TRANSFORMA INSIGHTS

Giesecke+Devrient

Transforming industry with global IoT connectivity

Introduction

The Internet of Things (IoT) has been poised to transform industries across the globe for the past decade, yet its large-scale impact, particularly in industrial sectors, remains in its infancy. Industrial IoT still faces significant barriers, including fragmented connectivity and complex deployment requirements. As digital transformation accelerates and industries seek to modernise operations, the potential for IoT to revolutionise sectors such as energy, transportation, manufacturing, and healthcare becomes increasingly evident. However, realising this potential requires more than just connected devices; it demands scalable, secure, and globally consistent connectivity solutions.

This report explores how IoT can enable transformative change in key verticals, focusing on Smart Grids and Smart Cities. It examines the critical role of global connectivity, cellular and satellite, and emerging technologies like eSIM, iSIM, and the GSMA's SGP.32 standard in enabling seamless, efficient, and cost-effective IoT deployment across borders and technologies. It also highlights the need for a centralised platform that can unify data, tools, technologies and insights from different connectivity systems into a cohesive 'single pane of glass' interface to simplify the management of a potentially very fragmented connectivity landscape.

IoT-enabled industrial transformation is still in its infancy

The IoT holds transformative potential across many industries. By connecting devices, sensors, and systems, IoT enables real-time data collection and intelligent decision-making. In healthcare, it can monitor patient vitals remotely, improving outcomes whilst also reducing costs. In agriculture, smart sensors enhance crop yield through precision farming and help to fully integrate production into supply chains. Manufacturing benefits from predictive maintenance and increased efficiency and reduced downtime.

As emerging technologies like 5th Generation (5G) cellular communications and artificial intelligence (AI) evolve, IoT's reach and efficiency will continue to accelerate. Overall, IoT promises to make our world more connected, efficient, and responsive than ever before.

In the following two subsections, we discuss the opportunities for IoT in Smart Grids and Smart Cities in more detail.

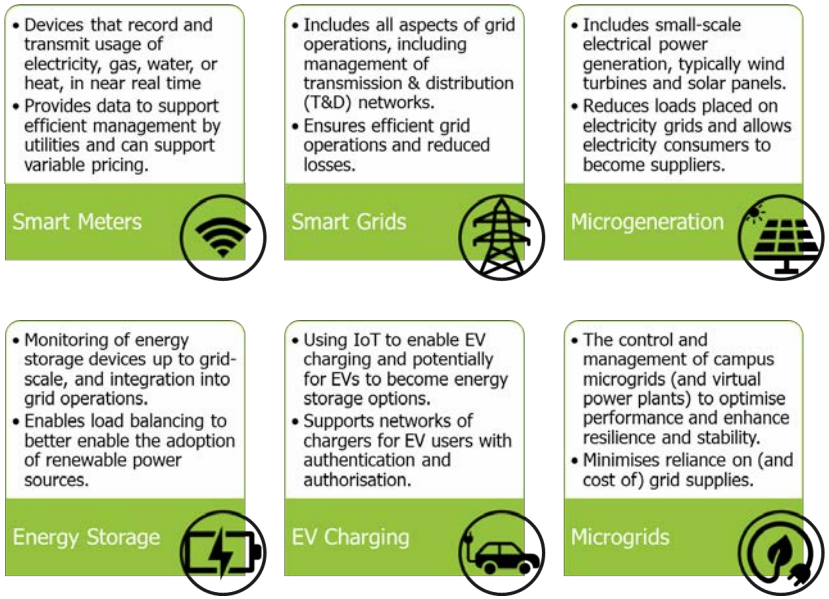
IoT for Smart Grids

IoT has tremendous potential to accelerate green energy transitions, including: the successful integration of renewables into the energy supply mix; the adoption of electrification in areas that have previously been powered by hydrocarbon fuels; improvements in energy storage; and more efficient management of gas, water, and heat distribution infrastructures.

