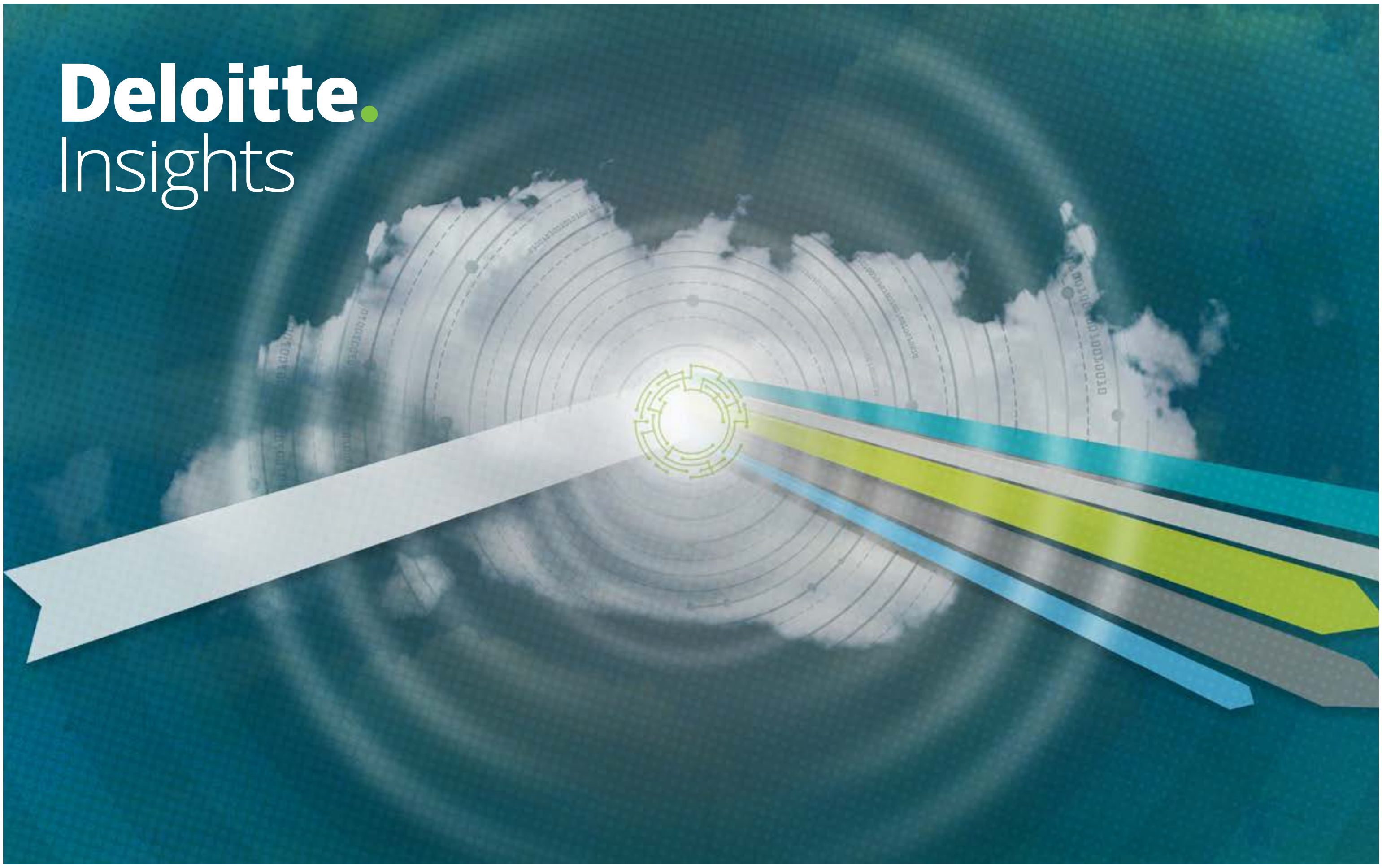

Five vectors of progress in the Internet of Things

By David Schatsky, Jonathan Camhi, and Sourabh Bumb

WHILE enterprise spending on Internet of Things (IoT) technology is growing briskly, many projects have struggled. The good news: Steadily improving technology is helping to overcome some of the barriers to IoT adoption. The five vectors of progress laid out here aim to help business and technology leaders time their investments effectively.

Signals

- In the last two years, vendors have brought to market numerous solutions designed to protect IoT devices from attack at both the hardware and network levels[1]
- Major IoT platform providers now boast dozens of partnerships and integrations with providers of IoT component technologies

- Low-power wide-area networks are providing low-cost connectivity for IoT devices in nearly 100 countries[2]
- Most major IoT platform providers have enhanced their offerings with artificial intelligence
- Launches of hardware and software products that support "edge computing"—analyzing data close to where it is generated rather than in the cloud—are up more than 30 percent so far in 2018 compared to all of 2017[3]

New applications, persistent obstacles

Enterprises are investing big money in Internet of Things technology. One three-year projection foresees companies spending nearly $15 billion on IT consulting and systems integration services to build and implement IoT solutions.[4] As this market develops, it is becoming increasingly specialized. Each of the major market segments—enterprise/industrial, consumer, and services/public sector—presents distinct opportunities to create value through diverse applications. (See table 1.)

