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THE CONNECTED CITY

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FOREWORD

THE CITY OF THE FUTURE

Dear Readers,

We are delighted to present to you the second edition of the u-blox magazine, with a focus on the Connected City and what it entails in terms of technological progress and our daily life in an urban environment.

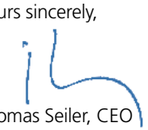
Nearly 70 percent of the world's population will be living in cities by 2050. With the trend of urban living increasing by the day, it seems only inevitable that a city should become smarter to accommodate this growth. The definition of a smart connected city is multifold, involving multiple stakeholders, but its primary objective is to enhance sustainability, quality of life and urban welfare. Practically, this means benefits for its inhabitants, such as less traffic congestion, lower pollution and increased security.

A smart connected and greener city doesn't happen overnight, though. It makes use of the latest connectivity technologies and platforms encompassed within the Internet of Things (IoT) that Really Matter. Six verticals are usually considered to be its pillars: smart energy and smart grids, smart water, smart transportation, smart buildings, smart infrastructure, and smart government. u-blox is a key element of the smart connected city's ecosystem, by establishing position and wirelessly connecting various devices within and across these verticals. This can be thought of as the connected city's nervous system.

So what will the connected city of the future look like? It seems to me that rather than a Utopian urban environment, it will simply be a place where the citizens' needs are best met.

We wish you informative and smart reading.

Yours sincerely,



Thomas Seiler, CEO

HOW OUR CITIES ARE BECOMING SMARTER AND WHAT IT MEANS FOR US, WHEREVER WE LIVE

While the definition of a smart city is multifold, it remains that the primary goal for making a city smart or smarter is to enhance the lives of its inhabitants. This is where the IoT comes into play, bringing connectivity to the supply of energy and water, transportation, infrastructures, the management of buildings and the work of municipal authorities.

The connected city is going to be a smarter city, but what does "smarter" mean in this context, and how will cities be connected? We don't yet have all the answers to these questions, but over the last few years public authorities, businesses, academic institutions, NGOs and individuals have evolved a common understanding of what smart cities are and how they will evolve in the future. It is not a one-size-fits-all scenario, though. Geographic, cultural, financial and technical considerations will dictate priorities for the application of technology to the smart city concept.

However, the unifying idea is that the smart city enhances the lives of its inhabitants. This may mean less traffic congestion and lower pollution, or the more effective supply of clean water. It can be a city where energy consumption and CO_2 emissions are minimized, and one in which businesses thrive and public authorities can deliver better services for their citizens. The smart, connected city is one of the most exciting aspects of the Internet of Things that Really Matter. And it's set to attract $133 billion of technology spending by 2019, according to researchers at BI Intelligence. Another analyst, Gartner, tells us that there will be 9.7 billion connected "things" deployed in smart cities by 2020.

While definitions and applications are still evolving, it's clear that the smart city concept embraces the supply of energy and water, transportation, infrastructures, the management of buildings and the work of municipal authorities. In all these areas, the multifaceted IoT enables us to collect data from an almost infinite variety of sensors and other sources, process that data locally or in the cloud, and initiate actions based on information derived from the data. The sensors, some of which will be location-aware, will communicate wirelessly with others around them and with gateways that link them to the cloud.

Smart meters have already been installed in many municipalities around the world. These enable better management and monitoring of energy consumption, for both consumers and

utility companies. Meter readings are instantly available to whomever needs them. Electricity, gas, oil and water consumption can be monitored locally or from anywhere in the world with an internet connection. Consumers program their electrical appliances to use off-peak energy, saving money and helping load-balancing on electricity grids. Utility companies no longer need to send people in vans to read their customers' meters. Instead, data is collected remotely, accurately, at low cost and in real time. Some of this data can be used to inform predictive maintenance programs, improving reliability of supply while lowering operating and maintenance costs. Other data can enable smarter management of the electricity grid, again reducing waste and saving money.

Lighting accounts for nearly 20% of the world's electricity consumption, and by far the largest proportion of this is city lighting. However, smart city lighting, for example in streets and in car parks, can now be controlled automatically. Light is provided when it's needed, but switched off to save energy when it's not. Sensors detect both environmental conditions and traffic levels to determine the most appropriate illumination level for street lighting.

The automation of traffic control promises shorter, safer journeys and lower pollution levels. Emergency services will reach their destinations faster, saving lives, and businesses will operate more efficiently by reducing wasted travel time. Citizens will benefit too; travel should become less stressful and shorter commuter journeys may result in more leisure time. Smart parking services will mean driving directly to available spaces, rather than circling streets or car parks to find that illusive vacant space.

The volume of data being generated by smart cities is already immense, and is growing at an accelerating rate. Although there are legitimate concerns about security and privacy relating to individuals, much of the data will be generated and transmitted as machine-to-machine (M2M) communications. Some will inform municipal authorities in ways that enable them to optimize their work, either by saving money or facilitating new and improved services. For example, chemical sensors will monitor air quality, cameras will improve security, inductive sensors in roads will provide instant traffic updates and waste collection services will become more effective and efficient thanks to innovations such as smart bins, whose location and status can be monitored remotely.

Other information derived from smart city networks can be made available to consumers on websites, via mobile apps and on displays. Real time information on public transportation services is already displayed at bus stops and railway stations in some cities. Businesses may also make use of smart city data to create targeted advertizing, perhaps delivered to smart screens at transport terminals, shopping malls, and sports and entertainment facilities.

Of course, connected devices will require robust, secure communications at every point in the chain, from sensor nodes to the cloud and back again. This is where a plethora of wireless positioning and communications technologies come into play.

Global navigation satellite system (GNSS) is becoming more accurate, partly due to data fusion techniques that combine satellite signals with location information derived from cellular and Wi-Fi networks and, in the case of vehicles, data from wheel-tick sensors.

Familiar Wi-Fi and Bluetooth links, in a variety of flavors suited to different IoT applications, will proliferate, particularly where cellphones are used as internet gateways. Then there's Narrowband IoT (Cat NB1), a new, ultra-low power technology for communicating small amounts of data over existing cellular radio networks. NB-IoT has already been proven in a number of applications, including remote metering, where it eliminates the need for dedicated networks. Here, it facilitates rapid smart meter deployment with communications delivered over established, secure and reliable cellular networks that offer guaranteed quality of service. NB-IoT is particularly effective in challenging locations such as inside buildings, or even in cellars.

For video and other high-bandwidth communications, high-speed, low latency 4G LTE networks are already playing a vital role. 5G is emerging, too, and in the near future will increase network capacity and speeds by an order of magnitude. Communications links will be able to carry data from millions more sensors, and consumers will be able to download Ultra HD videos in seconds.

u-blox's unique heritage combines in-depth experience in positioning, short range wireless and cellular radio technologies, so the company is perfectly positioned to provision smart city wireless networks. u-blox's integrated circuits and modules deliver secure, robust communications, whatever the environment.

Equally important, modules are simple to install, scalable and easily upgraded as standards evolve. They also feature low power consumption, long operating life, and minimal maintenance. As wireless standards develop, u-blox is playing a major role by participating in the most relevant industry bodies, enabling the company to keep its customers at the forefront of developments.

The smart city is bringing a better quality of life to hundreds of millions of citizens around the world. u-blox is delivering the connections that make it all possible in this vitally important aspect of the Internet of Things that Really Matter. ●

"THE UNIFYING IDEA IS THAT THE SMART CITY ENHANCES THE LIVES OF ITS INHABITANTS."

1
Citizens play an active role in a smarter city.

2
Lighting accounts for nearly 20% of the wold's electricity consumption.

3
Smart cities will creat big data volumes.

4
The automation of traffic control promises shorter, safer journeys and lower pollution levels.


1


2


3


4

WHEN SMART METERS GET SMARTER

Smart metering increasingly relies on cellular communication technology. We explain why.

Today smart metering is a cornerstone of efforts to reduce global energy consumption and costs. Governments, regional regulatory bodies, energy utilities, system integrators, design houses and original equipment manufacturers (OEMs) are involved in worldwide deployments of telemetry infrastructures used by utilities in residential, commercial, and industrial areas. Applications range from gas and water metering, to distribution automation, and to new areas of telemetry, including remote sub-monitoring of Home Area Network (HAN) devices such as Programmable Control Thermostats (PCT).

