Technology Trends
Working Committee

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Internet-of-Things in the Caribbean

- Connected Tourists and More…

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About the Authors

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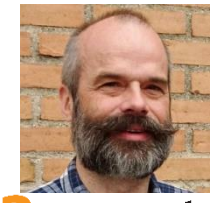
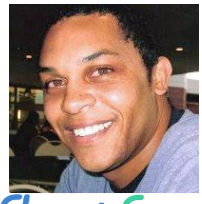


Søren Søndergaard is the OSS Solutions Architect at **2operate**, a leading OSS solutions provider, helping service providers to achieve better network visibility and operational productivity. Søren is an experienced solutions developer with more than 20 years of practical experience in deploying and operating mobile networks at service providers.



Ainsworth Spence is the President and co-founder of **FleetFare**, a provider of advanced hospitality and transportation services. FleetFare's solutions help owners control software applications geared towards the leisure and business travelers. Ainsworth is an inventor and digital design specialist with technical knowledge and expertise including strong conceptual skills, allowing him to give shape to abstract concepts.

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Introduction

As we consider the "*Internet of Things*" (IoT), we have to accept that the IoT is now firmly entrenched and is indeed a part of our everyday lives. A simple definition of the IoT is, "*A set of interconnected objects having an active role in what might be called the Future Internet*".

Figure 1: Connected car at Mobile World Congress 2016

IoT can be seen as the result of *Machine-to-Machine communication* (M2M) as stated by Vodafone in their "*M2M Barometer 2015*": "*Machine-to-Machine communication (M2M) connects machines, devices and objects to the internet, turning them into 'intelligent' assets that can communicate. M2M enables the Internet of Things (IoT)*".

For the past decades, IoT has emerged in the form of alarms, meters, and vehicles connected to backend servers over 2G or 3G data sessions, reporting their state and location. The reason for the increased interest today is the observed and potential growth of connected "things", enabled by an all-IP mobile 4G infrastructure which is much simpler from an application perspective than the old voice-centric networks. Predictions from different analysts foresee global revenues from IoT of around 1 trillion USD in 2020 with an annual growth rate of 25-30% until 2030. Any player in the IT and telecommunications industries must consider how to win a share of this new, lucrative revenue stream.

In this paper we consider the implication and opportunities of IoT to both service providers and solution providers in the Caribbean region.

"Things" in the Internet

Figure 2: Low-cost push buttons from Amazon enables extremely simple reordering

The *interconnected objects* (the "things") of the IoT cover a wide span of technology from simple, low-rate metering and push buttons (see Figure 2) to realtime, remote-controlled vehicles and specialized "*Industry 4.0*" solutions. Also, smartphones customized through special-purpose apps, effectively converting the smartphone to a camera, tracking device, or game console, can be seen as an important subset of these interconnected objects.

