host Interfaces	
SARA-N200	LGA	8	NB1			R13	●	●		●			●			UART	Professional
SARA-N201	LGA	5	NB1			R13	●	●		●			●			UART	Professional
SARA-N210	LGA	20	NB1			R13	●	●		●			●			UART	Professional
SARA-N211	LGA	8, 20	NB1			R13	●	●		●			●			UART	Professional
SARA-N280	LGA	28	NB1			R13	●	●		●			●			UART	Professional
SARA-R410M	LGA	Configurable	NB1(M1)			R13	●	●	(1)	●	●	●	●	●	(1)	USB,UART	Professional
SARA-R412M	LGA	Configurable	NB1(M1)		●	R13	●	●	(1)	●	●	●	●	●	(1)	USB,UART	Professional
																	Professional

(1) Subsequent firmware version
* Product based on Rel 13 with partial support of Rel14 functionalities

Technology comparison

Feature	2G (GSM / GPRS)	Cat M1 (Full duplex)	Cat M1 (Half duplex)	Cat NB1 (NB-IoT)	Ingenu (RPMA)	LoRa	SigFox
Application focus	Mobile connectivity / M2M	Mobile connectivity / M2M		M2M	M2M	M2M	M2M
Radio Spectrum	200 kHz 3GPP Licensed [1]	1.4 MHz 3GPP Licensed [1]		180 kHz 3GPP Licensed [1]	80 MHz ISM Unlicensed[2] Global 2.4 GHZ Band	125 kHz (typ) ISM Unlicensed [2] 868 MHz (EU) / 915 MHz (USA)	600 Hz ISM Unlicensed [2] 868 MHz (EU) / 915 MHz (USA)
Guaranteed Quality of Service (QoS)	Yes	Yes		Yes	Yes	No	No
Responsiveness	milliseconds => seconds	milliseconds	milliseconds => seconds	Seconds	seconds	seconds => minutes	sec's => min's (140 Tx / day limit)
Roaming	Global	Global		Global	Global	Local [3]	Single network
Peak Data Rate	Up to 85.6 kb/s (DL) Up to 42.8 kb/s (UL)	1 Mb/s (DL/UL)	375kb/s (DL/UL)	27.2 / 62.5 kb/s (DL/UL)	31 /15.6 kb/s (DL/UL)	5.5kb/s (125-bw) 50kb/s (500-bw)	100b/s (UL) 500b/s (DL) [4]
FOTA	No	Yes		Yes	Yes (broadcast channel) [5]	No	No
Range / MCL [6]	Above ground / 139.4 / 144 dB [6]	Basement / 155.7 dB		Underground / 164 dB [7]	Underground / 167 dB	Underground / 161 dB	Underground / 161 dB
Mobility	Vehicular (300kmh) (full handover)	Vehicular (300kmh) (full handover) [8]		Vehicular (100kmh) (no handover)	Vehicular (100kmh+) (full handover)	No	No
Voice Support	Yes (GSM)	Yes (incl. VoLTE) [9]		No	No	No	No
Battery life	5-10yrs	5-10yrs		10yrs+	10yrs+	10yrs+	10yrs+
Cost (Module or BoM)	$	$$	$	$	$+ (currently)	$	$

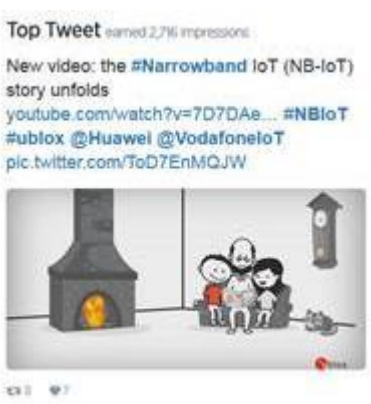
Notes:
1.3GPP Licensed spectrum in 450MHz and 700MHz – 3.5GHz
2.ISM (Industrial, Scientific, Medical) unlicensed spectrum
3.LoRa Public and Private networks are operated by entities in specific areas, there is no guarantee of cross-network operation
4.UL: Max 140 mssg w/ payload up to 12 bytes; DL: Max 4 mssg w/ payload up to 8 bytes
5.Separate broadcast channel allows multicast of FOTA, etc. to all devices at once
6.GSM has MCL (maximum coupling loss) of 139.4 dB, GPRS of 144 dB
7.NB-IoT uses Single-Tone signalling in the UL to ensure reliable operation to the cell-edge
8.MNO support initially only in Idle Mode, will support Connected Mode in future FW rel.
9.Future FW release

u-blox NB-IoT leadership position

SARA-N2 modules announcement

1st NB-IoT module announcement

June 27, 2016



[u-blox first to deliver Narrowband IoT module](#)
Electronics EETimes (registration) - Jun 27, 2016
The benefits of **NB-IoT** over other cellular radio technologies include lower device complexity, ultra-low power operation and support for up to ...

[**u-blox**' first **module** for narrow-band cellular IoT, low data rate comms](#)
EDN Europe (registration) (blog) - Jun 27, 2016
Swiss company **u-blox** has set out the specifications of its forthcoming SARA-N2 Narrowband IoT (**NB-IoT**) **module**, calling it the world's first ...