This trend is primarily enabled by innovations in communication technology, which introduce multiple benefits for both consumers and utilities, such as automated billing, profiling of end-user usage data, revenue protection and fraud reduction. Innovation also makes possible new industry-specific features that are rapidly affecting the complete value chain of the metering market. For example, electricity utilities use smart metering deployments as a building block to implement outage management or grid voltage optimization. These improvements translate into a better allocation of energy, reduced waste of resources, and more accurate control of network distribution.

Historically, Power Line Communication (PLC) and various versions of proprietary or unlicensed RF radio communication technologies were rolled-out on a worldwide basis in metering infrastructures. Today cellular communication is getting the lion's share of new deployments. This is the result of government mandates demanding the use of a technology based on open stan-

Manual reading of gas meters is on the way out.

1
Smart metering is used by water utilities to enhance network leakage control.

dards' specifications. Similarly, utilities are increasingly keen to leverage existing public cellular networks, thus reducing the total cost of ownership of massive roll-outs.

Cellular open standards bring additional benefits in the areas of interoperability, coverage and capacity, especially pertinent for multiservice utilities. Furthermore, cellular technology can help minimize network design complexity and secure quality of service by avoiding radio signal collision and interference.

Security is another increasingly important requirement for smart meter design. A malfunction or a malicious attack on smart meter firmware can result in millions of devices turning off simultaneously, causing massive damage to a large region or to the grid of an entire country. A key requirement of smart meter devices is that their firmware can be updated remotely with FOTA (Firmware Over-The-Air). Sending an engineer out is not just an expensive maintenance cost, it's critically slow especially in a situation when millions of meters may need to be updated, such as in the case of a security breach. The FOTA feature also provides means for an efficient wireless upgrade over a carrier network, which is extensively used in mobile phones, and is now supported in cellular M2M technology as well.

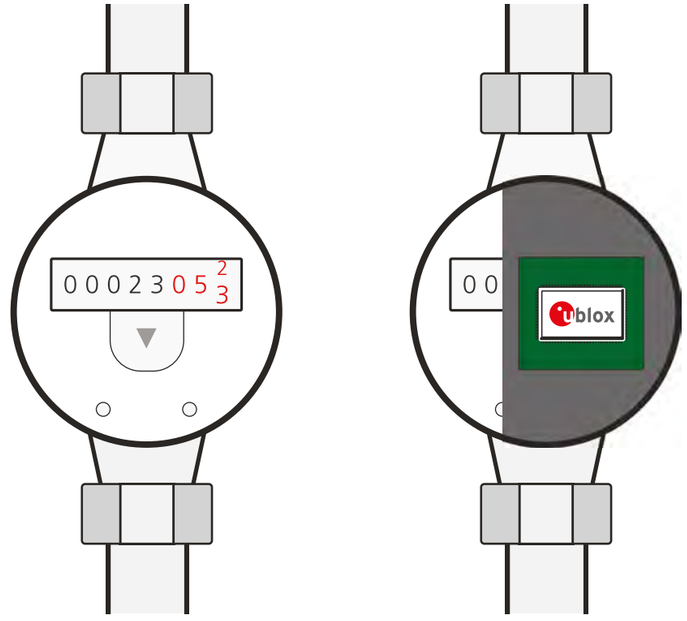
Thanks to all these inherent benefits, cellular technology is currently undergoing massive deployments, providing end-to-end connectivity in metering infrastructures. 2G and 3G connectivity has been commonly used in smart meters globally, because it provides cost-efficiency and sufficient data speeds. However, for future deployments, the utility ecosystem is already transitioning to 4G LTE connectivity due to two factors. First, the product and infrastructure longevity offered by LTE technology; second, the introduction of specific versions of the LTE specification, such as Category 1, Category M1 and Category NB1.

The availability of proven cellular communications modules can speed time-to-market and allow the creation of innovative solutions in metering markets. We foresee an exciting transition from smart metering to an era of efficient wireless connectivity between multiple new categories of smart IoT sensors. This will allow utilities to experiment with new business models at a rapid pace and with relatively minor investments compared to traditional infrastructure costs and timelines.

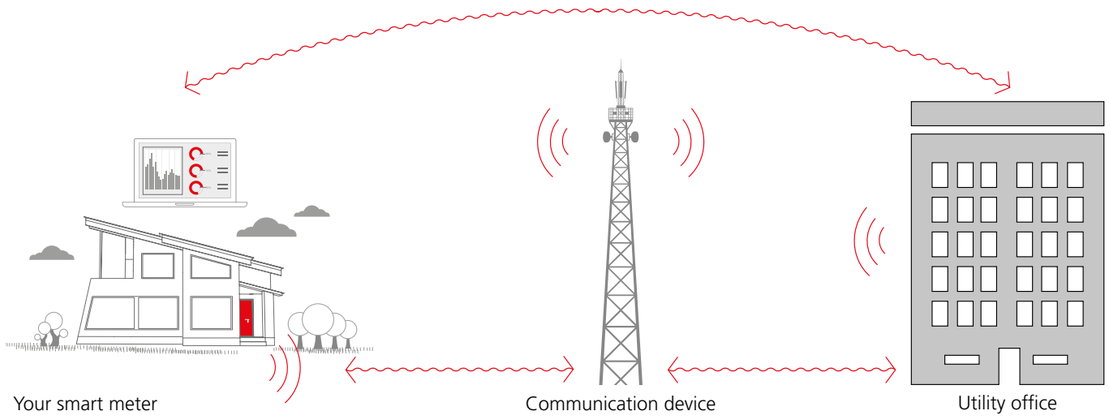
u-blox is committed to the smart metering market with an ATEX certified cellular portfolio and manufacturing based on ISO16785 to fulfill industry-specific rugged specifications. The u-blox portfolio of cellular modules is ready to contribute to enabling smart metering systems globally. ●

LEARN MORE:
www.u-blox.com/cellular

Smart meters will be equipped with communication modules.



How a smart meter works.



780 M
smart **electricity** meters worldwide by 2020.

150 M
smart **gas** meters worldwide by 2020.

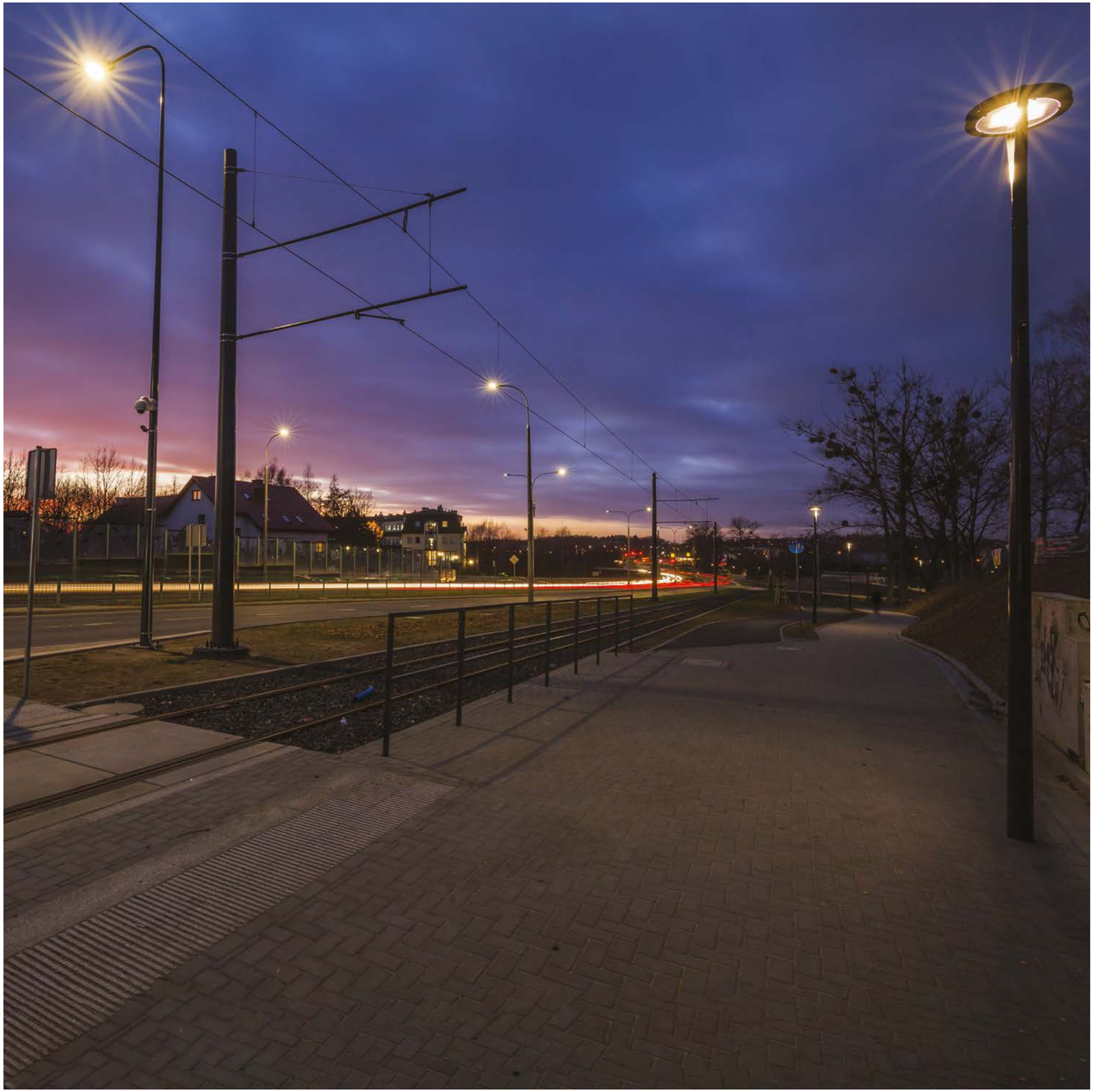
90 M
smart **water** meters worldwide by 2020.

