u-blox is redefining IoT security.

UBX-R5: Our 5G-ready cellular chipset designed fully in-house.

June 11th, 2019
Disclaimer

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Why did we develop a secure cellular chipset for the IoT?

Market insights.

UBX-R5 positioning.

UBX-R5 enables SARA-R5: Key strengths.

Expanding the revenue model.
We deliver leading wireless technology to reliably locate and connect people and devices.

We are convinced that the Internet of Things will change every aspect of our societies, our businesses, and our everyday lives.

That’s why we develop reliable and innovative positioning and wireless communication solutions that securely connect vehicles, industries, things, and millions of people around the world.
Why did we develop a secure cellular chipset for the IoT?
We master technology.
Independence from 3rd parties is key for future success.

• At the dawn of the 5G era, only a handful of companies are capable of designing 5G modems.
  • We sensed this when we started developing our platform.
  • Investment into a leading modem design team
• Sustainable differentiation is only possible if we own technology
  • Control of product life-cycle
  • No real innovation without access to the core
  • Optimized power consumption
  • Robust design for industrial and critical applications
  • Security concept encompassing all layers from HW to SW
We add security.
IoT security has quickly become an industry priority.

More than 80% of senior executives across industries, on average, say IoT is critical to some or all lines of their business in 2018.
(Source: Statista)

IoT security market is forecast to grow at CAGR of 36% between 2016 and 2021.
(Source: GSMA)

By 2020, 20% of annual security budgets will be devoted to IoT solutions (up from 1% in 2015).
(Source: GSMA)
Long lasting experience.
We’ve been creating chips and modules for more than two decades.

Since 1997
More than 20 years of experience as a chip and module maker.

480 M
GNSS chipsets shipped.

Since 2009
10 years experience in making cellular chips and modules.

45+ M
Cellular modules shipped.
Megatrends drive our growth.
Cellular technologies make them become reality.

**Mobility**
More and more automation is enabling the autonomous driving car.

  - BI Intelligence 2018

**Urbanization**
Infrastructure is becoming smart for better usage and service of the increasing population living in cities.

- 1 billion smart meters installed between 2019 - 2023.
  - ABI research 2018

**Industry 4.0**
Automation is linked with the cloud for closed control loops that enhance process efficiency.

  - BI Intelligence 2018

**New health**
The cloud is delivering services to mobile users and enhancing insights into a healthy life.

- Over a half billion sports and wellness trackers will be sold in the next 5 years (2019-2023).
  - TSR 2018
With UBX-R5 we complement our strategic core. An ecosystem of chips, modules, and value added services.

- Important addition of product offer and solution capability
- Essential for our mainstream customer in the Industrial internet of Things space

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<thead>
<tr>
<th>P</th>
<th>C</th>
<th>S</th>
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</thead>
<tbody>
<tr>
<td>Positioning</td>
<td>Cellular Communication</td>
<td>Short Range Communication</td>
</tr>
</tbody>
</table>

**Integrated Circuits**

**Modules**

**Services**

- 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 joint venture with industry partners
What are the key takeaways?

IoT is different from traditional cellular connectivity.

We have to solve new challenges in the IoT:

- **Device longevity**
  10+ years

- **Security concerns**
  Critical applications, confidential data

- **Complexity**
  # of deployed devices

- **Power consumption**
  Devices need to run from batteries
Market insights.
Cellular IoT solutions are growing.
Low Power Wide Area (LPWA) is crucial for several industries.

**Mobility** applications will reach global market revenue of $840M in 2022 for LTE-M and LTE Cat 1 products, where u-blox has a strong, established track record.

$840m

**Urbanization** requires a broad portfolio of LPWA products, reaching global market revenue of $640M in 2022.

$640m

**Industry 4.0** will see sustained growth, relying on LTE-M and LTE Cat 1 to reach $850M market revenue by 2022 in industrial asset tracking and metering alone.