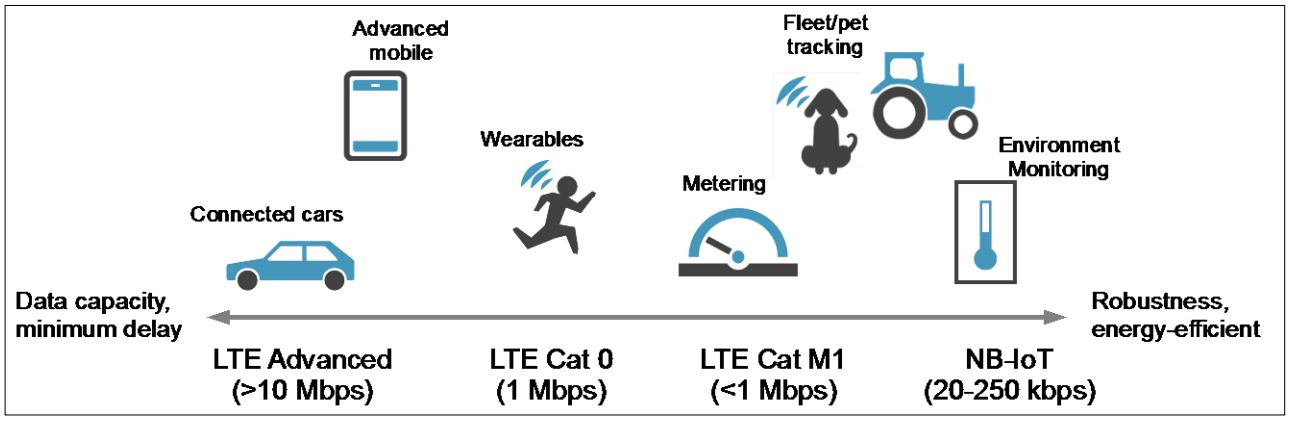


Figure 3: The purpose of the various LTE technologies in 3GPP Release 13

The variety of connected "things" can be seen in Figure 3 mapped to the sub-standards in the most recent LTE release (3GPP Release 13) from 2016. This also shows that the service provider will gain access to parts of the IoT revenue streams through its existing network and its logical upgrades. There will be other options for connectivity, especially for the right part of the figure, such as a dedicated IoT network using so-called LPWA technology (to be discussed in the "IoT Technology" section). Traditional service providers should take the potential competition from such alternative networks in their market into account.

To take advantage of the IoT opportunity, the service provider should exploit the fact that customers in the market find it natural to purchase new IoT services through their current service provider. Therefore, service providers should carefully select and offer IoT services from the global market with a significant revenue potential in their home market.

The following two sections will take a closer look at specific IoT services. First, we discuss an extremely successful case which demonstrates the possibilities in IoT over existing GSM. Next, we investigate the travel and tourism business which is extremely relevant for most Caribbean service providers.

Case: Trackunit – Tracking machinery and vehicles

Trackunit is a Danish fleet tracking system for construction machinery and vehicles. It consists of a tracking device to be mounted on the machinery, and a web-based user interface. Customers (owners of machinery) purchase the tracking device and subscribe to the access to online tracking. The tracking device connects via a standard 2G or 3G mobile network, continuously reporting its location which can be followed in the very user-friendly interface (see Figure 4).

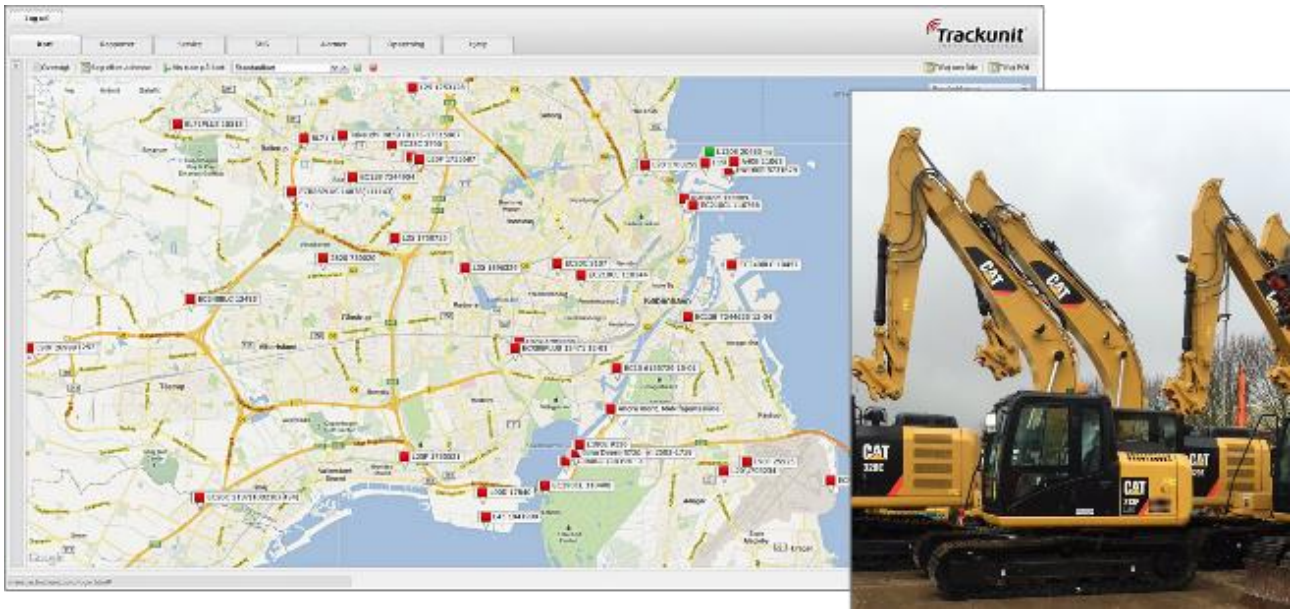


Figure 4: Trackunit provides an extremely simple solution for tracking heavy machinery

As a business, Trackunit can be seen as a pioneer in M2M/IoT. In a very innovative and pragmatic way, they have developed a simple and scalable solution which exploits the potential of more and more global mobile coverage. Because of this, Trackunit was bought by Goldman Sachs and GRO Capital in 2015 as a strategic acquisition in the IoT domain.