SMART STREET LIGHTING MEANS LIGHTING-ON-DEMAND

Smart lighting over a wireless, mesh network promises greater savings.

By 2025 there will be over 350 million streetlights in the world*. Huge energy savings are already achieved by replacing legacy lamps with LEDs, but smart lighting promises even greater savings. City lighting will respond to traffic density and automatically switch itself on when needed and off when not. The communications for this will be handled over a wireless, mesh network that's easy to install, automatically configurable, and scalable. This will be a network that's robust, low power, and distributed so that there's no single point of failure. u-blox's NINA-B1 Bluetooth low energy modules running the Wirepas connectivity protocol for large-scale decentralized IoT applications will be at the heart of such networks. ●

*According to market research, MarketsandMarkets



City lighting responds to traffic density to switch on or off.

TRAFFIC MANAGEMENT ENHANCED

Untethered Dead Reckoning technology helps to improve road tolling, pay-as-you-drive insurance schemes and parking.

UDR provides accurate positioning performance even in covered areas.

Untethered Dead Reckoning (UDR) is a technology that is revolutionizing traffic management. By combining locally generated data from in-vehicle sensors with satellite navigation data, it frees vehicles from absolute dependency on strong satellite signals in order to determine their position. They can be tracked accurately even when they're in short tunnels, or when satellite reception is poor due to signal interference. UDR systems have a typical accuracy of within a few meters and the data is available near to real-time (milliseconds), whereas GPS-only data become available around 100 milliseconds later.

UDR simplifies urban road tolling. It improves the accuracy of pay-as-you-drive insurance schemes and, in the event of an accident, delivers accurate data to help investigators understand how it was caused and its consequences. In addition, UDR improves fleet management by working hand-in-hand with vehicle-based telematics to provide engine diagnostics, accurate mileage and positioning data, and a check on how well vehicles are being driven. What's more, with the right app, it can direct you to the nearest available parking space in a crowded car park.

In summary, UDR enhances the speed of delivery and accuracy of positioning data, improves existing services and enables the development of new ones.

LEARN MORE:
www.u-blox.com/udr

Recent technology advances in satellite navigation help to smooth traffic flow in a city.

CUTTING THE WASTE IN WASTE MANAGEMENT

Narrowband IoT will enable smoother and cheaper waste management.

Waste management itself creates waste. Collection trucks use more fuel if routes are not optimized, creating extra emissions and wasting money. Here's where Narrowband IoT (Cat NB1) can help. It's a low power, wide area networking technology that works via existing cellular radio networks. Smart bins will have tags that use NB-IoT networks to tell waste management companies where they are, when they've been emptied and even when they're ready to be emptied. This enables smarter collecting, cutting the waste from waste management. u-blox's SARA-N2 cellular radio modules for NB-IoT make it possible, enabling the tags to run for years on a tiny battery. ●

Smart waste management allows sustainable dispatch of garbage collection fleets.

50 %

of service cost savings in the Portuguese city of Cascais thanks to route optimization

1 M

is the projected number of smart bins by 2021

90 %

of installed smart bins will be equipped with cellular technology, source: ABI Research

WATCH OUT!

Major changes are underway in the Home Security Market.

1

2

Cellular connectivity has become the technology of choice, replacing unwieldy wired landline installations, while providing the same level of security as a landline. Cellular connectivity also provides better mobility.

In the not-so-distant past, home security systems fulfilled a single basic need: To give home owners the peace of mind that an alarm would sound in the event of a burglary, thus notifying the home owner or local authorities via a call center.

But change is underway, which could lead to substantial growth in a market considered stable yet stagnant. Innovation is coming from smart home applications that are adding connectivity to lighting, thermostats, smoke detectors, flood sensors, door locks and similar functions around the home. Such smart home solutions are often successfully bundled with home security applications, sparking growth in adoption rates. For example, combined home automation and security solutions from tier one players in the US market now have a take rate of over 50% for new subscriptions. According to ABI Research, the market for hybrid home automation and security systems will grow 500% from 800k in 2016 to almost 5M in 2020.

Traditionally, home security hardware has been sold at a discount as part of a long term service contract that provided recurring revenue to system providers. In this model, security systems are professionally installed and monitored by a 24/7 call center with the capacity to take action in the event of an alarm (such as notifying the home owner or the local police department). Most professional installations were connected via landlines, considered much safer than WLAN connections, which could be disabled by cutting power to the home.

1
Traditional security systems were professionally installed and monitored by a 24/7 call center.

2
Self-installed and self-monitored home surveillance systems are increasingly popular.

In recent years, cellular connectivity has become the technology of choice, replacing unwieldy wired landline installations, while providing the same level of security as a landline. Cellular connectivity provides better mobility, allowing the system to be moved to a new location, such as a new home.

Simpler installations, system portability and lower device costs have opened the market to new entrants with systems designed for self-installation and even self-monitoring. In case of a self-installed system with professional monitoring, consumers are responsible for the purchase and installation of the system hardware. The system itself remains connected to a monitoring call center that can take action if needed, but often at a significantly lower monthly fee than through traditional service offerings. In the case of a fully self-monitored system, there is no call center or service fee. Home owners are responsible for purchasing and setting up the hardware. They are notified directly if an alarm is triggered and can choose which action they want to take.

Self-installed and self-monitored systems are seeing increasing popularity in markets and demographics with traditionally low home security system penetration, such as renters, owners of apartments and condos, first-time home owners, and less affluent demographics.

Among the many new market entrants are cellular network operators, cable companies, major retailers, and electronics OEMs, as well as the traditional home security companies looking to complement their offering. In many cases, they provide hybrid offerings for smart home applications, such as remote lighting and heat control, as well as security systems such as alarm panels and video monitoring.

Globally, 2G and 3G connectivity is still commonly used for many smart home and home security applications, as it provides cost-efficiency, in combination with voice support and sufficient data speeds. However, in the US market, new systems have already transitioned to 4G LTE connectivity. LTE Cat 1 will serve as a key technology, due to its cost effectiveness and ability to support both voice and video. For more video-focused installations, such as surveillance systems, it is likely that LTE Cat 4+ will play a larger role with its higher data throughput rates.

u-blox has a full line-up of products that can enable Security and Home Automation systems globally, ranging from the 2G SARA-G3 and 3G SARA-U2 product families to LARA-R2 and TOBY-R2, which support LTE Cat 1 and include Voice Over LTE (VoLTE). VoLTE is a feature that helps to eliminate the need for a separate 3G connection, thus reducing system complexity and cost. This u-blox portfolio targeting the remote monitoring and building automation segment is complemented by the TOBY-L2 family, which supports LTE Cat 4, enabling higher data throughput performance that is suitable for residential and urban video surveillance applications. ●

500%
Market growth for smart home automation and security systems until 2020.

THE SMART CONNECTED CITY

The phrase “smart city” doesn’t mean the same thing to everyone, but the concept is being rolled out globally and a common set of core technologies underpins its deployment.

The smart city concept is being embraced throughout the world. An amazing convergence of technologies is creating programmable, smart, connected cities - cities that improve the lives of their burgeoning populations. Billions of sensors transmit all kinds of data to powerful computers operating in the cloud. They are being installed in many cities at an accelerating pace. At the same time, machine learning, sometimes referred to as artificial intelligence, enables computers to analyze the zettabytes of data produced by these sensors in record time.