$850m

**New health** will reach global market revenue of $370M in 2022 with a focus on highly secure LTE-M, LTE Cat 1, and NB-IoT products.

$370m

Source: ABI 2019 and u-blox analysis
Secured IoT devices protect business and data. Security must be at the core of industrial IoT.

Connected health
Ensure patient safety by guaranteeing that medical devices are authentic and use does not exceed the safety limits.

Asset tracking
Ensure your data can be authenticated to the correct device, make better operational decisions, and improve efficiency.

Industrial monitoring
Protect mission-critical industrial equipment and make sure only authorized personnel has access to keep workers, plants, and communities safe.

TAM 2023: USD 47m
CAGR 2019-2024: 65%

TAM 2023: USD 134m
CAGR 2019-2024: 51%

TAM 2023: USD 146m
CAGR 2019-2024: 122%

1 Source: ABI Research Q1/2019

2 Source: HIS 2019
Low category LTE projects are on the rise. New IoT applications coming in daily.

- Strong growth with new applications
- Growth inflection point passed
- Year-to-date order quantity already 20% higher than all of 2018.
- Strong market penetration achieved with SARA-R4 modules.
- Capture growth surge with UBX-R5 based modules.

Source: company data
Migration to LTE-M in full swing.

u-blox has built leading presence in LTE-M applications with R4 modules.

- SARA-R4 is the predecessor module based on third party chips
- Remains available for legacy and lower tier applications
- Strong market penetration achieved with R4 modules
- A majority of top tier customers have designed in R4 modules
- Broad application base
- Mobile and stationary use
- Migration from 2G and 3G expanding in all regions
Competition is shaping the market.
There are several LTE-M chipsets in the market - most modules are Qualcomm based.

<table>
<thead>
<tr>
<th>Relevant chip vendors</th>
<th>Relevant module vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordic</td>
<td>Fibocom</td>
</tr>
<tr>
<td>Nordic</td>
<td>Gemalto</td>
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<tr>
<td>Nordic</td>
<td>Neoway</td>
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<td>Nordic</td>
<td>Quectel</td>
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<td>Nordic</td>
<td>Sierra Wireless</td>
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<td>Nordic</td>
<td>SIMCom</td>
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<td>Nordic</td>
<td>Telit</td>
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<td>Nordic</td>
<td>Wistron</td>
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<tr>
<td>EMEA</td>
<td>Asia</td>
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UBX-R5 positioning.
Cellular technologies are moving towards 5G.

5G is the long term evolution (LTE) for cellular IoT connectivity.

1: LPWA: Low Power Wide Area
Evolution in the LPWA space.
Cellular standards for the Industrial IoT.

<table>
<thead>
<tr>
<th>Year</th>
<th>Technology</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>5G</td>
<td>Ultra Reliable Low Latency Communication: Super low latency, Highly secure / resilient, Always available without interruption</td>
</tr>
<tr>
<td>2021</td>
<td></td>
<td>Massive Machine-Type Communication: 1 M devices per km², 10+ years battery life, Low data transmission</td>
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- **uRLLC**
  - Ultra Reliable Low Latency Communication
  - • Super low latency
  - • Highly secure / resilient
  - • Always available without interruption

- **mMTC**
  - Massive Machine-Type Communication
  - • 1 M devices per km²
  - • 10+ years battery life
  - • Low data transmission
Cellular technologies are moving towards 5G.
5G is the long term evolution (LTE) for cellular IoT connectivity.

4G LTE
- Rel-8/9
- 4G LTE-Advanced
  - Rel-12
- 4G LTE-Advanced Pro
  - Rel-13
  - Rel-14
- 5G
  - Rel-15
  - Rel-16

LPWA\(^1\) – the u-blox realm

1: LPWA: Low Power Wide Area
UBX-R5 LTE-M and NB-IoT chipset.
A new chipset beyond the state-of-the-art.