We asked Jacob Skøtt Zimmer, Senior Product Manager at Trackunit, about their business focus. They are still focusing on machinery for construction as their primary market with agricultural machinery as a secondary focus.

Concerning connectivity, Jacob Skøtt Zimmer explains that with the current focus and solutions (outdoor, reasonable GSM coverage), Trackunit works perfectly through GSM. For future solutions, they are following "Narrowband" (NB) technology development. Narrowband (in general LPWA – see the "IoT Technology" section) will open up for more robust connectivity indoor as well as out of normal GSM coverage.

Focus: Tourism

Tourism is a significant contributor to GDP in the Caribbean region. According to "*Travel & Tourism, ECONOMIC IMPACT 2016, CARIBBEAN*" by WTTC, tourism contributed USD 53.1 billion in total to the GDP (14.8%) in the Caribbean in 2015. By 2026, this predicted to grow to USD 76.2 billion (16.2%). So by extension, we can explore the concept of IoT for modern travel and tourism.

Travelers are characterized by being away from home and this brings a lot of special needs to replace certain services from home, and at the same time to provide special services relevant to someone on the move.

Looking specifically at the IoT strategy of airlines, according to "*SITA Airline IT Trends Survey 2015*", 86% of airline companies believe the IoT will provide clear benefits over the next three years. In particular, airline beacon applications will play an important role in transmitting relevant and targeted information to

smartphones in their proximity to help travelers navigate in airports. Also, tracking of devices (and its user) as well as the luggage will be very important.

Table 1: Airlines implementing/preparing beacon-enabled applications (source SITA)

Beacon-enabled application	Implemented in 2015	Expected in 2018
Wayfinding	8%	57%
Flight & gate info	14%	49%
Baggage collection	7%	40%
Walk to gate time	3%	34%
Duty free offers	5%	29%

Many of these applications will benefit from the possibility of installing special apps in the traveler's smartphone or tablet. Others assume that cheap tracking devices can be placed on e.g. the baggage, or suitcases could even be equipped with their own GPS tracker system (such as Trunkster in Figure 5).

Figure 5: Trunkster – the smart suitcase

In the hotel business, *mobile keys* have already been introduced in larger hotel companies such as Hilton and Starwood. Instead of waiting in line at the front desk, guests are notified in an app when their room is ready. Once at the room, you place your phone in front of the lock to open the door. You can imagine a range of extensions such as playlists, selection of TV channels, assortment of mini bar items, all based on guest preferences, booking of jet-skis and sea cruises, etc. through such systems. Since mobile keys are directly coupled to the hotel reservation system (app or website), it provides a very smooth experience to the guest, and it also allows for the hotel to collect data from both usage and satisfaction surveys.

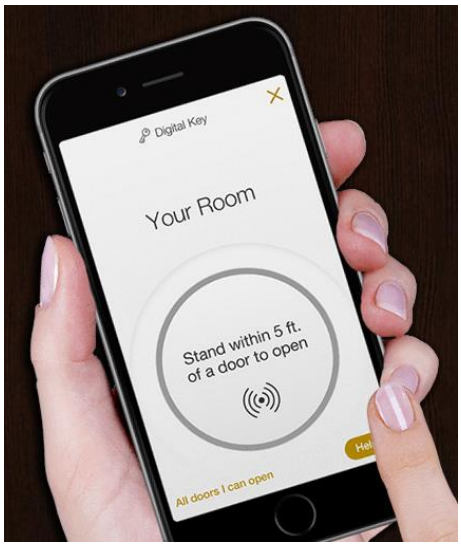


Figure 6: Mobile key as an app

Hotels may also exploit IoT for efficient remote equipment maintenance. Faulty equipment can be detected before causing too much inconvenience. Moreover, maintenance can in some case be done remotely or at least be planned for normal cleaning hours so that rooms do not need to be closed off.

In all these cases, connectivity is key, and connectivity is likely to be achieved through a combination of technology and available networks depending on the demand for robustness, security, bandwidth, etc.

IoT Technology

IoT is not new and technology for making IoT services is already there. Special IoT SIM cards for GSM networks have been in the market for several years. However, during the past 3 years the industry has gone through an explosive period of new development due to a number of factors.