Wireless communication technologies are critical to this transformation of our cities, and many applications also need to know the location of ‘things’. For example, accurate location information is for instance critical for deployment of autonomous vehicles, traffic management systems and public transport. Sometimes there is a need to transmit small packets of data infrequently, such as in utility metering, and low power consumption will be critical because devices may have to operate on small batteries for years. In other applications, we want to transmit multiple streams of high definition video, which requires high bandwidth networks, such as Wi-Fi and cellular LTE.

Smart connected city applications encompass environmental monitoring, street lighting, traffic management, waste management, utilities metering, information signage, surveillance and more. Low-power wide-area Networks (LPWAN) underpin a city’s development and this is based on a mesh and point-to-point topologies, including Narrowband IoT (Cat NB1) running over cellular radio infrastructure, the various flavors of Bluetooth and Wi-Fi, and others.

While the deployed technologies are broadly similar in every region, application priorities depend on cultural, economic, geographic and other factors. Traffic management may not be as important as water and waste management in some cities, particularly in the developing world. For others, it may be a critical factor affecting the health of its citizens if air pollution caused by cars and other vehicles has reached unacceptable levels.

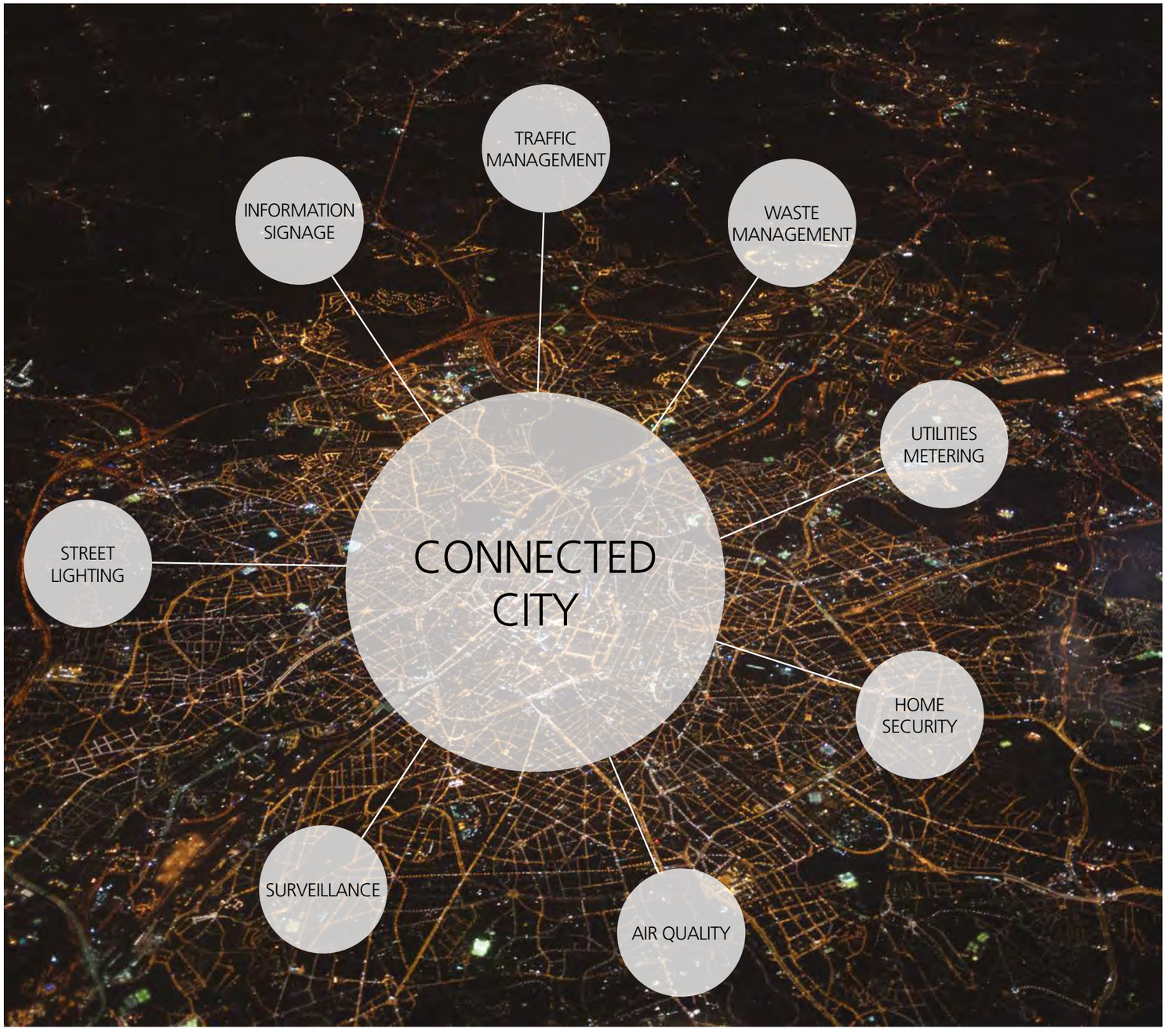
For example, in China Microsoft’s ‘Your Weather’ app combines China Meteorological Administration data with Microsoft’s machine learning to provide citizens with localized air quality and weather reports on their smartphones.

In the US, it’s estimated that smart metering and smart grid technologies will save nearly 10% of the electricity consumed, delivering both cost savings and environmental benefits.

In London, Thames Water forecasts a water shortage by 2040 equivalent to the consumption of two million people - a problem that smart water controls may help mitigate through conserving resources, in part through minimizing leakage.

And in some cities, connected devices and infrastructure are being used to reduce the risk of accidents, in particular collisions. A combination of positioning and short range solutions using sensors is being developed in Japan to track the movements of pedestrians and bicycles at junctions controlled by traffic lights.

These are just a few examples of how the IoT is being deployed to create smarter cities that are better places to live. u-blox’s positioning and multi-protocol communications products are at the heart of the networks that connect many of the applications involved. ●



AGUA DE VALENCIA

u-blox teams up with Vodafone and Huawei to pioneer smart water meters in Spain.

The Narrowband IoT (Cat NB1) protocol was developed so that small amounts of data may be transmitted over cellular radio networks from nodes that consume so little power, they operate for years on a small battery. Vodafone and Huawei are pioneers in its development and recently sent pre-standard NB-IoT messages to a u-blox pre-standard NB-IoT cellular radio module incorporated in test mobile units deployed at Agua de Valencia water meter locations. The sites included challenging environments below ground, in basements and other hard to reach places. The successful test confirmed that the use of NB-IoT means utility companies don't have to install their own communications infrastructure. They can deploy NB-IoT quickly and easily using existing cellular networks, which already have proven reliability and guaranteed quality of service. ●

LEARN MORE:
www.u-blox.com/nb-iot

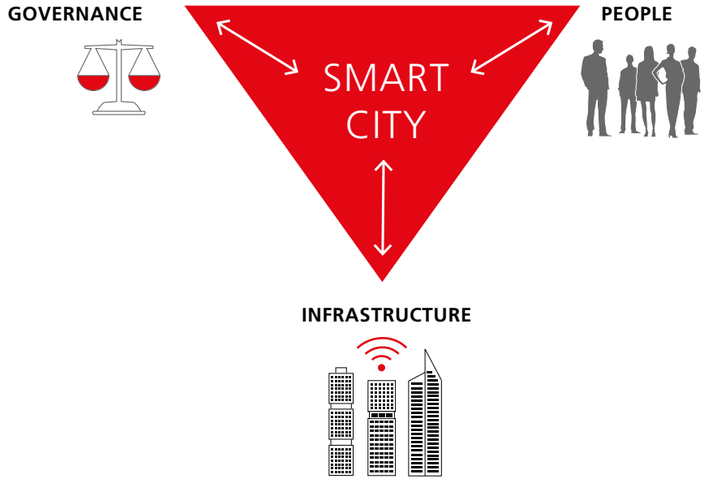
INTERVIEW

SMART CONNECTED CITIES: A REALITY CHECK ON THE UTOPIAN VISION

Many of the visions of a smart or connected city highlight a future Utopian world of rich interconnected services, where traffic systems are connected to a city infrastructure, such as roads and parking spaces and even street lights act as wireless hubs. Is this a realistic or attainable vision, or little more than a pipedream?