Best-in-class hardware-based security

Outstanding coverage and energy efficiency

5G ready to last an IoT lifetime

Integrated edge computing platform

Passed all inter-operability tests

Passed Swisscom Live network tests

Global certifications on-going
UBX-R5: A highly efficient platform investment.
Strong re-use of u-blox IP.

• The UBX-R5 platform is based on the UBX-R3 LTE Cat 1 platform, the first u-blox cellular chipset platform fully developed in-house.
• Strong re-use of modem IP in UBX-R5 for much shorter development time.
• Radio integrated on chip.
• LTE stack software proven on UBX-R3.

• UBX-R3: The first u-blox cellular chipset developed in-house (LTE Cat 1)
• For high data throughput (up to 10 Mb/s)
• Offers coverage in 324 live networks in 137 countries
What sets us apart with UBX-R5?

Solving the relevant problems of cellular connectivity.

Security
Built-in end-to-end security

Longevity
Designed to last an IoT lifetime

Services @ the core
Unique access to on-chip data sources

Low power
Very long battery life time
u-blox has full technology ownership.
Unprecedented benefits for industrial IoT applications.

• u-blox core IP for
  • LTE modem (radio, baseband processor)
  • Security
  • Power management
  • GNSS positioning

• Key benefits
  • Comprehensive problem solving for IoT
  • End-to-end secure solution
  • Only one product for world-wide use
  • Commitment to longevity of product availability
  • Highly competent technical support

• UBX-R5, the second u-blox cellular chipset
• LTE-M and NB-IoT technology
• 5G ready
• Certifications and approvals for Verizon, AT&T, T-Mobile, Giteki, Softbank, and many more
• FCC, ISED, GCF, RED, […] certified
Swisscom, as the leading 5G network operator in Europe, is going to refarm 2G by end of 2020. Therefore it is crucial for customers as well as for Swisscom to have products such as SARA-R5 which has been successfully passed first tests on Swisscom's LTE-M network, to migrate legacy m2m application to LTE IoT solutions.

Marco Canepa (Field CTO IoT)
UBX-R5 enables SARA-R5: Key strengths
SARA-R5 series.

How u-blox chipsets are integrated.

- SARA-R510M
- UBX-R5
- UBX-M8
- SARA-R511M

LTE-M and NB-IoT (Cat M1 & NB2) with internal GNSS
Introducing the SARA-R5 module.
Our most advanced, secure, and highly integrated chipset to date.

Designed to last an IoT lifetime and 5G-ready with the u-blox UBX-R5 chipset:

• Built-in end-to-end security with hardware-based Root of Trust inside discrete Secure Element, EAL5+ High compliant
• Accurate and reliable positioning, always and everywhere, with u-blox M8 GNSS receiver
• Optimized ultra-low power consumption
• Critical firmware updates delivered and services enabled via uFOTA
• Simplified multi-regional deployments with each hardware variant
Security: IoT security from the ground up.
How we create trust to secure functions.

Provision trust: Insert Root of Trust at production
An immutable chip ID and hardware-based Root of Trust provide foundational security and a unique device identity. The only product in the market.

Leverage trust: Derive trusted keys
Secure libraries allow generation of hardware-backed crypto functions and keys that securely connect to the cloud.

Guarantee trust: Use keys to secure any function
Ensures authenticity, integrity, and confidentiality to maintain control of device and data.

Security solutions developed in partnership with Kudelski, a world leader in securing digital content.
Longevity. Designed to last an IoT lifetime.

- Roadmap stability is an essential aspect we can guarantee
- **No third party dependencies** for key components like LTE or Positioning chipset
- **Long-term support** of the entire platform, from the module down to the chipset level
- **Full hardware and software ownership**
- Products are **5G ready** and will work in 5G LTE networks

A typical IoT device

Technology evolution cycles: **2-3 years**

Current LPWA chip lifecycles: **2-3 years**

5-10 year lifetime
• UBX-R5 is designed with a service-centric architecture
• Unique access to on-chip data sources used to provide reliable and highly secure services

• Localization – reliable position outdoors and indoors with CellLocate®
• Timing – accurate timing information everywhere with CellTime®
• Management – always up to date with uFOTA
• Scalable security – tailored offering of features and services
Power: Ultra low power.

