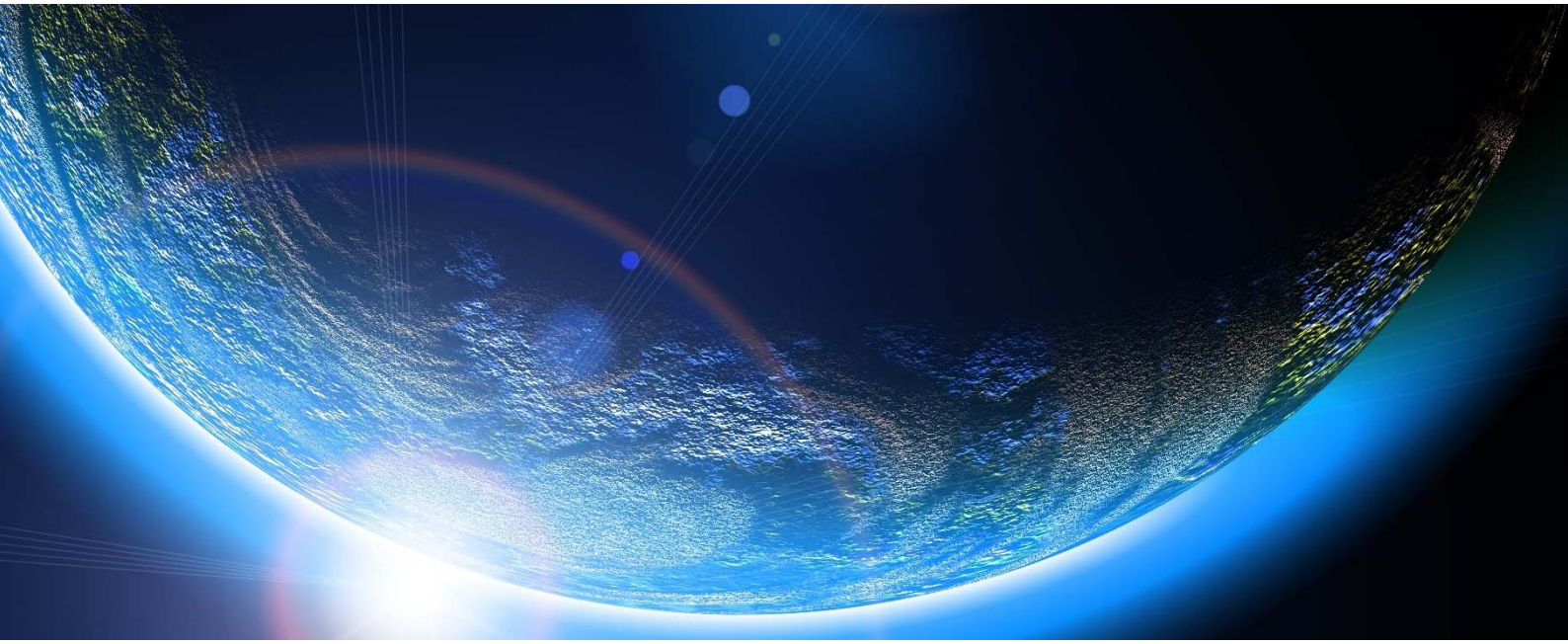

Building a World-Class IoT Solution as a Service:

How Telecom Argentina and Nokia Create Future Revenue Streams

By Offering New Enterprise Services

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The enterprise IoT market is now developing rapidly, both in terms of numbers of businesses requiring IoT solutions, as well as in the greater sophistication of those solutions. This is because, for an increasing number of businesses, IoT is moving from 'nice-to-have' to strategic necessity. At the same time, enterprise use of IoT is broadening its scope beyond local operations to cover increasingly international requirements.

It is in this context that Telecom Argentina, enabled by Nokia WING connectivity management and Nokia IMPACT IoT device management, is taking the position of a technology innovator and supporting enterprises in a wide range of industry verticals on their digital transformation journey.

Meeting new business outcomes with IoT

At its simplest, an IoT solution provides the opportunity for enterprises to save operational costs, introduce new service revenue opportunities, or help to ensure compliance of operational activities with new national or regional regulations as they arise. In practice, it is increasingly a combination of these that are reflected in a wide range of required business outcomes, some more urgent than others. For example, these required business outcomes might include:

- achieving greater operational efficiency
- reducing downtime
- reducing time to market for new product innovations
- improving competitive differentiation
- improving predictability/reliability
- meeting the demands of sustainable business.