As both centralised and distributed renewable energy sources are integrated into the grid, their variability poses a challenge for energy operators as these technologies lack what has historically been the principal quality for grid-level power generation: a stable and predictable power output. In this context, demand-side flexibility is important to ensure that customers shift their electricity demand to times when electricity is more 'plentiful and green' and reduce demand during traditionally high use periods. Digital technologies can help integrate a higher share of renewable power generation into grid infrastructures and better manage supply and demand by managing heterogeneous decentralised assets such as storage batteries, electric vehicles (EVs), and connected appliances. According to the International Energy Agency (IEA), digital technologies could save USD1.8 trillion of grid investment in the period to 2050 by extending the lifetime of grids, integrating renewables, and minimising supply chain disruptions.

Specific IoT applications that are particularly relevant for Smart Grids and utilities are highlighted in **figure 1**, right.

Figure 1: Key IoT Applications for Smart Grids



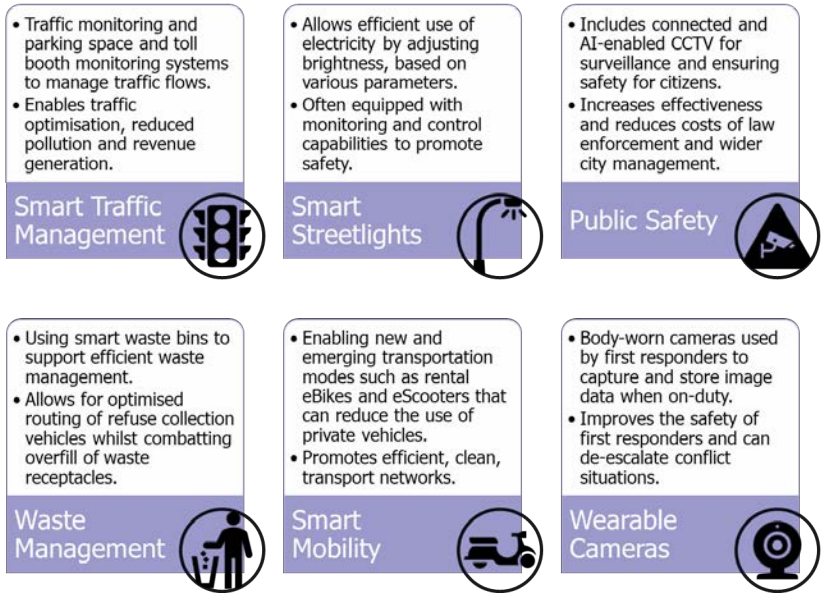
IoT for Smart Cities

Meanwhile, many city authorities have sought to deploy IoT to help modernise their city infrastructure with the aim of improving the quality of life for their residents. With rising urbanisation, increasing traffic congestion, air quality challenges and evolving security concerns authorities often feel obliged to introduce technology-enabled solutions and so contribute to the evolution of cities into smart cities.

Currently, the majority of the world's population resides in cities and most of the world's GDP is generated by urban centres, which puts ever-increasing pressure on generally limited city resources. To be successful the smart city ecosystem requires a cohesive collaboration between residents, businesses, and the relevant authorities to transform a city into a smart, environmentally friendly, and secure place to live and work. In this context, IoT-enabled solutions can be deployed to ease the day-to-day dynamics of a city, including by increasing efficiency of transport infrastructure and city administration and enhancing the well-being of residents by combatting pollution and crime.

Specific IoT applications that are particularly relevant for Smart Cities are highlighted in **figure 2**, right.

Figure 2: Key IoT Applications for Smart Cities



Global connectivity is often a key dependency

For a range of reasons, the demand for connectivity of IoT devices is often global in nature, or at least multi-country. Clearly, some IoT solutions are by nature global, including solutions for tracking goods through supply chains, container tracking and monitoring and often fleet logistics.

Connectivity is also often necessary in multiple geographies when an IoT solution provider aims to offer products or services across multiple countries or on a global scale. Additionally, many of the leading and most innovative companies driving the adoption of IoT are international in scope, requiring consistent, standardised IoT solutions to support their operations worldwide.