Smart Metering.

- LTE-M and NB-IoT standards decrease overall power consumption to meet industry requirements for long battery life time.
- SARA-R5 series assures maximum design flexibility, while preserving overall system power consumption.
- SARA-R510M is optimized to deliver the lowest achievable power consumption making it ideal for metering, smart city, connected health, security and surveillance, remote monitoring and other battery-powered applications.

- Unmatched stand-by current consumption < 1 µA
Reliable Positioning.
Combining core technologies.

- **SARA-R511M** for applications where **reliable positioning** is paramount
  - Powered by an integrated **UBX-M8 chip** design
- Targets mobile applications in the automotive, fleet management, tracking, and telematics sectors
- Maximum functionality
  - Transferring data and getting position concurrently
- Benefit from superior positioning performance of UBX-M8
  - Best in class sensitivity, accuracy, fix-time
Expanding the revenue model.
Pillars constitute UBX-R5 and deliver premium value. Various components of platform investment deliver enhanced ROI.

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<th>Revenue Model</th>
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<td>GNSS engine</td>
<td>Positioning and timing information</td>
<td>Unit revenue (add-on)</td>
</tr>
<tr>
<td>Edge computing</td>
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<td>Unit revenue (add-on)</td>
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<td>Edge computing</td>
<td>Less data volume</td>
<td>Unit revenue (add-on)</td>
</tr>
<tr>
<td>Secure element</td>
<td>End-to-end security</td>
<td>Upfront (add-on) or recurring fee</td>
</tr>
<tr>
<td>Services @core</td>
<td>Enhanced product values</td>
<td>Upfront (add-on) or recurring fee</td>
</tr>
</tbody>
</table>
Migration to SARA-R5 for extracting more value.
Secure IoT and maintenance services.

- **Basic connectivity only**
  - OEM must add key functionality, as far as supported by chipset

- **Basic connectivity plus**
  - Built-in security
  - Services @ the core
  - Edge computing
  - Ultra low power
  - Positioning and timing with cellular services
  - Built to last an IoT lifetime

Securing IoT connectivity a lifetime long
Long harvesting time available.
Standards and networks have a long lifetime.

UBX-R3
- New radio
- New signal processor

Research & Development
- 2011
- 2016
- 2019
- 2025
- 2030

UBX-R5
- Seven patents filed
- First time right chipset

Research & Development
- 2016
- 2019
- 2025
- 2030
# Market Valuation of wireless technology

Comparables from recent M&A activity.

<table>
<thead>
<tr>
<th>Acquirer</th>
<th>Target</th>
<th>Transaction Value (in Million USD)</th>
<th>Enterprise Value (EV)/Sales 2019</th>
<th>EV/EBITDA 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Semi</td>
<td>Quantenna</td>
<td>939</td>
<td>4.2</td>
<td>18.1</td>
</tr>
<tr>
<td>NXP</td>
<td>Marvell Wi-Fi/BT business</td>
<td>1760</td>
<td>5.9</td>
<td>&gt;25*</td>
</tr>
<tr>
<td>Infineon</td>
<td>Cypress company</td>
<td>9132</td>
<td>4.6</td>
<td>18.6</td>
</tr>
</tbody>
</table>

*estimated; **estimated without memory business (wireless only)
Summarizing.

u-blox brings core wireless technology to the benefit of IoT.

• Developing cellular chipsets is hard, only a few players are capable doing it.
• We own the required technology to realize secure cellular connectivity.
• With chipset and modules we can tailor our offering to serve the entire IoT market.
• Wireless technology is highly valued by capital markets.
The best is yet to come!