LoRaWAN®

WHY LoRaWAN® IS THE CONNECTIVITY PLATFORM FOR SMART CITY APPLICATIONS

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INTRODUCTION

We live in a rapidly urbanizing world, in which two-thirds of the population will live in cities by 2050, adding another 2.5 billion city-dwellers to the current just over 4 billion urban residents[1].

Smart cities are the ultimate in interconnected, intelligent infrastructure, with services, devices and systems linked that encompass simple inputs such as sensors on waste bins or controls for streetlighting to complex citizen services composed of multiple systems integrating with each other to enable smart transportation or connected vehicles.

The connection of infrastructure and services in a city includes buildings, businesses and municipal assets, and operates alongside smart buildings, smart vehicles and smart utilities. The common goal is to make money, save money or achieve compliance. Often, it's all three.

As in all complex technological deployments, smart cities rely on an ecosystem of developers, equipment makers and service providers to provide the various pieces of the smart city architecture. This ecosystem looks very similar for all digitally transformed sectors, not just smart cities.

The equation is composed of hardware, software, connectivity and data processing capability. There are sensors and actuators to measure variables and then react to them. For example, for turning a light off at dawn, there is software to define that decision, and to aid management of devices, there are radio access networks to connect devices according to their needs and ensure connectivity is ubiquitously available at an appropriate cost. There are also data visualisation and analytics tools to derive actionable insights from the data that is collected and communicated.

Individual endpoints differ from vertical to vertical as they perform different and sector-specific tasks, but the infrastructure of the network and the data handling is largely the same, providing a vast base of development and engineering resources. Thankfully, it's not necessary to reinvent the wheel every time you look to connect a new endpoint device. The connectivity needs of an air conditioner are similar to those of a streetlight, although the data transmitted and the frequency of that transmission might be very different.

This is not to suggest that smart cities do not have specific requirements when it comes to infrastructure. They're clearly different from a smart agriculture environment, for example, which has far fewer applications to support, fewer constraints in terms of dense urban topology, and involves fewer stakeholders to integrate across the ecosystem.

Smart cities are complex in terms of the number of different services, applications and endpoints involved; they have challenging wireless network propagation characteristics, such as needs for in-building and underground network coverage; they involve multiple vendors and types of users;

and involve integration of third parties into the smart city infrastructure securely. In addition, many of these are public projects that fall under financial and regulatory scrutiny, so the focus is not only on achieving commercial goals but on delivering societal benefits for citizens.

HOW LoRaWAN® CAN BE AN ENABLER OF SMART CITIES

Smart cities depend on connectivity that is ubiquitously available indoors and outdoors, even with the ability for signals to reach underground locations. This ubiquity is vital to connect all the disparate endpoints of a smart city—don't forget a smart city is a complex ecosystem, not a simple point-to-point connection of a single type of device with a centralized computing function.

Smart cities connect waste bins, streetlights, public transport, traffic, cleaning, environmental and many other systems, all of which require secure, available, cost-effective connectivity. Unlike other IoT application areas, smart cities by definition have a clearly defined geographical area, making them ideal for private networks. LoRaWAN can be an ideal solution for these—at much lower cost and with greater ease of deployment than cellular networks.

As always, it's a case of selecting the appropriate technology for the appropriate application, and different technologies can be complementary to each other. For example, licensed spectrum technologies—the cellular networks—typically offer a quality of service based on an OpEx business model, while unlicensed technologies have fewer regulations and lower associated costs. However, there are no capex guarantees with owning a private network, and there is no opex business model flexibility.

This variance comes before we even get into the applications that networks support, and it needs to address the specific topology of a city, the population and building density, the capacity that already exists as well as fundamentals, such as whether the GDP of a population can support the cost of the service being provided. Different network types have different strengths and weaknesses, and often the decision is not an either/or question. Multiple types of connectivity can be selected to provide the best option across the different dynamics.

When it comes to the apps themselves, LoRaWAN won't be suitable for the low-latency demands of autonomous vehicles, but it's perfect for tracking buses, managing streetlighting, streamlining waste collections and numerous other applications detailed in the use cases section below.

A key strength of LoRaWAN is its ability to support large numbers of devices per gateway. Depending on the policy applied and the time allowed on the network per device per day, more than 1,000 devices can be supported. For simple applications, like a waste bin signalling that it's full, this is ideal and, coupled with the range of LoRaWAN—which is measured in miles—it's easy to see how LoRaWAN could enable many thousands of low bandwidth smart city devices cost effectively and securely.

Of similar importance is that this is not a high bandwidth industry. The asset only needs to communicate its location in order to be tracked and, even advanced applications, such as cold chain transport, only need to transmit small amounts of data about the temperature of the product being shipped. Therefore, relatively low bandwidth and low latency connectivity are ideal.

A further strength is that LoRaWAN devices typically have very long battery life, making them ideal for long-term deployments. Use cases such as streetlighting, air quality sensors, bin emptying and many others can all have long deployment-lives without the need for battery maintenance. This saves on the overall cost of the solution.

Smart cities by their nature are busy, fast-moving environments subject to extremes of temperature, weather and the general rough and tumble of city life. LoRaWAN offers robust performance, so it can continue to operate in most extreme situations, in spite of, e.g., shock impacts or vibration.