First, the market had to realize the growth and potential of IoT services. Next, the large industrial players (represented by 3GPP) had to understand that existing network technology was not necessarily good enough. Before this happened, a range of alternative, proprietary network technologies had started to appear, competing directly with the 3GPP standards. These included in particular a number of very robust "*LPWA*" protocols which were ideal for many IoT purposes in terms of coverage and power consumption of devices.

Low-Power Wide Area (LPWA)

Where many of the high-data-rate services are expected to go onto the existing and upcoming 4G/LTE and 5G networks, many IoT services have different demands. Often, these services involve battery-driven devices where low power consumption is critical and extended (indoor) coverage is critical. On the other hand, they may need only very low data rates and have only limited realtime demands.

A range of new network technologies for this type of IoT has emerged under the common term *Low-Power Wide Area* (LPWA), most of these outside 3GPP standardization, and therefore not necessarily the logical choice of traditional mobile network operators. The most significant such LPWA technologies are:

1. **Sigfox** is both a (France-based) company and an ambitious LPWA network for low-rate IoT purposes. By early 2016 the network claims to cover all of France, Spain, Portugal, Netherlands, and the 10 biggest cities of UK. Rollouts are ongoing in several European countries and USA. Data rates of Sigfox are 0.1-1 kbps.
2. **LoRa** is another LPWA network developed specifically for IoT. LoRa is developed and standardized by the LoRa Alliance, founded by IBM, Cisco, Bouygues Telecom, Singtel, KPN, Swisscom, Belgacom, and others. Data rates of LoRa are 0.3-50 kbps.
3. **HaLow** is the Wi-Fi Alliance's answer to Sigfox, LoRa, and LTE/NB-IoT (next section). It was announced in January 2016 and is based on IEEE 802.11ah. HaLow will provide up to 150 kbps.

All these are designed for sub-gigahertz spectrum (typically around 900MHz) where coverage is excellent both outdoor and indoor, even capable of reaching underground objects. This means that networks can be set with a minimum of investment, since a limited number of sites are able to cover an entire city.

IoT in LTE Release 12 and 13

IoT technology standardization under 3GPP was quite chaotic, with different players initially promoting different variants of the NB-IoT standard up until the meeting in September 2015 where disagreements were resolved. At this point, the industry realized that they simply had to find common ground in order to avoid losing the battle against the alternative LPWA networks which had started to roll out, also by traditional service providers such as KPN in the Netherlands who had announced LoRa-based IoT offerings in 2015.

To satisfy the needs for IoT services and to meet the competition from LPWA technologies, 3GPP agreed on the following set of new sub-standards under LTE Release 12 and 13 (see also the full picture of LTE Release 13 in Figure 3):

1. **LTE Cat 0:** Where LTE was developed for high bandwidth purposes using multiple antennas, the LTE Cat 0 standard was introduced in LTE Release 12 (2014-2015) to meet the growing demand for IoT services. Compared to the main LTE standards, Cat 0 uses a single antenna, complexity of modems is lower, and it provides data rates of only up to 1 Mbps.
2. **LTE Cat M1 (LTE MTC):** LTE Cat M1 is new in Release 13, and it reduces power consumption even more than LTE Cat-0. Again, the purpose is M2M/IoT (the original name "MTC" stands for "Machine-Type Communication"). Data rates are up to 1 Mbps.
3. **NB-IoT (Narrowband IoT, also LTE Cat NB1):** This is 3GPP's direct answer in Release 13 to the unlicensed LPWA technologies, providing robustness, maximum coverage, and really low data rates.

Security and Operational Aspects

The range of IoT services has many different requirements in terms of security, privacy, and support. Some devices such as push buttons or tracking units are extremely inexpensive and may be lost without notice. Others, such as connected cars and industrial applications, represent a significant cost per unit and will typically need constant monitoring and support. Many of these also demand highly secure connectivity.

Figure 7 illustrates the types of monitoring that will typically be required for so-called "*Industry 4.0*"-type IoT solutions. Compared to traditional corporate customers, high-end IoT solutions will require a deeper level of understanding of the state of the network. A simple SLA report may not be good enough.