Even in the context of Smart Cities and Smart Grid, which may initially seem to be intrinsically national contexts, suppliers of IoT-enabled solutions will often operate globally. In turn, domestically focussed buyers of IoT solutions can benefit from the global scale of suppliers, better enabling more sophisticated IoT solutions and at lower costs.

For many reasons, therefore, a key requirement to sustain and accelerate the current pace of adoption of IoT is the potential to have consistent solutions globally, supported by a homogenous global connectivity solution.

Cellular connectivity is ideally suited to providing homogenous global connectivity

Cellular connectivity has long been the preferred choice for connecting mobile or hard-to-reach devices, offering broad coverage and flexibility. With multiple cellular networks typically available in most countries, global enterprises can leverage these to develop robust international IoT solutions.

Traditionally, enterprises have relied on a single-identity SIM from a preferred operator, using roaming agreements to maintain connectivity abroad. Today, however, eSIM and iSIM technologies are gaining popularity, allowing remote updates to SIM credentials so that IoT devices can connect to potentially multiple different cellular networks. A recent development to further simplify this process is referred to as 'SGP.32' (see callout box, "Backgrounder: SGP.32").

eSIMs and iSIMs both enable devices to switch to local carriers for improved cost efficiency, regulatory compliance, and enhanced network performance. With the addition of 'bootstrap' default SIM credentials that support connectivity for a cellular connected IoT device when it is first switched on, and during the process of acquiring updated credentials for accessing a preferred local network using a SGP.32 process, such a proposition allows for seamless out-of-the-box connectivity whilst also optimising cost and performance.

Currently, 4G is the most widely used cellular technology for IoT, with population coverage nearing 100% in many areas such as China, the U.S., and Europe. However, gaps remain in regions like Latin America and Sub-Saharan Africa and IoT applications located in (or travelling through) remote locations even in markets that claim 100% population coverage can often benefit from the greater reach of satellite-based communications. The 3rd Generation Partnership Project (3GPP), the standards body for cellular networks, has identified this need and is in the process of integrating satellite connectivity options into traditional (terrestrial) cellular networks, with the aim of enabling seamless integration between terrestrial and non-terrestrial connectivity options (see callout box, "Backgrounder: 3GPP Non-Terrestrial Networking").

Backgrounder: SGP.32

SGP.32 is a technical specification developed by the GSM Association of cellular ecosystem vendors for the remote provisioning and management of eSIMs specifically designed for IoT devices. It builds on earlier similar specifications but is optimised for constrained, low-power IoT environments and does not require a 'human in the loop'. SGP.32 introduces a lightweight and flexible architecture, reducing complexity and enabling efficient over-the-air profile downloads and updates. This is particularly useful for massive IoT deployments, such as smart meters, asset trackers, and industrial sensors, where scalability and minimal device interaction are essential. By supporting remote SIM provisioning, SGP.32 enhances operational efficiency, simplifies logistics, and enables greater flexibility in choosing cellular connectivity providers.

Backgrounder: 3GPP Non-Terrestrial Networking

The 3rd Generation Partnership Project (3GPP), the standards body for cellular networks, launched the Non-Terrestrial Networks (NTN) initiative to extend cellular coverage beyond traditional ground-based infrastructure. By incorporating satellite and high-altitude platform systems into the 5G ecosystem, NTN aims to deliver global connectivity, particularly in remote, underserved, or disaster-affected areas. Key use cases include emergency response, maritime and aviation communications, rural broadband, and IoT deployment in isolated regions. A central objective is seamless integration, enabling users to move between terrestrial and non-terrestrial networks without service interruption or device changes. Release 17 (March 2022) introduced NTN support for NB-IoT and LTE-M technologies for IoT, with future releases set to enhance bandwidth and performance capabilities.