To ensure these and other outcomes are achieved, it will increasingly become necessary to process large amounts of data in real time to support current business operations. It may also be necessary to integrate these new real time data flows with traditional batch update data typical of IT systems already in use. Those requirements increase yet further when these data flows need to interoperate smoothly and securely across several different business operations or with business partners all in real time. This introduces yet another dimension that is increasingly needed – regional or even global coverage.

An IoT platform needs to cater for these diverse requirements, building IoT solutions that will stand the test of time and deliver the business outcomes required. Yet all of these also need to be managed within an environment that is secure end-to-end. There is no doubt that, over the next few years, enterprises will increasingly rely on the huge amounts of data collected through their IoT solutions to meet these business outcomes. Communication Service Providers (CSPs) have a major part to play in this, especially with the network evolution to 5G and the enhanced capabilities this offers.

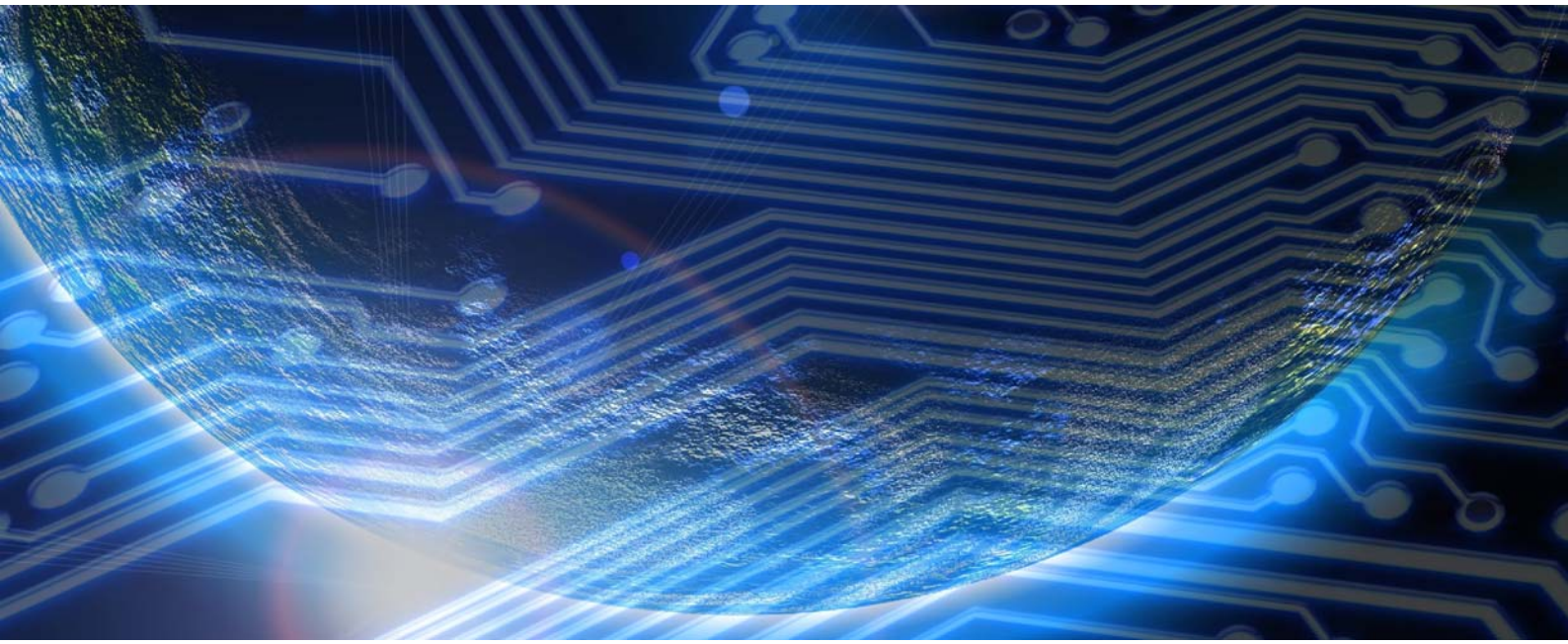
Building IoT solutions for enterprise use

For any IoT solution involving connected devices, there are three key elements that must be managed:

1. **The connected device,** that may be sensors measuring temperature, location or some other parameter or assets such as vehicles that have many sensors each measuring something different. Device management aspects may include device identity in the network, provisioning for use of the network and secure over-the-air update of device firmware. These and other related areas are part of Device Management.