The IoT is advancing along a bumpy road, however, with technical challenges keeping many

Table 1. IoT market structure

Segment	Enterprise/industrial	Consumer	Service/public sector
Representative value opportunities	• Planning and inventory • Factory and operations • Supply network and logistics • New business models • New products and product development • Asset management	• Customer experience • Channel connectivity • Aftermarket support • New products and extensions • Lifestyle enhancement	• Health care delivery • Commercial building energy management • Public sector safety • Public sector traffic management • Crop yield management
Representative use cases	• Demand and supply synchronization • Quality sensing and prediction • Condition-based monitoring • Dynamic routing and scheduling	• Smart homes • Remote appliances • Connected cars • Personal lifestyle monitoring • Personal asset tracking	• Smart buildings • Smart cities • Smart irrigation • Patient surveillance • Smart law enforcement
Additional features	• Manufacturing operations and product driven • Private cloud primarily • Hybrid architecture • Fewer devices • Relatively complex data sets • B2B channels	• Customer and product driven • Public cloud primarily • Millions of devices • Simpler data sets • B2C channels	• Public sector, services driven • Public/private cloud mix • Variable data set complexity • Medium number of devices • B2B2B, B2B, B2C channels
Projected global IoT spending share by 2020	50–60%	20–25%	20–25%

Source: Deloitte analysis.

Deloitte Insights | deloitte.com/insights initiatives from achieving their goals.[5] In a 2017 survey, more than 1,800 IT and business decision-makers in the United States, United Kingdom, and India reported that close to three-fourths of their IoT projects were failing.[6]

The reasons are various. Multiple enterprise surveys identify security as a top IoT deployment challenge.[7] Other challenges include implementation complexity and costs[8] and lack of talent with necessary skills.[9] Going to the heart of the value of the IoT, some enterprises are finding it hard to manage, analyze, and derive benefit from IoT-generated data,[10] and they struggle to process it in real time to gain actionable insights.[11] Fortunately, progress in IoT technology is helping to overcome these obstacles.

Five vectors of progress

We see further adoption of IoT technology propelled in part by progress along five vectors, each of which addresses an important challenge. These progress vectors are not all applicable to every industry or application type. But collectively they will likely continue to help drive adoption of IoT solutions and create new possibilities for business and technology leaders.

SECURITY

New device hardware is helping to overcome the technical challenges of securing IoT devices, while machine learning is helping to secure the networks that connect them. Earlier generations of IoT devices often lacked the necessary computing and battery power to run traditional cybersecurity applications and protocols, leaving them vulnerable to attack.[12] But recently, microprocessor manufacturers have introduced low-power hardware products that embed security features—such as providing trusted identities to certify devices on networks—directly into IoT devices.

Securing IoT networks has also been a challenge in part because existing security tools designed for corporate IT networks were poorly suited for recognizing threats in networks of IoT devices. But cybersecurity solutions tailored for IoT networks are becoming widely available. Some use machine learning to recognize IoT devices' unique network activity and behaviors to spot anomalies and potentially compromised devices; the city of Las Vegas, for instance, is using machine learning-based threat detection to monitor its smart city infrastructure for possible intrusions.[13]

PLATFORMS

Things are getting easier for companies looking to develop and deploy IoT solutions, thanks to the introduction of IoT platforms: software that makes it easier to integrate IoT hardware, networks, and applications.[14] Providers are mitigating the complexity of building solutions by preintegrating third-party technologies through vendor partnerships.

Over the last two years, leading IoT platform providers have launched and expanded their partner ecosystems and now boast dozens of major vendor partners each. To illustrate how preintegrated components can accelerate the development of IoT applications, several platform providers report helping clients get proofs of concept and pilots up and running in a matter of weeks through their partner ecosystems.[15] IoT platforms are already a common element of enterprise IoT deployments: In a recent survey, 57 percent of IT decision-makers said their companies already used them for their IoT projects; another 35 percent said they planned to.[16]

In addition to IoT platforms—which provide "horizontal" capabilities that can make it easier to build a wide variety of applications—"vertical" IoT solutions continue to arrive on the market.[17] These offerings preintegrate sensors, devices, analytics, and other components to create complete solutions. Manufacturers have taken advantage of such turnkey IoT solutions, but they are spreading to more industries. One luxury clothing retailer deployed a platform with preintegrated software, sensors, in-store analytics, and RFID tags from different vendors to gain insights on shopper behaviors and real-time inventory visibility.[18] (To learn more about the turnkey IoT trend, see *Turnkey IoT: Bundled solutions promise to reduce complexity and accelerate ROI*.[19])

LOW-COST, POWER-EFFICIENT NETWORKS

Low-power wide-area networks (LPWANs) are proliferating worldwide, providing connectivity at low cost and with low power requirements, a crucial advance for a major class of IoT application that relies on battery-powered sensors and spans large geographical areas.