Finally, among the low-power network options, only LoRaWAN has the mature ecosystem and out-of-the-box availability to support the wide range of smart city use cases, as illustrated below. No other technology has anything like the scale and depth of its developer ecosystem coupled with the ease of deployment that LoRaWAN delivers. It therefore has a substantial and clearly defined position alongside cellular and other alternatives in connecting smart cities.

USE CASES

By their nature, smart cities represent a highly dense environment that accommodates a vast array of applications and services. Below, many of the potential smart city use cases are listed, and it is important to recognize that many of these have low bandwidth requirements and only infrequent needs to communicate. This relatively low level of network demand fits well with the capabilities of LoRaWAN. Other apps with demands for high bandwidth and low latency may be better served by cellular alternatives.

However, applications providers and city authorities do not need to agree to long contracts with cellular providers or establish individual networks for each of the low bandwidth, infrequent use cases. Instead, they can own a private LoRaWAN over which they can run many of the applications listed below.

City authorities need information to be able to plan for future demand for their services and to ensure the safety and improved quality of life for citizens. LoRaWAN-enabled sensors can collect and communicate critical data in areas, such as temperature, humidity, air quality, vibration and noise.

Examples of these include monitoring temperature to decide whether to salt roads in winter; monitoring nitrogen oxide levels to plan for reduction in the environmental impact of traffic; monitoring of humidity to fight damp within buildings; and monitoring for excess noise levels. All of this data can be collected and acted upon, and additional sensors, such as ones embedded in roads, can provide information on the salt level on a particular road and thereby eliminate wasted re-salting.

Other examples of monitoring include sensors on waste bins to alert when a bin is becoming full, so it can be emptied when required, rather than as part of a weekly routine in which some bins are overflowing and others are barely used. In addition, soil sensors can be used to determine when public parks or sports grounds require irrigation, and rainfall sensors can be used to trigger flood defenses or emergency support for citizens.

Much of the data collected can be analyzed alongside historical data to enable trend analysis and predictive action to be taken, thereby increasing efficiency and improving citizens' lives.

However, smart cities are not only about the collection of data. Activation of functions is also required. Examples of this include the control and maintenance of streetlighting,

management of smart parking, and security-related applications such as building surveillance, and access control and monitoring.

Having the deep indoor coverage of LoRaWAN across a city using a network that is owned by the city means new applications can be added and served extremely cost effectively, adding further to the business case for rolling out LoRaWAN.

EXAMPLES

As explained above, there is a wide portfolio of smart city applications that can be readily supported by citywide LoRaWAN coverage. Many of these make the business case for LoRaWAN alone; however, many other applications can also be supported at the same time. In addition, other applications may need to access cellular infrastructure to support their QoS, latency or throughout needs.

SMART PARKING

A European city has rolled out a smart parking system to reduce the time spent by drivers searching for spaces and the environmental impact of circulating traffic that is looking to park. By being able to inform drivers of the nearest available space, the city is able to increase revenue through targeted revenue and reduce illegal parking and instances where paid-for parking time is exceeded.

This initiative, which involves placing sensors in each bay and communicating their status over LoRaWAN also ties into city initiatives to encourage electric vehicle use. The city knows more about user habits and therefore can install charging points where they are most needed. In future, it is expected that the data gathered will enable the city to perform more effective parking management for busy locations.

WASTE MANAGEMENT

The task of emptying garbage bins has traditionally been performed by city operatives driving round in trucks to empty bins. This is inefficient, because some bins do not need emptying as often as others, and some bins need to be emptied more frequently. One city has radically increased the capacity of its bins by creating large underfloor containers for the storage of waste and recycling. This infrastructure requires emptying less often than small traditional bins, and has already saved the city 50% of its disposal trips.

The system relies on LoRaWAN's below-ground capacity to monitor underfloor waste storage capacity, and to communicate when it is nearing the time to be emptied. The city passes the savings directly on to the citizen in the form of reduced local taxation.

LEISURE FACILITY MANAGEMENT

A Swiss city has deployed swimming pool sensors at its pools to inform users of the temperatures of its pools. The city also benefits because its workers do not need to manually measure temperature and pH of the water. The temperature data is provided for citizens via displays at pool entrances and by the city's app.

Efficiency is improved because pool temperatures can be continuously monitored and maintained at the optimum temperature. This increases swimmers' satisfaction.

SMART TRANSPORT

A North American city has used LoRaWAN to enable intelligent traffic announcements for its urban transport, allowing the accurate delivery of bus arrival time information. LoRaWAN displays show the arrival and departure times of buses, showing delays and updates as required. In addition, the system allows advertising to be presented and updated in real time.

CONCLUSION

LoRaWAN offers versatile, flexible, cost-effective, reliable and secure connectivity, with a range of business models to support the varying requirements of municipal authorities. In addition, it offers the widest ecosystem of app and device developers so cities can get exactly the right devices and connectivity for their smart city deployments. Naturally, LoRaWAN capabilities are augmented by cellular and other network technologies to address market needs that are outside the scope of LoRaWAN's technical capabilities, and LoRaWAN can readily integrate with these.

Smart cities are not a one-solution-fits-all connectivity arena, but LoRaWAN is well-positioned for ease of deployment, maturity of ecosystem, coverage, cost and throughput to address many smart cities use cases.

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REFERENCES

[1] https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html