2. **The connection**, from each device to a server to which the data is transmitted for processing. That may be a short-range or long-range connection, wired or wireless, or a combination thereof. The server may be at the network edge or in the cloud, or in both for different needs. Some of the areas that need managing are connectivity options, coverage, network protocol support and billing/usage. These and other related areas are part of Connectivity Management.

3. **The data generated** needs to be stored, processed – sometimes in real time – either on its own or in combination with other data, to create results. Additional areas that need managing are: workflow handling, visualisation, orchestration and data analytics. These and other related areas are part of Data Management.



In addition to these, an application usually needs to be developed or provided to make specific use of the data created. All of this must be carried out securely so that the device itself and anything that is using the data, such as a controller, is not compromised. Security needs to bind together all the other elements so that potential attack surfaces are minimised.

These elements can be illustrated as in Figure 1, where they form a stack that sits above the sensors and network infrastructure. Since Device Management requires the connectivity to be in place before it can function for remote devices, it sits above Connectivity Management.

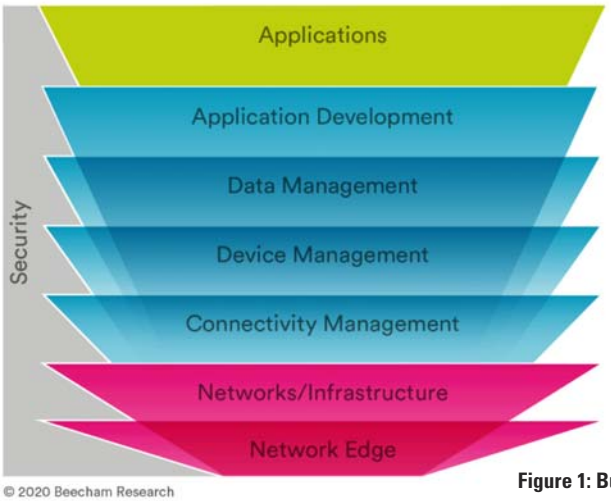


Figure 1: Building an IoT Solution

These are then also the main elements of an IoT platform, which is essentially a software middleware suite that facilitates secure monitoring, control and analysis of device and sensor behaviour in the field. In essence, it provides an enabling layer between these connected devices/sensors and user applications.

IoT platforms have been created for the express purpose of reducing the time and cost of getting new IoT solutions built and implemented. As shown in the Figure, there are several layers to an IoT solution and these are becoming increasingly complex as the market develops. The IoT platform takes advantage of the fact that the majority of what is needed in IoT solutions is the same and does not need to be redeveloped for every application. In theory, at least 80% of IoT solutions are made from common parts, so can be predesigned and made available through an IoT platform. The platform then also provides the means for customising and configuring the solution (the other 20%) for a specific application need.