Right:
Andrew Brown
Executive Director at Strategy Analytics

Left:
Tony Milbourn
VP Corporate Strategy at u-blox



Smart City – A triangle of opportunity, three corners of challenge.
Source: © Strategy Analytics

Could you summarize what is meant by smart city?

ANDREW BROWN – To describe a smart city, I first have to describe what a city is. A city is an organic system that enables trade between people, and helps meet their needs. Cities in general are more than pure concentrations of dwellings or workplaces. Cities have economies of scale. Positive parameters, such as wages, patients, and hospitals, scale at a ratio of 1.5 for a doubling of city size. Negative parameters, such as crime and some diseases, also tend to follow the same rule. There are currently about a hundred cities that are pretty small, but are going to become much more significant over time, as you see greater levels of urbanization.

> "I THINK THE VISION OF AN OPEN CITY OPERATING SYSTEM PLATFORM, ON WHICH OTHER SERVICES ARE BUILT AND IMPLEMENTED IN SOME PLACES, FEELS LIKE A PIPEDREAM."
> ANDREW BROWN

What really underpins smart cities is ICT (Information and Communications Technology) and infrastructure. When we move from a city to a smart city, there must be key ICT elements that allow many of the challenges a smart city faces to become more manageable, better handled and with multiple different stakeholders. A smart city's infrastructure relies on collaboration between corners of a triangle with key stakeholders at each point: ICT providers, citizens and government. When one looks at smart cities, one looks at managing and measuring key things within that city for a better environment and better living: energy (smart grids, street lights), water, transportation (parking, traffic), buildings and infrastructure, smart government and citizen information.

Smart cities also tend to be resilient and evolutionary places of trade, and are divided into two types: retrofitted existing cities, and new smart cities built from scratch that are meant to provide a test bed for best practice from a holistic standpoint. Such examples are Songdo in South Korea or Masdar City in Abu Dhabi. These scratch-built cities highlight the efficiencies of making a city smart, but also the challenges in automating processes. For example, Songdo's waste management and recycling system is operated by only seven employees for the whole city and therefore represents a single point of failure should something go wrong.

TONY MILBOURN – That's a very interesting analysis. But it seems to me that we abuse the term smart city, don't we? What are we talking about when we talk about "smart" cities? I think we are bringing the benefits of sensors, communications, software and analytics to that thing that is called the city and its environment, which you described so nicely. If we are thinking of smart cities as just a collection of individual vertical systems such as a water system, a traffic system, etc., it is relatively easy to implement "smartness" in any one of these verticals. And the benefits are financial ones for the stakeholders in each of these verticals. In other words, it's largely about giving a ROI to the person who has invested in the smart infrastructure.

However, when we want to put all these verticals into something that we would consider a truly smart city, it turns out to be really hard because, unlike many of the other "smart" examples, a city is chaotic, isn't it? And why would somebody pay to bring all the information together and who is benefiting from doing so?

A.B. – I agree. In a way it is easier when you have a managed government such as in Singapore, or China where there are several government initiatives around energy management. In a city like Dehli, it isn't as clear, because the government/ICT relationship is more fragmented, which when combined with huge urbanization challenges creates real roadblocks. I think the vision of an open city OS (Operating System) platform, on which other services are built and implemented in some places, feels like a pipedream. Many of these smart city ele-

"U-BLOX IS ACTING AS A NERVOUS SYSTEM UNDERPINNING THE VITAL CONNECTED ASPECTS OF A SMART CITY INFRASTRUCTURE."

TONY MILBOURN

ments have started moving ahead in their own ecosystem, for instance smart energy, smart water, smart buildings etc. These are happening at different stages, in different markets.

T.M. – I really like the idea of the city OS, and a sort of city API (Application Programming Interface), as a concept for smart cities, but I think it's extremely difficult to get there. And the reason is probably systems architecture. How are you going to put the city together to provide a unified API? Partly it has to do with separation between the verticals. Sometimes the smart metering or energy program are not driven at a city level, but at the electricity provider level. At the same time, the economic justification for the verticals is very sensitive to the whole life cost of deployment, so smart cities are not going to come about unless the costs of deployment for these individual verticals are very low. That's what we are trying to address with Narrowband IoT (Cat NB1). I think smart cities might become reality, because these verticals have a financial imperative to improve efficiency, by becoming smart. Driving out inefficiencies is one of the key motivators for smart cities, don't you think?

A.B. – I think that driving inefficiency out and saving costs, are fundamental drivers for smart cities. But also creating a better environment.

What are the major trends in today's smart cities?

T.M. – Are we not saying that the major trends are cost savings and driving out inefficiency in particular application areas in a city? And that it varies quite a lot depending on where you are in the world, from both the nature of the city itself and the sort of political environment in which it sits?

A.B. – Those are key ones, but I would also say breaking down barriers between the government and its citizens is actually another big one. What I mean is the need to increase transparency to improve trust between a government and its citizens, and to let citizens know what's happening in a city and a city environment.

T.M. – An open government takes advantage of the smart city?

A.B.– Yes, exactly. People don't have an understanding of the challenges that local governments face. In the UK, for example, local government has faced reduced central government funding for a number of years. For example when refuse is collected fortnightly rather than weekly, many people assume local government is cutting corners. A smart city would allow these local governments to show how funding has been reduced or how funds have been spent elsewhere, as well as related spending (e.g. smart rubbish bins in city centers). This transparency not only builds a degree of trust, but may also help to reduce corruption.

T.M. – Do you sense this is a motivation for governments to implement smart cities: in order to provide citizens with information? Or is it just a side effect?

A.B. – Obviously there are areas such as energy management or preventing water leaks which are critical infrastructure issues and therefore a priority, but improving the information flow between governments and the services they provide and citizens is important.

What city illustrates best nowadays, in your opinion, the concept of smart city?

Cities are
chaotic by nature.
Challenges are, too.

A.B. – I like Bristol, because of its open nature and the fact that there has been a high level of citizen engagement on how it should develop. The problem you get there, and the same with cities such as Amsterdam, is getting things done. With a lot of testing and good ideas, some come to fruition, some don't, if you crowd source them. The sink or swim approach does at least check how robust a particular offering is, however.

T.M. – What about Singapore, that regularly appears on top of the list of smart cities?

A.B. – Yes and that's because Singapore already has very high-levels of ITC penetration: broadband penetration, Internet usage, a very savvy populace and highly involved government. Therefore deploying a very successful transportation network there is somehow easier than in Bristol, because you already have an infrastructure in place that is quite sophisticated.

T.M. – I quite like Nice. It's not very big, with only 400,000 citizens. I think that if we want to look at how smart cities' elements can be implemented in a relatively dynamic way, that size of city makes a more interesting example than the really big ones.

A.B. – Yes, Pisa is another good example. It is again not big but a very historical city with a lot of challenges and very old infrastructure, older roads and massive parking problems.

> "WITH SO MANY SECURITY CHALLENGES, A SMART CITY IS MORE LIKELY TO SUCCEED AND BENEFIT ITS CITIZENS, THE ENVIRONMENT, AND THE OTHER STAKEHOLDERS IF SOME OF THESE DIFFERENT SILOS ARE SUCCESSFULLY IMPLEMENTED."
>
> ANDREW BROWN

How easy are smart cities to implement? What are the issues: current infrastructure, investment, etc.?

T.M. – I think that there are two keywords here: standards and architecture. Standards help a lot with implementation. An example here is the Oyster Card on the London Tube. The London transport people introduced a smart card for the Tube, and then about two years later, passengers can use their credit card to pay, instead of the smart card. And that's only because of standards: the NFC (Near-Field Communication) standard of the Oyster Card is compatible with the credit card. The benefit to the citizens is huge. So when the verticals we discussed earlier come together, there will be ways to do that kind of thing. The other aspect of architecture is API, open OS or open city, as we talked about before.

But who is it that owns implementation of the concept of smart cities? It seems that no-one in government is thinking about what's happening in the different verticals and wanting to make sure that they happen in a way that in five years, or ten years time we can put these data together and get the value-added that comes as a result.

