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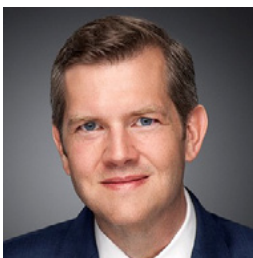Smart Cities
Summit

CONTENTS

INTRODUCTION

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IoT Viewpoints 2019: Your roadmap to the future of the Internet of Things

Ovum's third annual edition of IoT Viewpoints brings together the latest thought leadership and industry data on emerging IoT trends, technologies and opportunities. We are delighted to be joined this year by our new colleagues at Tractica, who look at IoT through the lens of their deep expertise on artificial intelligence.

In some sectors and geographies, IoT is already becoming deeply intertwined with business processes, while in others, it is still in the earliest phase of take-up. Enterprises and governments are realizing IoT's potential in manufacturing, transport and logistics, utilities and environmental applications. For consumers, IoT applications and devices are fast becoming part of everyday life for millions of users worldwide.

As discussed in the following pages, technologies are key enablers for IoT development. 5G is becoming an important area of investment. Low-power wide area networks, blockchain, edge computing and robotics, are increasing the opportunities to leverage IoT data for business and social benefit.

Market players are also shifting strategies to meet the evolving IoT demands of their customers. Communications service providers are starting to innovate with a variety of IoT offers. Alternative IoT connectivity providers and MVNOs, as well as systems integrators, will play an increasingly critical role in driving IoT innovation and commercialization.

Many challenges must still be overcome for the IoT market to reach its full potential. Ovum and Tractica - the TMT and AI research and consulting arms of the wider Informa Tech business – are ready to help. Ovum's 30-year history as a leading advisor on the ICT market gives us unique perspective and a wealth of data on IoT developments and forecasts. Tractica's keen eye for future opportunities in the AI market complements this, looking ahead to the ways IoT will enable machine learning, AI, and ever-smarter devices.

We hope the IoT insights presented here will inform your decisions, challenge your thinking, and inspire you to look at market opportunities in a new light. We welcome your feedback, questions, and ideas on how Ovum and Tractica can further support your success in the IoT world, and beyond.

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IOT TRENDS TO WATCH

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"The IoT market is moving to the active commercialization phase, with LPWAN, 5G and industrial IoT emerging as leading trends."

SUMMARY

The IoT market is moving into a new phase. The hype is beginning to die down, although the intersections between IoT and 5G, and between IoT and artificial intelligence, still offer pockets of exuberance. We are now moving to active commercialization. Use cases in many industry verticals have been proven to deliver value. Growth figures for IoT connections and devices continue to accelerate. The range of enabling technologies is growing, and clear winners are emerging. Below we discuss the most important trends that successful IoT market players need to watch in 2019.

2019 WILL BE THE YEAR LPWAN TAKES OFF, BUT 5G IS FURTHER OUT

Roll-outs of licensed spectrum 3GPP LPWAN technologies NB-IoT and LTE-M have been slower than expected, but coverage is now established in and around major cities, and nationally in some markets – notably China and the US. Ecosystem development is still lagging, but is starting to pick up, particularly for NB-IoT; device availability is improving and module costs are declining. NB-IoT adoption will gain pace and LTE-M networks will finally go live in significant numbers in 2019.

Unlicensed spectrum LPWAN technologies – in particular LoRaWAN, which looks likely to become the de facto standard for this category of technology - have enjoyed an early mover advantage. As of December 2018, LoRaWAN accounted for over one-third of total LPWAN network deployment announcements tracked by Ovum, through the 3GPP technologies are catching up and NB-IoT connections will pass LoRaWAN connections by the end of 2019 (see Figure 1).

