Low-power Wide-area Networks: Enabling Geo-IoT

Although the term ‘Internet of Things’ (IoT) has actually been around since the end of the last millennium, the true potential of IoT has only started to unfold beyond the interest of pioneers in the last couple of years. One of the reasons IoT is now booming is the emergence of more low-power wide-area networks (LPWANs) that enable location-aware devices to interconnect in a power-efficient manner. This article explains the concept of LPWANs and the link to geographic information.

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LPWANs are designed to allow wireless communication over a long range at a low data rate. These two distinctive characteristics open up a whole new range of applications, in particular because of the lower power consumption and lower costs that are associated with LPWANs as opposed to traditional machine-to-machine (M2M) communication using SIM cards. For example, installing and maintaining numerous water-quality sensors in a river, canal or other water body becomes a lot more cost efficient if you do not have to replace batteries every few months nor pay for an expensive mobile data subscription for each of your sensors. Provided the hardware is designed efficiently, you could now leave sensors unattended in the field for up to several years, plus the network costs per sensor drop significantly. Additional emerging technologies such as energy harvesting – in which devices collect small amounts of energy in various ways to replenish their power – can even potentially make sensors and devices completely autonomous throughout their entire product lifetime.

Protocols

There are various types of LPWANs, and both the technology and the commercial market are still in development. For the purpose of simplicity, this article will briefly compare the most widely known LPWANs: LoRaWAN, Sigfox, Narrow-Band IoT (NB-IOT) and LTE-M. These LPWANs all differ in their communication implementation, individual power consumption, bandwidth and type of band, geolocation capabilities, type of native security, current coverage for deployment and whether they make use of open standards or proprietary technology. LoRaWAN, for example, is a wideband system that requires a specialised chip developed by Semtech (which implies it is not an open standard), but there are a couple of network suppliers to choose from. The French system Sigfox, which is a type of ultra-narrow band (UNB) network, is considered to be one of the most power-efficient networks currently available but its bandwidth is very limited and more suitable for one-way than two-way communication. And although it uses an open standard – so anyone can potentially develop a device for use with Sigfox – it still requires you to use the Sigfox network. Both NB-IOT and LTE-M differ from LoRaWAN and UNB in that they make use of existing cellular networks. For example, NB-IOT reallocates part of the 4G band for the LPWAN. This means there is no new network infrastructure required, as the technology uses existing cellular network towers.

Competition

Table 1 gives an overview of the relative advantages and disadvantages of the four LPWANs. The question that often arises from such comparisons is: who is going to win the LPWAN battle? Sigfox and LoRaWAN have the time advantage as they are currently more mature than NB-IOT and LTE-M. The latter two, however, will probably become strong competitors (if – arguably – not winners eventually) thanks to their different business model and promising technical characteristics. But the future battle is not just between the four IoT enablers discussed here; there are also various current initiatives to launch an IoT network into space based on small (nano-) satellites that together deliver global coverage for internet access and tracking services. It is just a matter of time before these plans become reality.

***Table 1**, Some properties of LPWAN technologies that determine their fitness for use for a particular application.*

	LoRaWAN	**Sigfox**	**NB-IOT**	**LTE-M**
Power consumption	low	very low	very low	low

Amount of data transfer	low, amount depends on local providers	very low, mainly suitable for one-way communication	low	medium
Native localisation available	yes, differential time of arrival calculated at network	yes, differential time of arrival calculated at network	possible to inherit from existing LTE positioning	possible to inherit from existing LTE positioning
Suitable for time-critical applications	no	yes	yes	yes
Type of band	unlicensed	unlicensed	licensed	licensed
Potential choice of network	multiple network initiatives	requires Sigfox network to be used	delivered by cellular network providers	delivered by cellular network providers
Potential choice of hardware	requires Semtech chip	no restrictions	no restrictions	no restrictions
Current coverage for deployment	initiatives worldwide, but still mainly operational in Europe	parts of Europe, some other countries planned for roll-out	first trials operational	still in development phase

Positioning

One service that is of particular interest to the geomatics industry is the delivery of positioning by LPWAN providers without the need for GNSS. LoRaWAN and Sigfox enable medium-accuracy geolocation of devices through different time of arrival that is carried out by the network itself, which sends back the location information to the device. In this way, the device requires no additional hardware or power to become a smart, location-aware end node. Similarly, NB-IOT and LTE-M can inherit the existing LTE positioning technology to provide native localisation.

Location is key

The market for new IoT applications is expected to become very big. LPWANs enable many new applications with a geographic component. The growing number of devices can either gather large amounts of geographic data, or they can be triggered to perform specific actions based on their location. In both cases geographic data plays a vital role, which opens up a wide range of opportunities for the geomatics industry to enter the world of geo-IoT.