A.B. – Nobody is worrying about the value-added at this stage and I think people are taking it step by step. Your point about NFC is very interesting, and that's part of the problem we have with the IoT aspect today. There is a severe amount of fragmentation about what these standards should be and at any level. That's part of the theory of an open city OS, to make sure that you can plug into it with open APIs, to avoid issues we had in the beginning of the cloud; avoiding vendor silos is imperative. The problem we have from a wireless technology perspective – and I'd like to get your take on this given the fact that u-blox has a big stake in it – what is the best fit for a city's needs? Is it determined by use cases in a particular area? How do you consider the potential expansion of a city? Will it be relevant to everything in three or four years, or is it short-term planning? You might have chosen a particular technology for your parking meters, but in the future, if you want to tie together different elements of your infrastructure and you are using something different for your street lighting, cellular connectivity in your smart waste bins, etc., then you have a problem.

T.M. – I see. That's why we get back to this point of architecture. The pure engineering view of this kind of uniform and consistent approach across a smart city is attractive but naïve. What we will see are blobs of applications. To take your example, we don't really mind what standard we use for parking or lighting. What we want is that the parking system can talk to the lighting system. The architecture is actually a network of blobbed pieces of infrastructure that can then communicate in a common way. A smart city is ideally a stack-based thing: verticals where you get a ROI, justifiable within that vertical, and across the top of the verticals, the icing on the cake, a place when you can pull all the data together and get the value-added. That's why you need the standards.

I think there are two ways to look at this whole concept. If you say smart cities, some people think of a NASA like control room, with lots of screens and operators controlling the dynamics of the city. Or is it people-driven where cities are providing information from the different verticals and people are taking advantage of it with apps. Is it top-down or bottom-up? Control-driven or people-driven?

A.B. – I think the other question is what is there in the first place. In the UK, we have the highest global penetration of CCTV (closed-circuit television). What information already exists that you might be able to leverage for something else, from a big data perspective. What are those systems using?

T.M. – A nice example, isn't it? But then what about privacy?

1
Masdar City in Abu Dhabi is a newborn town.

2
New smart city Songdo in South Korea.

This leads us to our next question: do you think smart cities will affect city and individual lives?

T.M. – There is a real privacy issue there. How will people react to this kind of deep monitoring of their lives?

A.B. – It is clear that the surveillance culture is increasing in the face of threats such as terrorism and cybercrime and many are prepared to allow this to pass unchecked in the face of these threats. Generally speaking, people are prepared to give up a degree of privacy to receive a service. In Google Maps, you give permission to monitor your movements, but do we know what happens to this information? Suppliers say it is all kept anonymous, they just know it's a person moving from A to B. This is what auto makers obviously do. BMW knows where all their connected vehicles are on any map.

T.M. – That's a nice analogy. If you apply the BMW and Google approach to the city and put the data together, it means that we know that A gets up at 8 am in the morning, drinks a coffee, takes the bus to work,

etc. So how does the smart city protects its citizens and their privacy, in that context?

A.B. – That's the million dollar question, because there is no way of controlling what these outside influences are.

T.M. – You cannot detach the smart city from politics, so this is a pretty important topic I think.

What is the role of u-blox in the whole IoT/ICT ecosystem supporting smart cities?

T.M. – Take the analogy of a smart city and a person. The city uses sensors and a person has five senses, the city communicates with short and long range technologies and the person has a nervous system; the city uses computers and the person has a brain; the city uses analytics and the person has knowledge. If you compare this with u-blox, then u-blox is the nervous system of a smart city. It is providing communication, but not the actual sensors and the analytic tools. You want this system to work reliably and cheaply and not consume a lot of power. I also like our little phrase "what, where and when": it's about what data you gather, where you gather it and when you gather it. When we start putting information together across the verticals, to get the value-added, that's where you need this because you can never dissociate from the "what, where and when".

A.B. – u-blox is one of a number of stakeholders within the ICT ecosystem: everything from service to LPWAN (Low-Power Wide-Area Network) providers, then the sensors, the application layers, then the APIs that link into the different applications that provide the services, such as e-government, metering, maintenance, and so on.

Is data security a challenge for smart cities?

T.M. – I think we can put several things in the same pot here. One is security of the data and the system and the other is the robustness of the system to failure. I think in both cases, no matter how careful the design and how tight the security, you can assume that the system is going to fail, with security breaches and robustness issues. So again we end up with this point about architecture, because if you have the Utopian image of everything connected to everything, you end up with a single point of failure. We need better design than that.

A.B. – I think your point about a single point of failure is well taken. I believe the only way a smart city can be secure and safe in terms of information being shared, is if you have these separate silos, truly isolated, or networked in silos but controlled from end to end.

T.M. – So there is a link here: more value-added by linking data from verticals brings more danger of breaches of security and failures of the system.

A.B. – Yes, exactly. You have to isolate these different systems. The other thing about APIs is that they are exposed, with very sensitive information in some of these verticals. This actually comes down to ICT architecture questions around private APIs and the sensitivity of exposed APIs. I think that part of the problem is that most of the drivers for smart cities right now are built around pain points.

T.M. – So who owns the responsibility to make sure a smart city is secure?

A.B. – In IoT, nobody takes ownership. Everyone is busy taking care of their piece of it.

T.M. – At this point I should mention that u-blox has a policy for security within our products, with five principles implemented across the product line. We are a component in the security chain, but we play our part.

A.B. – The problem we have is that people don't want to pay for security and kind of expect it to be built in. You cannot monetize it very easily. What you can do is guarantee connectivity within a licensed spectrum rather than unlicensed. There are also best security practices (TLS, SSL, AES etc.) that you can ensure are included, but beyond that it's just about how you architect the solutions.

How do you see the future in 10 years? The autonomous car is already around the corner, but how long until we have a truly smart city?

T.M. – In my example where we are monitoring the water supply system in the city and we detect that there is a leak, we deploy a van to fix the leak, clear the parking places around the leak, optimize the traffic lights so that it can get there quickly and re-route traffic to avoid the obstruction. Is this going to happen autonomously in ten years time? I doubt it. A city is more complex than a car. A car is made by one company that has full control. It might be that if you build that Utopian city with one company, you'd be able to implement all of this stuff more easily, but nobody is going to build a city like that and, if they do, they are going to fail. The complexity, the unstructured nature of a smart city is a thing that will slow down its implementation. We are trying to impose structure, architecture and value on something that is inherently loosely structured.

A.B. – That's a very good point. You have big companies with their own agenda, trying to push their own products, their own software stacks, and maybe even license their own software platforms to others OEMs, providing smart city elements to others. But this holistic pipedream of everything talking to each other is not going to happen. However, you will see more phones and devices connected than they are today, to elements of city infrastructure. An increasing amount of automation in some of the areas that we discussed will drive this. With so many security challenges, a smart city is more likely to succeed and benefit its citizens, the environment, and the other stakeholders if some of these different silos are successfully implemented, rather than seeking to make an entire city "smart" in a holistic way, which will face countless challenges around interoperability and security. ●

1

Singapore already has very high levels of ITC penetration: broadband penetration, Internet usage, a very savvy populace and highly involved government.

2

Surveillance systems have up and downsides.

RESEARCH SUMMARY

WHAT DRIVES THE GROWTH OF CONNECTED CITIES

Here are some facts & figures.
Would you have known?

82 %
of, respectively, the North American,
(Source: Strategy Analytics)

80 %
Latin American/ Caribbean and

73 %
European population now live in urban areas

1 M
additional people each week in the world's cities
(Source: Strategy Analytics)

80 %
of global energy consumption comes from cities
(Source: The Climate Group)

80 M
smart meters will be installed in Japan by 2025
(Source: Strategy Analytics)

8 %
increase in outdoor air pollution in the past five years, with fast-growing cities in the developing world worst affected
(Source: World Health Organisation (WHO))

10 %
of currently used electricity to be saved in the US market thanks to a combination of smart meter and smart grid technology
(Source: Smart Grid Consumer Collaborative (US))