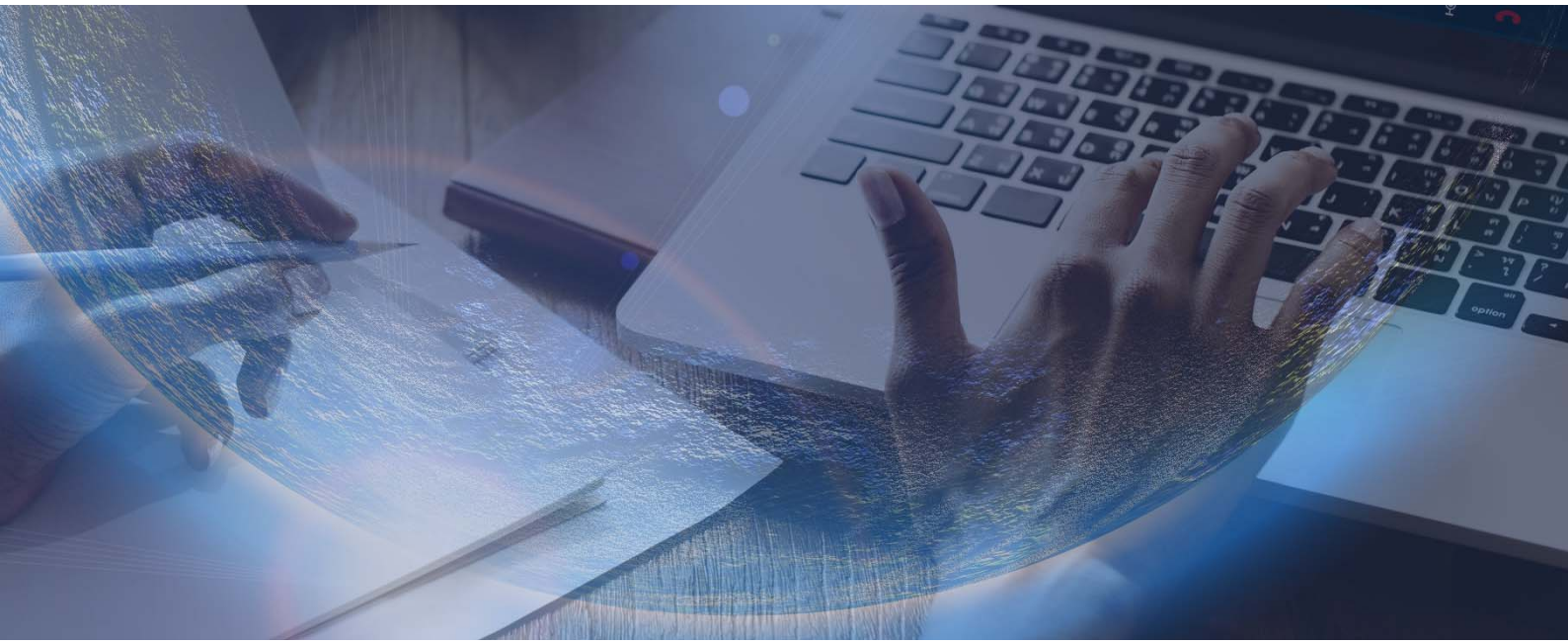
To some extent, this is why there are so many IoT platforms on the market – well over 500 at this time. Some have a narrow market focus and specialise in particular application areas – such as Smart City or Smart Energy – while others provide a more horizontal capability that aims to satisfy requirements across a wider range of vertical sectors. In reality, what has been found is that those with a narrow market focus typically have less customisation to do for any one project (more like 90%:10% rather than 80%:20%). On the other hand, those with a more horizontal platform often find more customization is required (more like 70%: 30%). Either approach is still far preferable to building a new platform from scratch for each new IoT solution required.

Nokia WING and IMPACT IoT

As illustrated in Figure 2, Nokia's Worldwide IoT Network Grid or WING is a managed service that offers operators the ability to support their enterprise customers with global IoT connectivity across borders and different connectivity technologies. It consists of a real-time connectivity management platform that can work together with IMPACT's IoT device management platform. These two are designed to integrate together as part of the full stack in Figure 1 as well as operate independently with other vendor equipment and with third party applications. This provides significant advantages as each is fully featured to compete in its own market as well as operating seamlessly together where required.

Figure 2: Nokia Worldwide IoT Network Grid (WING)

Nokia WING also offers ready-to-deploy vertical IoT solutions to accelerate operator revenue and to support operators becoming full stack IoT service providers. These are off-the-shelf, as-a-Service IoT applications that provide the ability to rapidly address the agriculture, livestock management, logistics and asset management markets with minimal investment and less risk.



Key features of Nokia WING include:

- Globally distributed, cloud-native IoT infrastructure as-a-Service
- Single global Connectivity Management Platform, for the real-time management of IoT devices and services anywhere in the world and with the ability to white label under the operator brand to the enterprise market.
- Flexible pay-as-you-grow pricing models based on consumption, offering a low start-up cost and low financial risk model for operators
- 24x7x365 IoT command center, with committed SLAs and the ability for consistent service experience across different markets.
- Seamless upgrade to 5G when required. The 5G-ready core network enables operators to offer 5G IoT services quickly and cost-effectively while addressing demanding latency, security and throughput requirements. A new 5G WING testbed in Dallas provides a worldwide platform to test the full range of 5G use cases.