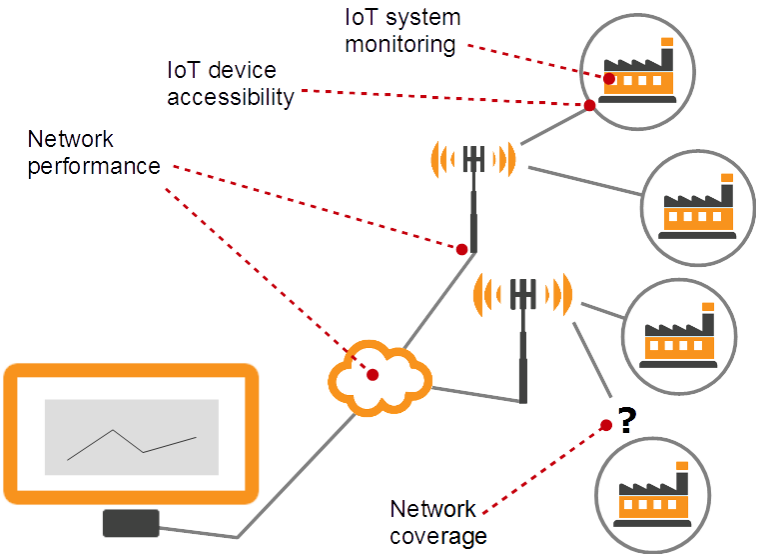


Figure 7: Monitoring of an "Industry 4.0"-type IoT system

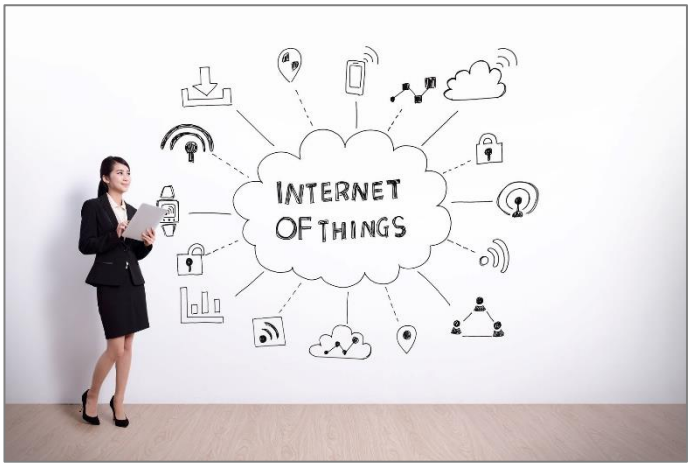
The monitoring needed will be:

1. IoT system monitoring: This is the primary data of the IoT system which is collected and used for analytics and automation.
2. IoT device accessibility: The first step in monitoring of system performance and connectivity is IoT device accessibility (is my device accessible?).
3. Network performance: To troubleshoot IoT system connectivity problems, it will be necessary to have basic network performance monitoring (uptime, blocking, alarms).
4. Network coverage: For the IoT solution customer to decide if a new IoT device (e.g. a new factory) can be deployed, up-to-date network coverage monitoring must be available.

By making such information available to the IoT customer through e.g. a light-weight *Operations Support System* (OSS), service providers will be able to charge significant extra fees. Moreover, this would be a competitive advantage over more simple SLA-based reporting.

It is important for the service provider to realize that they can play an important role as the *preferred expert* in the local market for IoT services. Service providers already have the trust of local customers and this can be a win/win with the (unknown) IoT solution providers who may at the same time prefer to avoid a local setup for scalability reasons. Special-purpose IoT OSS platforms capable of monitoring the entire IoT solution will be key to offer such support in general.

The Take Away



IoT is an important new revenue stream which is expected to grow by 25-30% per year until 2030, and service providers all over the world are currently defining their IoT strategy.

The IoT area is very heterogeneous and to some extend unpredictable. Today, we already see both low-cost, mass-market monitoring devices and push buttons along with high-end machinery tracking solutions and a range of advanced offerings for the traveler. For Caribbean service providers, there will be great opportunities inside and outside of the tourism business. Looking at the range of IoT services mentioned in this paper, the service providers will not necessarily be the leaders of IoT services innovation. Innovation is more likely to come from specialized IoT solution providers (often start-ups), each with an aim to solve some non-telecoms problem.

The IoT business case for service providers will be to facilitate growth and innovation by provide great, secure, and well-documented connectivity. In addition, to promote and support a selected set of (high-end) IoT services through their sales channels.

Regarding the choice of technology, service providers could stay on the LTE train which is guaranteed to take off (with some delay), assuming that the mix of LTE sub-standards for IoT supports all needs until 5G is here. In 5G, it must be expected that the same sub-standards continue to evolve. Another option is to build e.g. a dedicated LoRa or HaLow IoT network, which is quite inexpensive (compared to a full-blown LTE network), but which may add extra complexity to operations.

With the hasty development of IoT, it will be critical to follow development (both service and technology), identify and deploy great tools for IoT service monitoring, and be agile towards opportunities and competition.