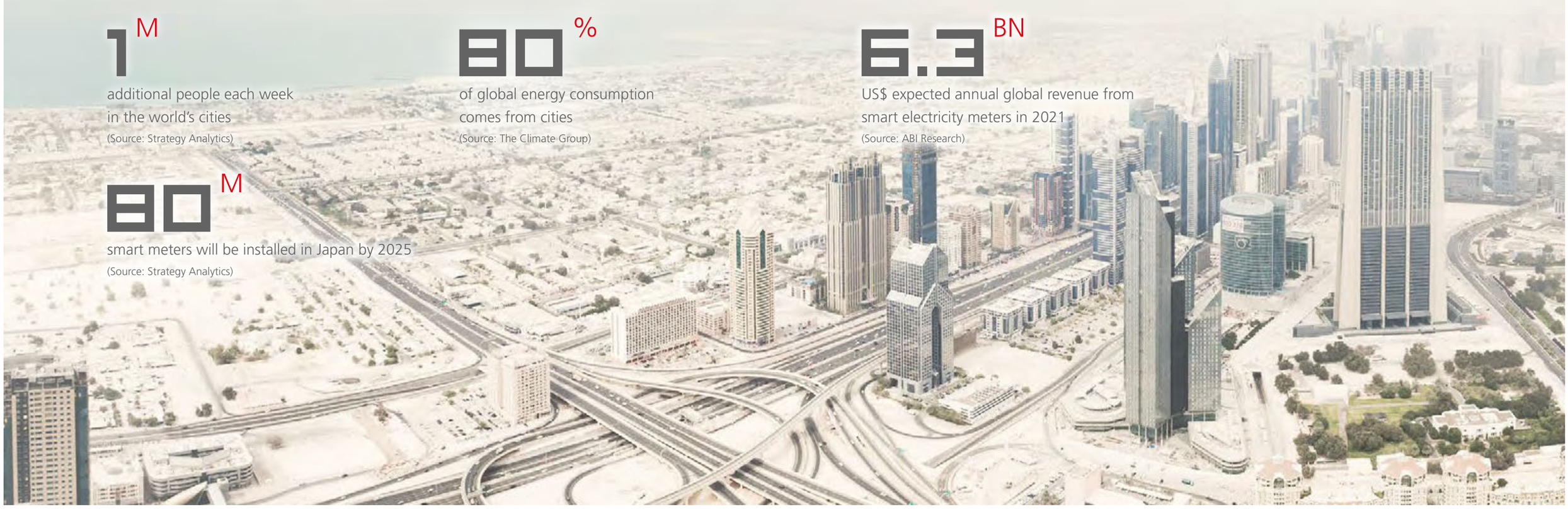
11.9 BN
worldwide urban IoT connections associated with smart city solutions in 2020
(Source: Strategy Analytics)

20 BN
US$ projected to be saved by 2020 thanks to the smart city projects initiated in New York City and Chicago
(Source: Strategy Analytics)

291 BN
US$ ICT-related revenue for smart infrastructure by 2022
(Source: Strategy Analytics)

242 BN
US$ ICT-related revenue for smart health by 2022
(Source: Strategy Analytics)

6.3 BN
US$ expected annual global revenue from smart electricity meters in 2021
(Source: ABI Research)



CASE STUDY

BARCELONA: AN EPITOME OF THE SMART CITY

Or how smart technologies are already improving urban living.

Barcelona is one of the leading cities* to put new smart technologies at the service of their residents, thereby guaranteeing sustainable social, economic and urban development. Only a few years ago, the city started developing an ecosystem where ubiquitous smart sensors gather and share big data to improve key areas of urban life. The number of applications already in place and using the data is impressive. Noise and air quality sensors are found along a major thoroughfare, while 22 self-powered lighting units line the Llevant Beach using solar and wind power with an autonomy of up to 6 days. An intuitive, faster and better connected bus network system is part of the smart traffic system, which also includes traffic lights emitting sounds for blind people and an application enabling drivers to pay for Green-Area and Blue-Zone parking directly via their smartphones. And because Barcelona is a world city, a free Wi-Fi service is available at nearly 600 access points, while smartphone apps help tourists navigate the city's sights. ●

LEARN MORE:
Barcelona's official Smart City website:
http://smartcity.bcn.cat/en

*Named 1st Smart City in the world in 2015 by Juniper Research

IOT TOGETHER WITH INGENU

u-blox partners with Ingenu to develop modules based on Random Phase Multiple Access (RPMA) technology.

As the cellular Internet of Things (IoT) continues to grow, it is becoming paramount that the communication technologies best-suited to support the IoT devices must be specifically designed for the unique needs of M2M applications.

u-blox has chosen to partner with Ingenu, the pioneer in delivering connectivity exclusively to machines, to create the next generation of modules based on Ingenu's patented RPMA technology. With this partnership, u-blox complements its existing roadmap of modules supporting 3GPP licensed technologies such as Cat NB1 and LTE Cat M1 with RPMA, an unlicensed technology in the global 2.4 GHz ISM band. u-blox selected RPMA, because it is similar in performance and reliability to the 3GPP technologies the company already supports, while offering some specific and unique benefits.
In a world where devices communicate seamlessly with one another, it is crucial to optimize technologies for the sporadic transmittal of small data packages. Connections to devices even in hard to reach locations must be assured, while they maintain their high power efficiency, allowing for years of operation on a single charge.

Such is the case in the oil market for example, where companies rely on the collection of data from oil wells, which are often located in remote locations. Since RPMA utilizes the globally available 2.4 GHz ISM band, it is possible to use the same end-point device in installations around the world, no matter what their location. And, because RPMA utilizes a stand-alone broadcast channel to deliver firmware updates to connected devices, critical security patches can be delivered quickly to millions of devices at the same time.

The two companies have agreed that u-blox will develop and manufacture products supporting RPMA technology The u-blox modules feature extended temperature range and will allow for simple integration of positioning services.

"u-blox is highly regarded in the wireless module market, and this partnership will open a range of possibilities for our technology," said John Horn, CEO, Ingenu. "Ingenu's collaboration with u-blox will further the success we have realized in the IoT space, and will provide our valuable partners with significant advantages to develop solutions based on RPMA technology." ●

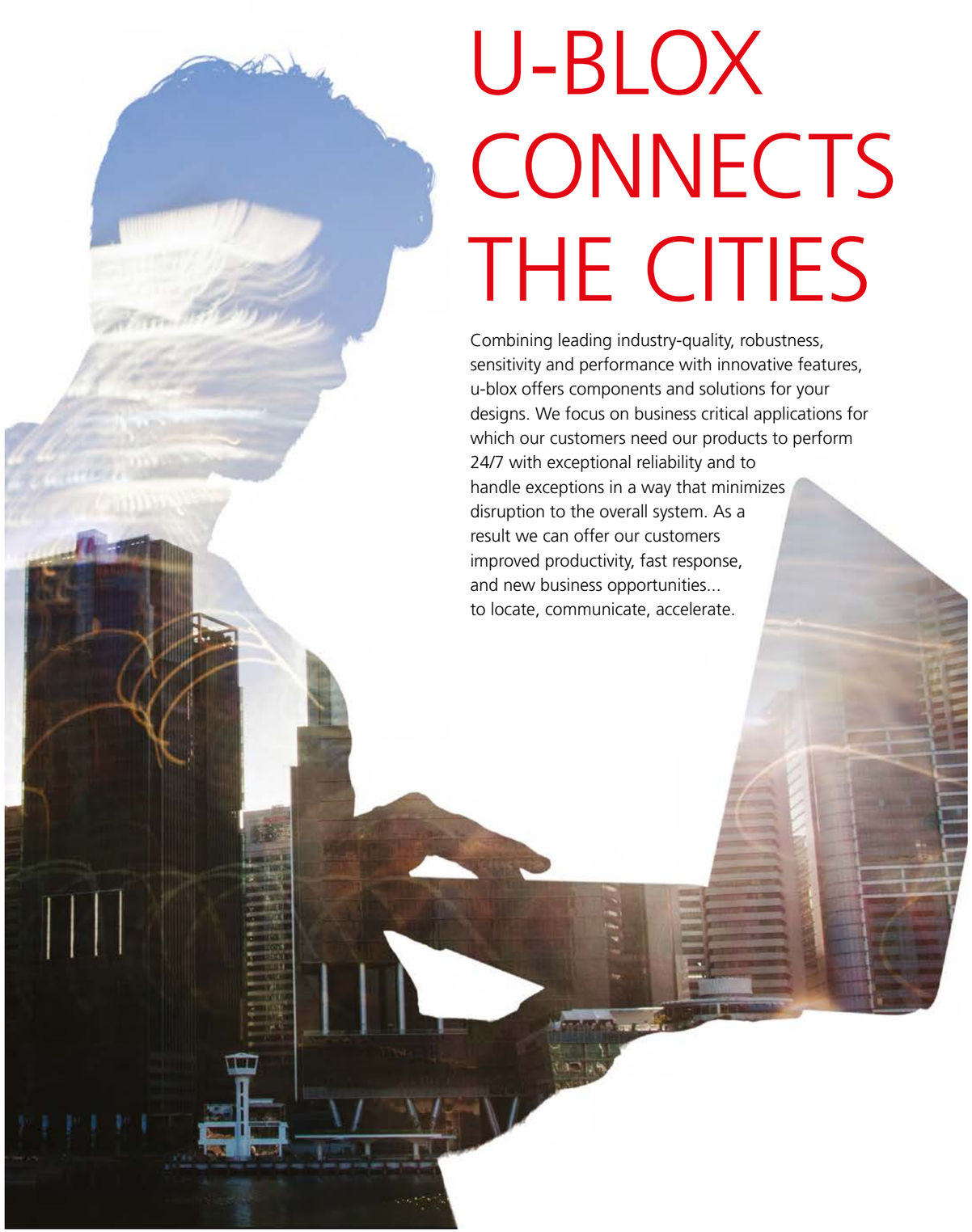
LEARN MORE:
www.ingenu.com

1

2

1
"This partnership with u-blox will open a range of possibilities for our technology," said John Horn, CEO, Ingenu.