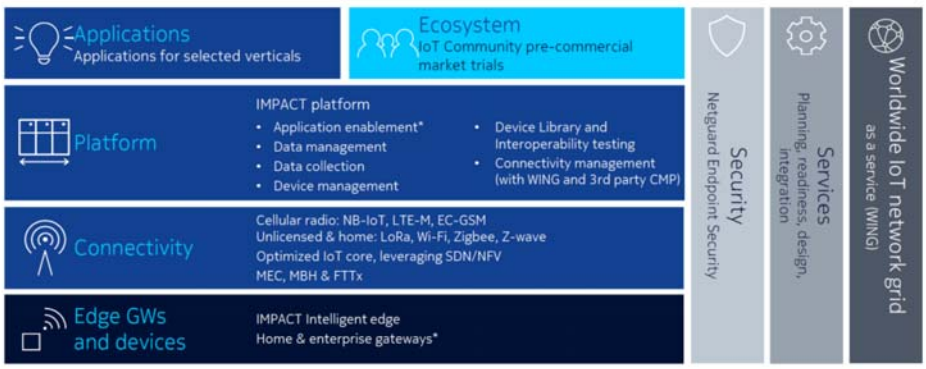
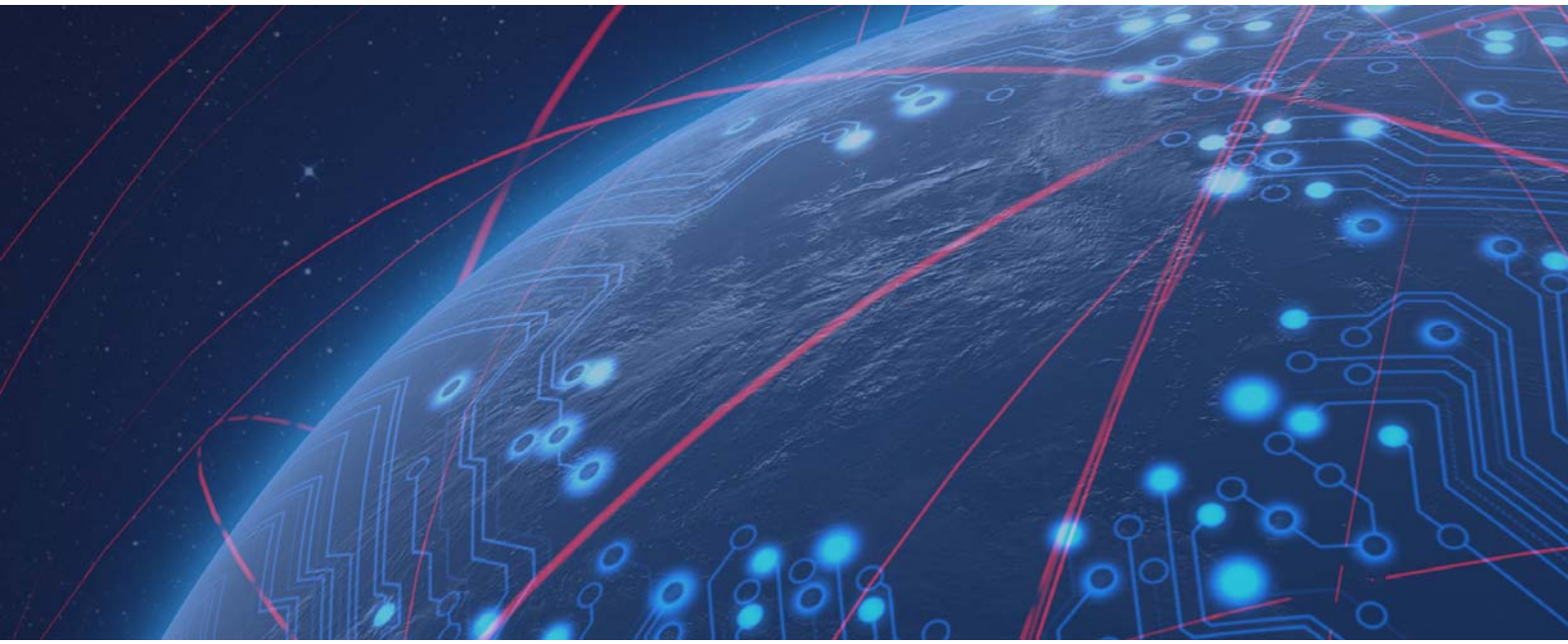


Figure 3: Nokia IMPACT IoT Device Management Platform

(*) partner components can be integrated to IMPACT

Figure 3 then shows where the IMPACT platform sits with regard to WING and other elements of the full IoT solution. IMPACT provides service providers and enterprises with a standards-based platform for securely managing devices, protocols and applications. The platform's broad feature set includes the following:

- Zero Touch device detection, configuration and activation
- Multi-tenant architecture, enabling SaaS for enterprise users and CSPs to support all customers across all networks from a single screen
- Intelligent gateway, enabling the management of devices and sensors in closed area networks
- Device interoperability and certification, lowering certification costs by enabling OEMs to self-certify devices and allowing CSPs and enterprises to launch new devices quickly and cost effectively
- Secure firmware and software updates for devices in the field
- Application Enablement providing access to device data streams



Of particular note also is Nokia's NetGuard Enpoint Security (NES), which provides an end-to-end, consumer-facing network-based malware detection, notification, and remediation solution. Utilising Nokia's Threat Intelligence Center and network-based malware sensors, it monitors consumer, enterprise, and critical infrastructure network traffic for malware and attack activity. NES identifies infected end-point devices (Gateways, Sensors or Actuators) and takes immediate action to notify or block malware and prevent security breaches. The system enables the service provider's security operations team to collect live threat intelligence on malware activity in their network. This allows them to protect their network infrastructure from attack and offer revenue-generating malware protection services to their customers. Nokia IMPACT and NES are fully integrated such that threats can be acted upon automatically in a closed loop way without the need for any human interaction and thus can scale to the very large numbers expected in the IoT.

Nokia WING and IMPACT use cases

Nokia WING supports nearly a dozen operators across six countries. Examples of the use cases from these are as follows:

1. WING is being used to improve the livelihood of farmers, while mitigating the impacts of climate change, through enhanced and sustainable agriculture. Sensors include soil probes, weather stations, insect traps and crop cameras and insights from the data help farmers to boost yields and lower costs while reducing their impact on the environment.

2. WING is being used for global asset tracking for new revenues and business optimization with enhanced asset utilization. Nokia's asset tracking solution gives visibility of any assets, where they are and how they are operating. This solution is being utilized by a global A/C manufacturer to increase product competitiveness and grow additional revenues by gaining end-to-end visibility of operations and leveraging on-site data

3. WING is being used to modernize port operations and enhance operational efficiencies with greater visibility of port assets in one of the most important hub of Thailand. The port was able to monitor KPIs in real time, such as the location of trucks, cranes and other port vehicles on site, as well as track the number of loaded and off-loaded containers.

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Nokia IMPACT manages over 1.9 billion devices worldwide. As such, it is a proven platform in the market with many use cases. Illustrating its flexibility and scalability, some of these use cases are as follows:

1. IMPACT is being used to monetize a low power NB-IoT access network providing water meter collection and management services to residential and commercial users. With IMPACT, the water companies can use standardized meters from any vendor and gain substantial cost savings in their operations.

2. IMPACT is being used for Smart City applications, an example being Smart Lighting. Using LTE-M provides a very cost-effective way of managing, controlling and monitoring streetlights with at very low cost. A huge benefit being that the Municipality does not need to build and maintain their own network.

3. IMPACT is being used for device management and data collection in landslide and earthquake detection for the purpose of highway management. This uses a combination of in-field gateways connected to movement sensors that can detect changes in ground conditions. The solution triggers alerts to drivers with a partner application and to signage that initiates notifications and road closures. This is in a remote location, so NB-IoT has been utilised enabling battery-powered equipment with long service life.

Creating new business value with fast time to market: the case for Telecom Argentina

These platform capabilities enable Telecom Argentina to bring new value to enterprise customers through its IoT solutions, both within Argentina and beyond in the global market. The 'as a Service' model enables flexibility and lowers financial and project risk. It means that projects can rapidly go through a 'try and fail or try then scale' process to quickly establish the best way to deliver on the key required business outcomes. This means that Telecom Argentina can quickly respond to business needs and concentrate resources to build the right solution, creating new revenue streams that deliver real business value with a fast time to market. In essence, the combination of Nokia WING and Nokia IMPACT provide Telecom Argentina with:

- New enterprise IoT services in the country and across Latin America, in an 'as a Service' format that has low entry cost and end-to-end security
- The capability to capture new IoT opportunities in key industry verticals, including automotive, agriculture, utilities, finance and services
- Fast time to market with scalable onboarding process for Telecom Argentina's IoT customers
- A path for the introduction of 5G features in IoT solutions for the future.

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