LPWAN take-up will initially be driven by relatively simple applications such as smart lighting; smart parking; water monitoring and leak detection; fire

FIGURE 1: GLOBAL LPWA AND M2M CONNECTIONS
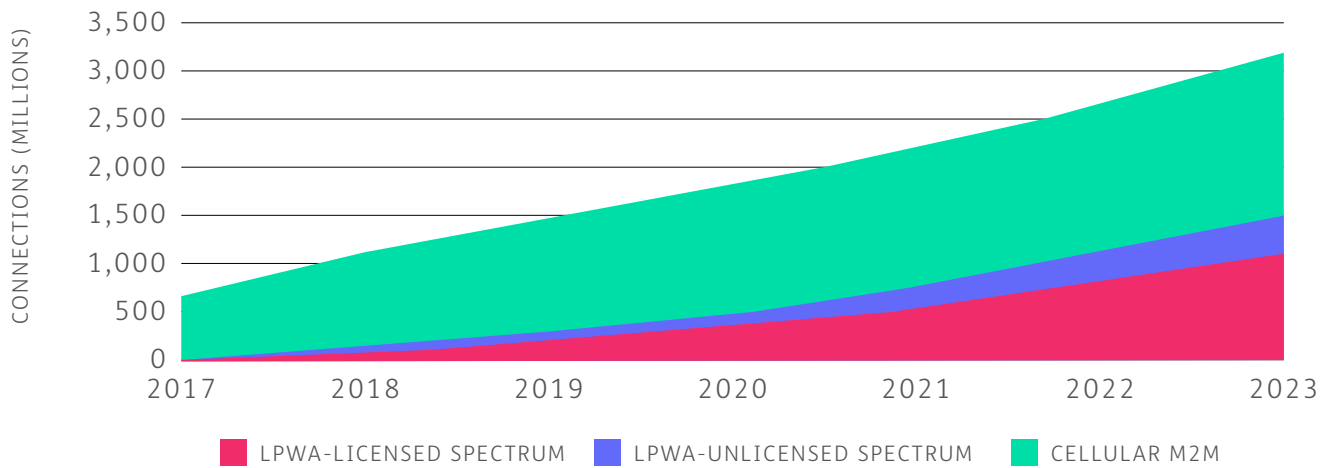
Source: Ovum IoT Forecast: LPWAN 2017-2023

monitoring; smart metering; and monitoring of crops, animals and environment for smart agriculture. Going forward, we will see the emergence of additional use cases across new verticals including healthcare, automotive, transport and logistics and consumer wearables.

5G for IoT is still several years off for full standardization and commercialization, but is high on the agenda for providers. 5G testbeds are springing up, particularly for smart cities, industrial sites and automotive. There will be plenty of exploration around use cases in 2019, though the economic case is still unclear for many. There's a lot of life yet in LTE, and LPWAN will pick up most of the previous 2G-type IoT demand. Real growth in the 5G market will come in the medium-to-long term.

INDUSTRIAL IOT WILL ATTRACT NEW FOCUS AND DRIVE PRIVATE LTE

The biggest IoT vertical trend for 2019 will be the rise of new opportunities in industrial IoT (IIoT). As the manufacturing sector comes under increasing economic pressure and competition intensifies, there is growing interest in new technology that can help increase efficiency, agility and differentiation. IoT solutions are a relatively easy fit in manufacturing and industrial settings, where they can play a role in delivering automation and efficiency gains in the factory setting and the supply chain. Germany's Industrie 4.0 initiatives have already shown the way in this area. A vision of the "Factory of the Future" is emerging – a flexible, wireless-based site that allows quicker retooling and reconfiguration of industrial equipment, and high levels of precision and personalization. Looking ahead, 5G will be a key enabler for IIoT, and manufacturing facilities and industrial campuses will be important testbeds in 2019 and beyond.

Industrial IoT adoption faces a number of barriers. While customer interest is strong, manufacturing tends to be a conservative sector. Technology shifts involving significant investment and changes

to process don't happen quickly. IT/OT data integration will be a further challenge for industrial IoT deployments. Security concerns for both equipment and data are also high for manufacturers, so IoT solutions and device providers need to be sure these are addressed up-front and credibly in customer discussions.

Linked to the growing interest in industrial IoT, private LTE is being touted as a solution to support IoT and communications in the manufacturing sector. Ports and mines are also potential sites for private LTE, given coverage and mobility requirements, the need for high levels of reliability and flexibility, and the mix of different types of communications. Private deployments can also provide testbeds for 5G infrastructure and applications.

Private LTE is being promoted heavily by infrastructure vendors. CSPs are also starting to recognise the potential of private LTE to drive IoT and other revenue, despite their historical resistance to private networks. There are significant opportunities for hybrid cellular private network-CSP network solutions to support both IoT and other enterprise communications requirements. Private LTE operators are also starting to emerge, e.g., Nokia works with private LTE provider Ukkoverkot on deployments in Finland.