2
Ingenu is a pioneer in delivering connectivity exclusively to machines.



U-BLOX CONNECTS THE CITIES

Combining leading industry-quality, robustness, sensitivity and performance with innovative features, u-blox offers components and solutions for your designs. We focus on business critical applications for which our customers need our products to perform 24/7 with exceptional reliability and to handle exceptions in a way that minimizes disruption to the overall system. As a result we can offer our customers improved productivity, fast response, and new business opportunities... to locate, communicate, accelerate.

Positioning and wireless technologies are at the service of the smart and connected city.

EVA-M8Q

The miniature GNSS receiver EVA-M8Q (EVA 7x7 mm form factor) has been optimized for covert asset tracking. It provides leading acquisition and tracking sensitivity, ideal for use with small antennas either in covert applications such as asset tracking and stolen vehicle recovery, or in portable devices.

EVA-M8 series are the smallest GNSS modules featuring GPS, BeiDou, Galileo and GLONASS reception. Three out of the four GNSS constellations can be received concurrently, which leads to the highest positioning accuracy. The series also features anti-spoofing and anti-jamming technology. ●

LEARN MORE:
www.u-blox.com/eva-m8q

NINA-B1

This Bluetooth low energy stand-alone module complies with the Bluetooth 4.2 specification, offers state-of-the-art power performance and is globally certified. NINA-B1 has Serial Port and GATT services pre-flashed and it offers full flexibility for customers to add their application to run on the built in Cortex-M4 MCU @ 64 MHz. Future upgrades include Bluetooth low energy, mesh, Bluetooth 5 and more.

The NINA-B1 in combination with the Wirepas Connectivity software enables short time to market on a large scale and decentralized (mesh) industrial IoT applications in segments such as street lighting, sensors, asset tracking and beacons. ●

LEARN MORE:
www.u-blox.com/nina-b1

SARA-N2

The world's first cellular Cat NB1 module compliant to the 3GPP Release 13 has been optimized for applications that need to securely communicate small amounts of data over long periods in challenging radio propagation conditions, such as an underground environment.

Designed for use in applications such as smart metering, remote monitoring & control, and smart city initiatives, such as lighting, parking sensors and waste management, the SARA-N2 will operate for between 10 and 20 years from a single-cell primary battery. ●

LEARN MORE:
www.u-blox.com/sara-n2

CERTAINLY CERTIFIED

Efficient and effective certification cut costs and time-to-market.

Certification is a procedure by which an accredited or authorized entity assesses and verifies that a product complies with established requirements or standards.

Comprehensive certification of u-blox products and processes gives customers significant competitive advantage. It reduces or eliminates certification costs, reduces risk and cuts the time-to-market for new products. These factors can be critical to success of our customers' products.

Certification covers requirements for products and product documentation, manufacturing, quality control and other company processes.

Worldwide certification is supported at regulatory, telecom industry and mobile network operator levels, and u-blox is an active participant in all major industry groups, including the GCF, GSMA, ETSI, PTCRB and FCC. In-house testing is complemented by working with fully-accredited external laboratories.

Within u-blox, we adopt common certification policies across the group in order to provide harmonized, easy-to-understand information to our customers. What's more, our decades of certification experience have enabled us to develop a knowledge base that we share openly with our customers, supporting the devices we sell throughout their lifecycles. ●

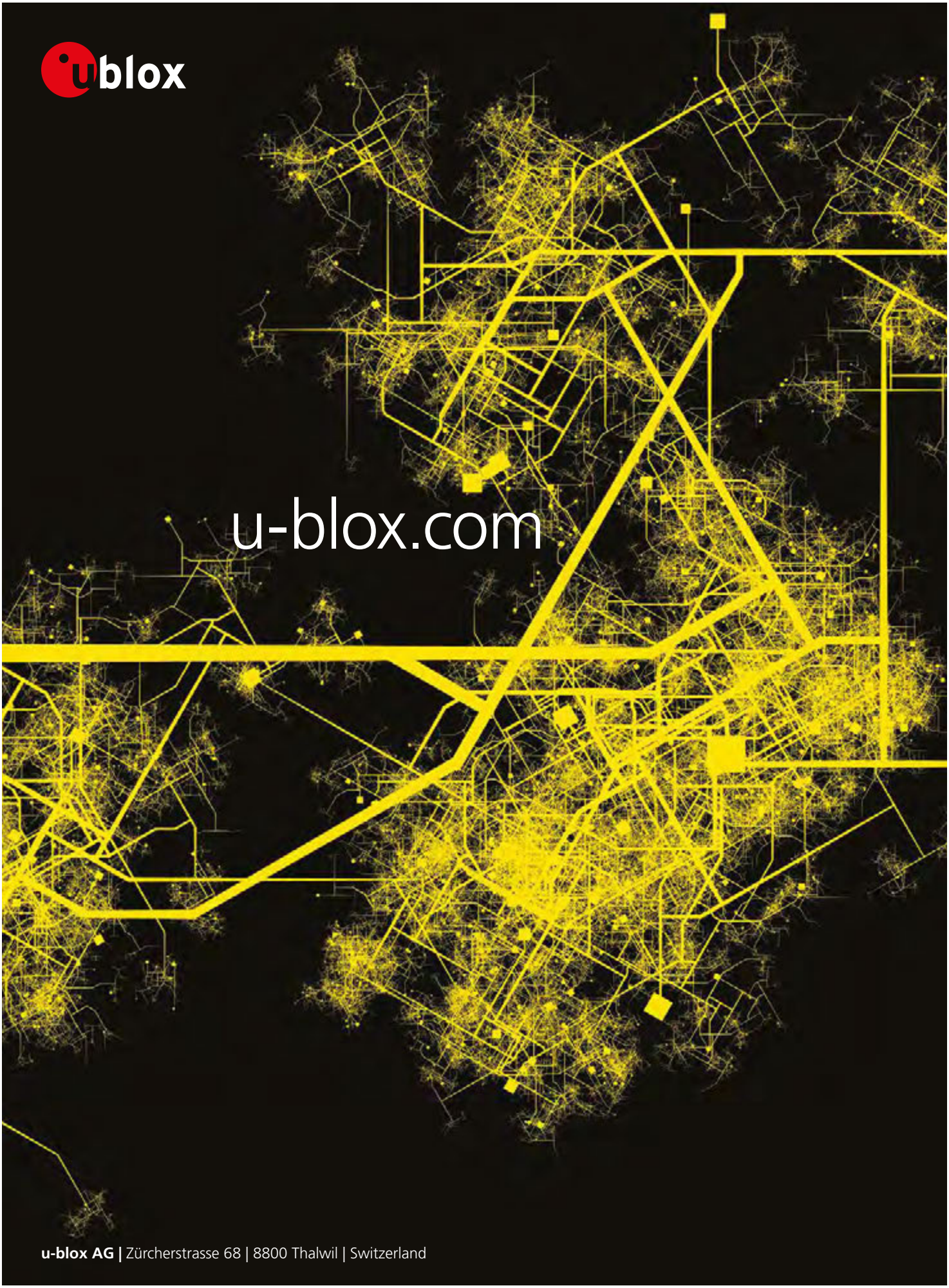
Example Certifications

Mobile Network Operator
- ATT (USA)
- DoCoMo (Japan)
- KT (Korea)
- Orange
- SoftBank (Japan)
- SKT (Korea)
- Telefonica (Europe)
- TIM
- Vodafone

Regulatory
- Analtel (Brazil)
- CE Marking (Europe)
- FCC (USA)
- Ocasa (South Africa)
- IC (Canada)
- RCM (Australia)

Telecom Industry
- GCF
- PTCRB

Certification is equal to reliability.



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