[How narrowband IoT will connect our cities](#)
Embedded Computing Design (blog) - Dec 2, 2016
In addition, the **NB-IoT** wireless **modules** in this use case can last 10 years ... is the Senior Principal of Strategic Partnerships EMEA at **u-blox**.

https://youtu.be/7D7DAeB_Hwg

The world's 1st NB-IoT module

- **Ultra low power consumption**, delivering 10+ years of battery life on a single cell primary battery
- **Excellent extended range in buildings and underground** (MCL of 164 dB [1])
- **Extended temperature range**
- **Easy migration** between u-blox 2G, 3G and 4G modules
- **Very small** 16x26mm SARA LGA form factor for easy manufacturing

[1] Maximum Coupling Loss, as compared to GSM 139.4 dB MCL

NB-IoT market rollout

- u-blox working on several demos and trials
  - The end device solutions may be different, but characteristics are the same
  - These demos/trials continue to demonstrate the benefits of the new technology

    Low power, low cost and better penetration
- Technology trials done with multiple key operators and applications
  - Smart Water, Smart Gas
  - Street Lighting
  - Smart Parking
  - Waste Management
  - Animal Tracking

Key Highlights

SARA-R4 Series

Key Highlights

Flexible Selection
LTE Cat M1, NB1, and EGPRS only or preferred modes

Ultra Compact
16.0 x 26.0 mm

Easy Migration
Between u-blox 2G, 3G and 4G modules

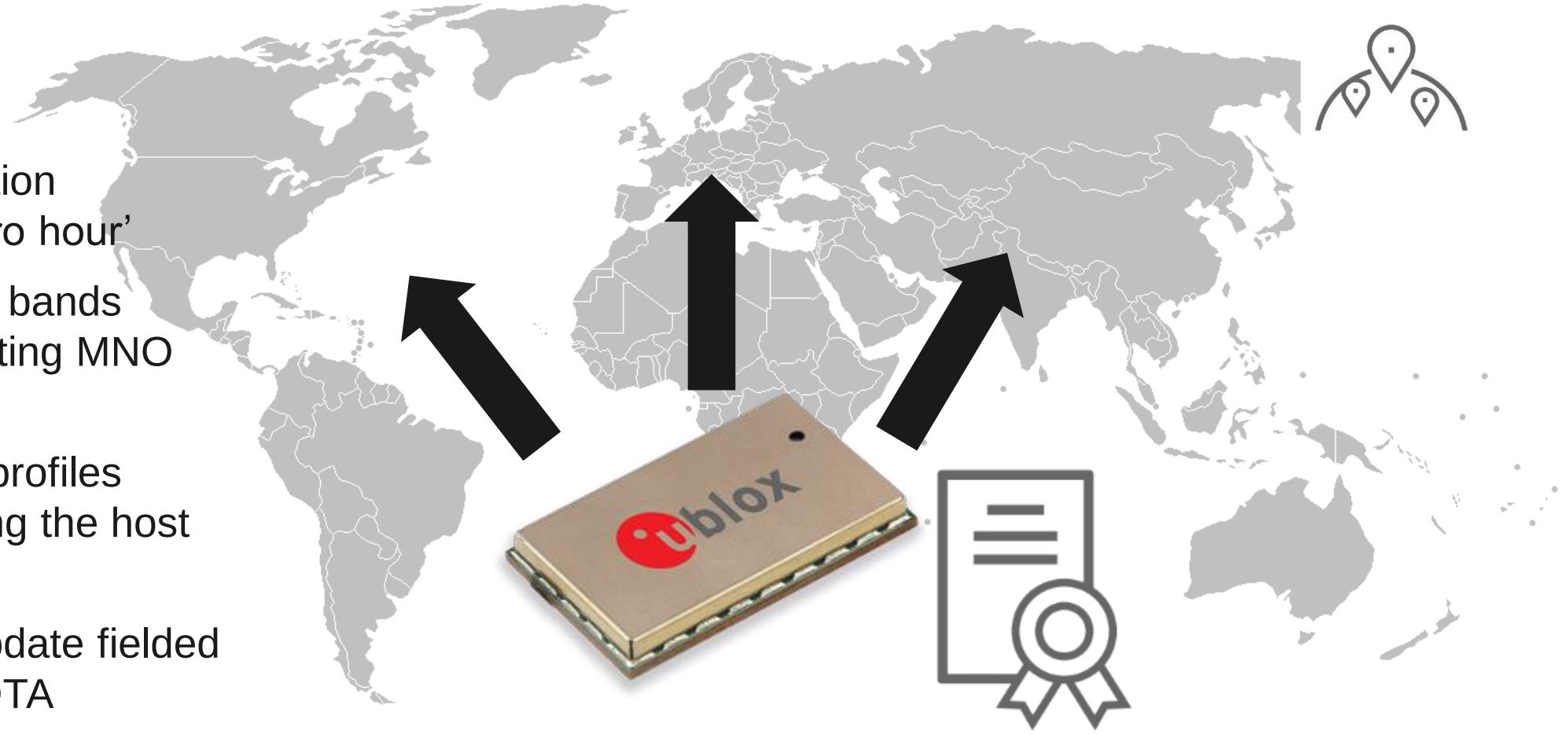
Voice Support
Via VoLTE on Cat M1 (future)