Major telecom players have launched more than 40 LPWANs.[20] Smaller LPWAN specialists are also expanding their proprietary networks globally; networks based on the LoRaWAN standard now cover 100 countries around the world.[21]

Batteries powering LPWAN sensors can last for years, with the networks providing connectivity for IoT devices for as little as $3 per year.[22] In comparison, cellular connectivity for IoT devices can cost at least a few dollars per month.[23] Rapidly falling LPWAN module prices can also help reduce implementation costs; some are already less expensive than traditional cellular modules.[24] ABI Research predicts that LPWANs will connect more than 4 billion IoT devices by 2025, making it the fastest-growing IoT connectivity option.[25] (To learn more about how low-power wide-area networks enable IoT adoption, see *Internet of Things: Dedicated networks and edge analytics will broaden adoption*.[26])

The growth of these LPWAN networks is helping drive adoption of IoT-based devices for applications such as condition-based monitoring and optimization of capital assets in smart cities, smart utilities, and smart agriculture projects. One industrial equipment maker is using LPWAN technology to remotely monitor connected boilers, for instance, which would have been too costly with other connectivity options.[27] And an Asian water utility firm is using LPWANs to connect smart water meters, gaining better access to meters located underground and in basements than cellular options could deliver.[28]

ARTIFICIAL INTELLIGENCE

AI technologies such as machine learning and computer vision are increasingly being used to analyze IoT-generated data and automate operational decision-making. Nearly every major IoT platform vendor has now augmented its offerings with AI capabilities.

The rich insights and self-learning that AI can provide enhances the value and utility of the IoT in applications such as process optimization, predictive maintenance, dynamic routing and scheduling, and security. For instance, machine learning can reveal hidden patterns in airplane engine performance to make predictive maintenance feasible.[29] Seeing new patterns in changing data can be crucial in applications that monitor and respond to changing conditions such as weather in agricultural settings, vital signs in health care, and operating parameters in industrial settings. (To learn more about the convergence of IoT and AI technologies, see *Intelligent IoT: Bringing the power of AI to the Internet of Things*.[30])

ANALYTICS ON THE EDGE

Analysis of data generated from IoT devices is increasingly occurring not in the cloud but at the network "edge," physically close to where the data is generated—on local servers, micro data centers, or even on the device generating the data. New hardware and software product launches related to edge computing and the IoT have increased more than 30 percent so far in 2018 compared to the entire year of 2017.[31]

Analyzing data at the edge sidesteps the latency associated with transmitting data between the sensors that generate it and the cloud-based applications that analyze it. Lower latency makes it possible to generate real-time alerts and insights that can improve operational safety and performance in industrial, enterprise, and smart city settings, among others. For instance, performing analytics in micro data centers positioned near its plant, a major chemicals manufacturer gained real-time visibility into plant operations, enhancing fire safety and equipment uptime.[32] Analyzing data at the edge can also help reduce data transmission and storage costs. A major European rail operator pre-processes data on smart sensors before sending it to the cloud for predictive railway maintenance to save on data transmission costs.[33]

Additionally, AI technology is increasingly making its way onto edge devices. Major cloud providers have been tailoring their AI solutions for on-device deployments, while manufacturers are embedding AI capabilities directly into smaller, low-power chips designed specifically for smart sensors, cameras, and other IoT devices. Deploying AI at the edge may help avoid running afoul of data privacy regulations and reduce dependency on unreliable network connectivity in remote areas.

Gartner predicts that the majority of industrial IoT data analysis will happen at the edge by 2022, up from less than 10 percent last year.[34] (To learn more about how edge computing empowers IoT applications, see *Internet of Things: Dedicated network and edge analytics will broaden adoption*.[35])

Progress and opportunity in the IoT

The five vectors of progress described above are increasing IoT technology's value in many industries: reducing risk in health care[36] and banking,[37] improving operational costs and uptime in mining[38] and energy,[39] enhancing service delivery in utilities[40] and retail,[41] and more. This progress is making it easier in some instances for executives to make a sound business case for investing in an IoT solution. As barriers to adoption of IoT technology in the enterprise continue to fall, business and technology leaders would do well to keep an eye on these vectors of progress.

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ABOUT THE AUTHORS

DAVID SCHATSKY

David Schatsky is a managing director at Deloitte LLP. He tracks and analyzes emerging technology and business trends, including the growing impact of cognitive technologies, for the firm's leaders and its clients. He is based in New York City. Connect with him at twitter.com/dschatsky.

JONATHAN CAMHI

Jonathan Camhi is a senior consultant at Deloitte LLP. He analyzes trends related to emerging technologies such as artificial intelligence, blockchain, and IoT. Camhi has several years of experience as a journalist and researcher writing about emerging technologies and their impact on businesses.

SOURABH BUMB

Sourabh Bumb is a senior analyst at Deloitte Services India Pvt. Ltd. He tracks and analyzes emerging technology and business trends, with a primary focus on the Internet of Things, for Deloitte's leaders and its clients. Prior to Deloitte, Sourabh worked with multiple companies as part of technology and business research teams.

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