NEW ENABLING TECHNOLOGIES TAKE CENTER STAGE

Newer enabling technologies like edge compute and blockchain will be important for IoT evolution, although they're still early stage and will be most relevant for selected use cases. With IoT devices proliferating, edge processing offers the ability to deal with high volumes of data generated at sensor and device level locally, rather than sending this to the cloud or data center. This enables lower latency and higher efficiency for IoT data processing and device control. It should also allow IoT solutions to offer greater local analytical functionality, in real time.

Blockchain's combination of decentralized, readily-queryable, independently verifiable and highly secure record-keeping maps well to the requirements of a variety of IoT applications. Blockchain in particular is very early in terms of usage for IoT, with supply chain tracking and verification emerging as areas of interest. Micro-contracts - for IoT applications such as tracking payments and contributions within neighborhood energy grids - may also be a good fit for blockchain. Secure authentication of devices joining an IoT network is another potential use case.

AI is rising to the top of the agenda for tech firms involved in the IoT market, and investment patterns reflect this, as discussed in our IoT Investment article later in this report. As AI starts to become part of the overall set of capabilities that technology and service providers must provide (or at least support), the need for data to feed AI engines is growing too, and IoT will be a key source. Over time, AI will begin to play a more important role in informing and controlling IoT devices and systems, so these two areas are highly interdependent, and will become more so. Technology firms' investment strategies will increasingly need to encompass both.

- **Push on commercializing LPWAN and be realistic about 5G RoI timelines.** LPWAN module costs are now coming down, and coverage is improving. LPWAN device availability has been a barrier, especially for 3GPP technologies, and a more proactive approach is needed to address this. More end-customer education is also needed. Despite the 5G hype, the timeframe for realizing commercial value from 5G for IoT is not short-term. There is plenty of opportunity to leverage existing cellular and new LPWAN networks in the meantime.

- **Flexible approaches will be key to IoT success.** These include flexible IoT partnering strategies and openness to new business models. To develop successful vertical propositions and channels to market, CSPs and vendors need to partner across the IoT value chain – and/or invest in vertical specialists. A simple, agile process for identifying and managing IoT partnerships for IoT will be important. A flexible approach to business models will also help - CSPs must recognize that private, shared, or hybrid business models are not their enemy, but rather can be a way to drive IoT and other revenue.

- **Emerging technologies like edge, blockchain and AI need to become part of the IoT strategy for both vendors and CSPs.** Now that much of the basic IoT hardware technology has been developed, software and applications are taking center stage. CSPs must work with vendors to explore the best ways to incorporate emerging technologies into their IoT propositions, given their interest in building IoT revenue further up the stack, beyond pure connectivity. New technologies, such as edge computing, blockchain and AI can bring different capabilities and potential differentiation to IoT offerings.

- **Driving scalability and bringing people into the IoT equation remain challenges.** PoCs may be compelling, but IoT growth in many areas has not (yet) met expectations. The people and process issues that IoT can engender remain barriers to uptake in many sectors and enterprise settings. For all the excitement around new areas of IoT, technology solutions alone are not enough to drive growth.

CSPs GO VERTICAL TO MOVE BEYOND IOT CONNECTIVITY

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"Smart cities and buildings applications contracts with CSPs have seen significant growth over 2017-2018. Manufacturing/Industry 4.0 is also picking up momentum, particularly around machine monitoring and predictive maintenance."

SUMMARY

IoT has been one of the growth 'bright spots' for many communications services providers (CSPs) globally. Ovum's IoT Service Provider Contract Tracker provides useful color on CSP activities in this market, detailing more than 940 publicly announced IoT contracts between CSPs and enterprise customers.

Below we discuss some of the key findings highlighted in the most recent tracker update. Key takeaways include:

- the dominance of a small number of key IoT CSPs in winning contracts;
- the growth of IoT MVNOs;
- the large number of Smart Cities and Fleet and Logistics contracts;
- the growing importance of CSP IoT opportunities in the manufacturing sector.

THE TOP 10 PLAYERS ACCOUNT FOR 65% OF CSP IOT CONTRACTS

Figure 2 shows the cumulative IoT customer contracts publicly announced by CSPs from 2014 to 2018.