Delivering the solution

Combining diverse connectivity options, such as cellular and satellite, offers clear benefits for achieving truly global IoT coverage. However, such solutions inevitably rely on services provided by multiple mobile network operators (MNOs) and quite possibly also satellite providers, creating potential for fragmentation and complexity. In particular, satellite connectivity using NTN standards introduces added complexity and likely higher costs, making effective management crucial. Ideally devices should minimise satellite usage in terms of both connection time and data volume.

To address this complexity, it is essential to manage connectivity across all layers of the solution stack in a consistent way, both across multiple geographies and technologies. A centralised management platform or dashboard can unify data, tools, and insights from different systems into a cohesive 'single pane of glass' interface to enable more efficient and effective management of any connectivity solution.

Ideally, a centralised management platform should not only support the efficient administration of connectivity but also provide a single point of commercial contact including for billing and service support. The platform should also support effective connectivity monitoring, including optimisation across different terrestrial carriers and also NTN options in terms of both the quality and costs of connectivity. Ideally the platform should support automations so that it does not require manual intervention for basic and routine tasks, such as the provisioning or selection of profiles for connectivity services for specific devices.

Much of the optimisation of connectivity as discussed in this report is underpinned by newly emerging SGP.32 and eSIM technologies for IoT. Accordingly, there are additional benefits if the centralised management platform includes within its scope the necessary capabilities for SGP.32 administration and if these are well-integrated into the eSIM and iSIM hardware ecosystems.