Global Configurability
With a single hardware version

uFOTA with LWM2M
Deliver critical firmware updates over the air

One world, one module

- Defer configuration decisions to ‘zero hour’
- Enable roaming bands beyond the existing MNO default profile
- Add new MNO profiles without changing the host software
- Continuously update fielded devices via uFOTA



TA approved MNO profiles are pre-existing within the module software

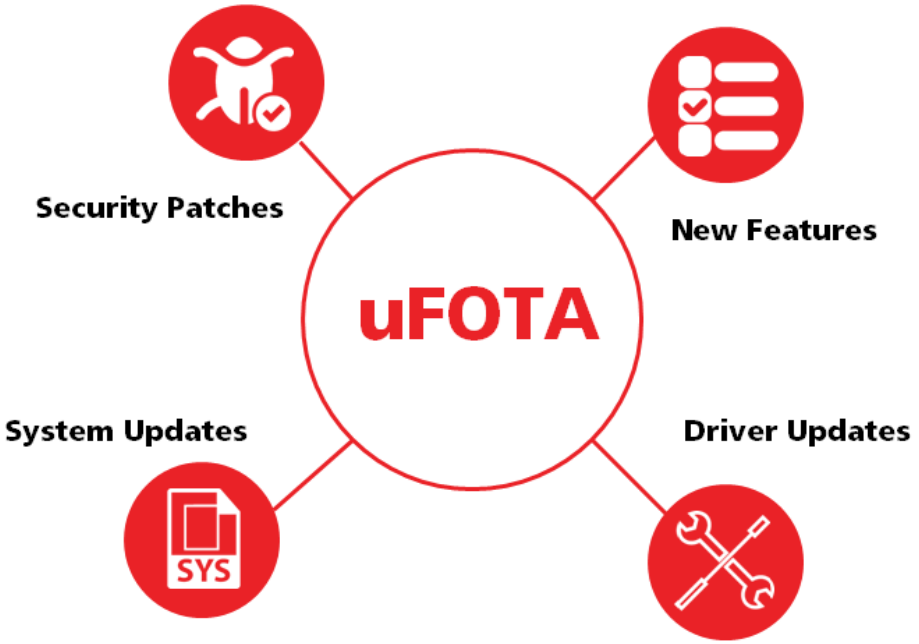
NOTE: customer must comply with end device regulatory/certification restrictions

Remote firmware updates with uFOTA client server solution

Deliver critical updates with uFOTA using LWM2M, a light and compact protocol that is ideal for IoT

Over-the-Air Update System:

- FOTA Engine
- OMA LWM2M Client
- Delta File Generator and Web Interface
- OMA-LWM2M Server / FUMO Server
- Deployed across the cellular product portfolio



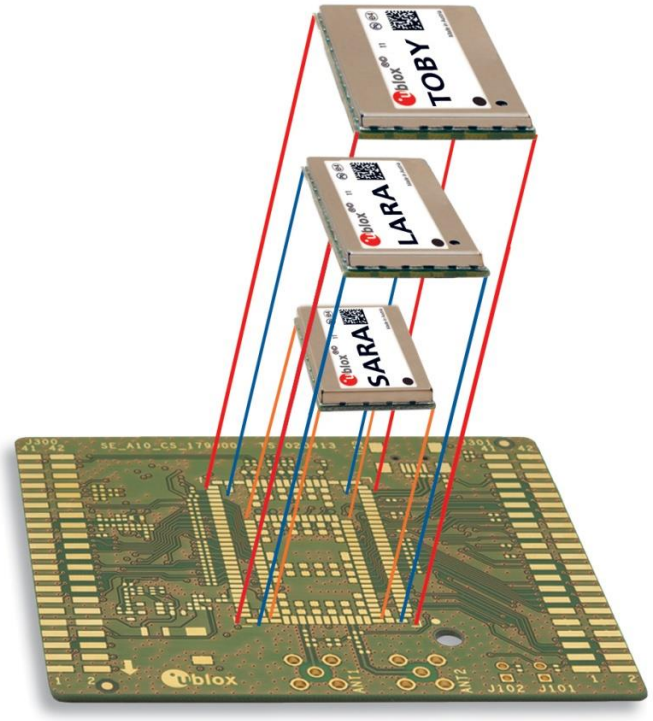
SARA form factor, ease of migration

Easy migration among u-blox SARA designs:

- SARA-G: 2G
- SARA-U: 3G
- SARA-R4: LTE Cat M1, Cat NB1 and EGPRS
- SARA-N2: LTE Cat NB1

Advantages

- Optimal solution for cost, size and wireless technology
- Easy migration between wireless technologies and module generations
- AT command compatibility to minimize software migration effort



Thank you
for your attention