Together the top 10 players account for 65% of the IoT contracts logged in our tracker. Vodafone leads with 145 publicly announced contracts, growing steadily over the full tracker period (2009-2018). AT&T is close behind with 133 customer IoT contracts, with growth mainly from 2015 onward. Other noteworthy CSPs in the top ten are Deutsche Telekom, Orange, Telenor, Verizon, and China Unicom. It should be noted that our visibility on Chinese operators is limited due to the relatively small number of public contract announcements they release; for instance China Mobile - the world's largest IoT provider - does not appear on this chart.

FIGURE 2: TOP 10 SERVICE PROVIDERS FOR PUBLICLY ANNOUNCED IOT CONTRACTS, BY NUMBER OF CONTRACTS
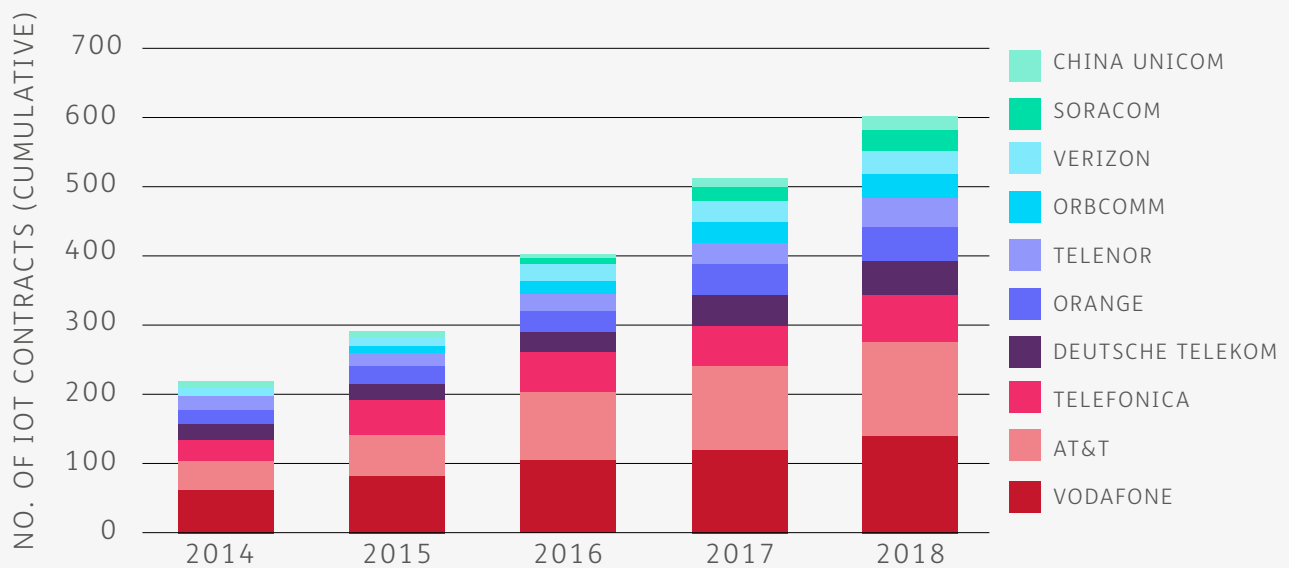
Source: Ovum IoT Service Provider Contract Tracker: 1Q19.
Data shows cumulative contracts reported from 2009 onwards.

Interestingly, the rise of the IoT specialist MVNOs means that two such players feature in our top ten; Orbcomm at 7th and Soracom at 9th position. Ovum's recent report, Market Landscape: Alternative IoT Network Operators, discussed the positioning and strategies of the growing number of IoT MVNOs. Like their traditional mobile network operator competitors, most are focused on IoT connectivity, but a few are specializing within verticals. Orbcomm has found success in the transport, fleet, and logistics vertical, whereas Soracom is winning contracts within manufacturing and Industry 4.0.

SMART CITIES DRIVE SIGNIFICANT NUMBERS OF CONTRACTS, WHILE MANUFACTURING INCREASES IN IMPORTANCE

Ovum segments the global Internet of Things into nine key verticals. We analyze which IoT application verticals account for the greatest number of contracts for CSPs, based on volumes of contracts announced. We determine the application vertical categorization based on the type of IoT project or application being deployed. For example, if the project is for asset tracking, it is categorized as 'Transport, Fleet and Logistics', even if the customer comes from a different industry segment.