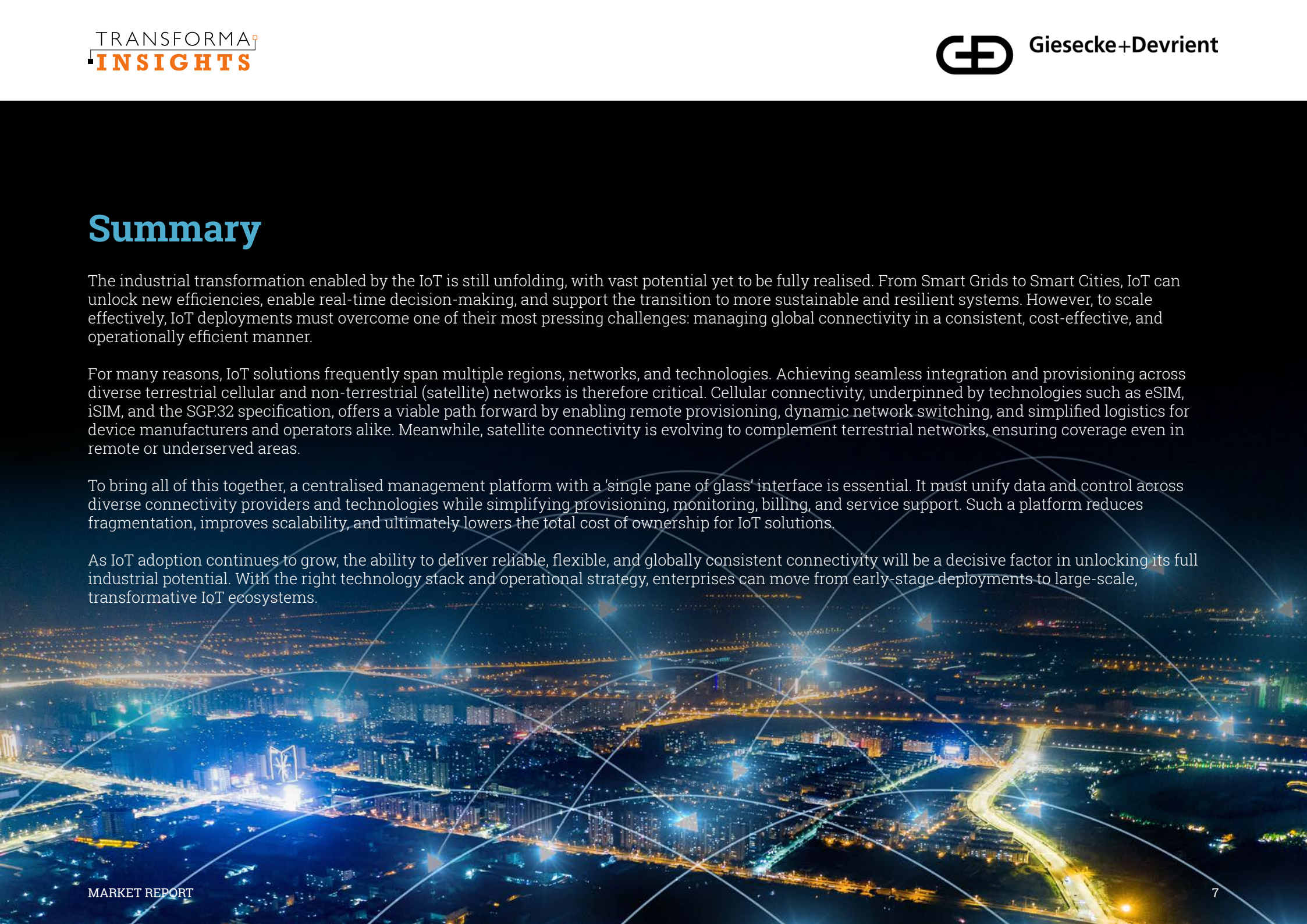
Summary

The industrial transformation enabled by the IoT is still unfolding, with vast potential yet to be fully realised. From Smart Grids to Smart Cities, IoT can unlock new efficiencies, enable real-time decision-making, and support the transition to more sustainable and resilient systems. However, to scale effectively, IoT deployments must overcome one of their most pressing challenges: managing global connectivity in a consistent, cost-effective, and operationally efficient manner.

For many reasons, IoT solutions frequently span multiple regions, networks, and technologies. Achieving seamless integration and provisioning across diverse terrestrial cellular and non-terrestrial (satellite) networks is therefore critical. Cellular connectivity, underpinned by technologies such as eSIM, iSIM, and the SGP.32 specification, offers a viable path forward by enabling remote provisioning, dynamic network switching, and simplified logistics for device manufacturers and operators alike. Meanwhile, satellite connectivity is evolving to complement terrestrial networks, ensuring coverage even in remote or underserved areas.

To bring all of this together, a centralised management platform with a 'single pane of glass' interface is essential. It must unify data and control across diverse connectivity providers and technologies while simplifying provisioning, monitoring, billing, and service support. Such a platform reduces fragmentation, improves scalability, and ultimately lowers the total cost of ownership for IoT solutions.

As IoT adoption continues to grow, the ability to deliver reliable, flexible, and globally consistent connectivity will be a decisive factor in unlocking its full industrial potential. With the right technology stack and operational strategy, enterprises can move from early-stage deployments to large-scale, transformative IoT ecosystems.



Giesecke+Devrient

Leading providers are already unlocking the full industrial potential of the IoT. G+D is at the forefront of this transformation, thanks to their unique offering: a full-stack IoT connectivity solution, spanning SIM hardware, secure connectivity, embedded security elements, and a robust connectivity management platform, all from a single provider.

With access to 600 networks in 185 countries, including satellite backup, G+D ensures reliable and truly global coverage. The company was also the first to standardize SGP.32 to the eUICC and already has a commercially available end-to-end solution: AirOn360® IoT.

Security is a cornerstone of this approach. G+D was the first to finalize the GSMA eSA and eSIM Compliance certification for its IoT eUICC products, achieving certification in less than two months from the specification's release.

Through AirOn360® IoT Suite, G+D provides not just IoT Connectivity-as-a-Service, but also a powerful connectivity management platform that enables enterprises to simplify, automate, and scale frictionless cellular IoT connectivity worldwide. Supporting all Remote SIM Provisioning (RSP) standards – from In-Factory to In-Field – via a single, unified platform, it removes complexity from managing diverse device fleets across their entire lifecycle and delivers a future-proof solution for global IoT deployments.

For more information visit: www.gi-de.com