Figure 3 shows that smart cities and buildings applications account for the greatest number of announced CSP IoT contracts, with a total of 203 contracts by the end of December 2018, equivalent to 22% of the total publicly announced contracts we track. Growth in this sector has mainly been from 2016 onward. Prior to that, the greatest number of IoT contracts were for applications in the transport, fleet, and logistics vertical. While this vertical remains important for CSPs, the number of application deals in the smart cities and buildings vertical is growing at a faster pace.

Another vertical which dominated early IoT contracts (up to the end of 2015) was energy, utilities, and resources. While this also remains an important application vertical for service providers, with smart metering in particular driving many contracts, it has not kept pace with growth in the top two verticals.

FIGURE 3: TOTAL PUBLICLY-ANNOUNCED CSP IOT CONTRACTS, BY APPLICATION VERTICAL (2009-2018)
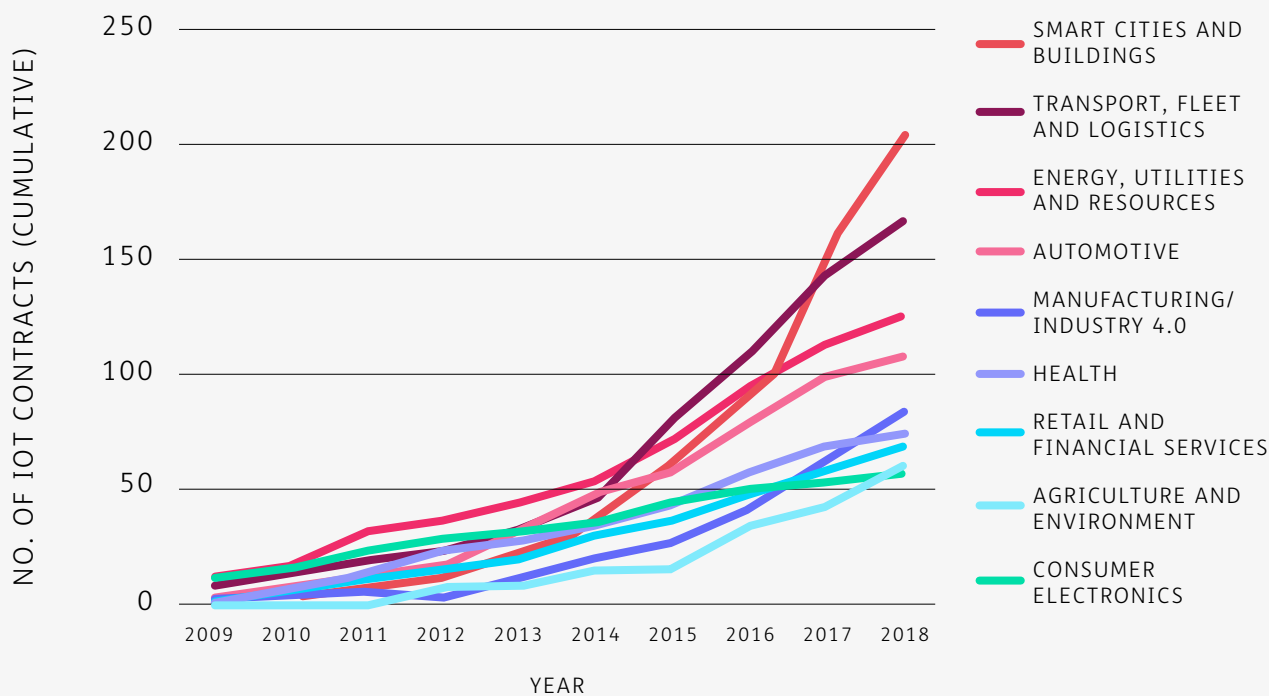
Source: Ovum IoT Service Provider Contract Tracker: 1Q19

Manufacturing/Industry 4.0 applications contracts are experiencing high growth, particularly around machine monitoring and predictive maintenance. While this sector is more dominated by specialist vendors, CSPs are still finding opportunities in this space, though in many cases these will come via partnerships with specialist industrial players. We expect this vertical to grow in importance in 2019, and partnerships are going to be key for CSPs looking to provide more than just the underlying connectivity.

IOT CUSTOMERS IN THE MANUFACTURING SECTOR ARE THE LARGEST GROUP

Within the tracker we not only analyze what type of applications are being deployed, but also the industries of the customers who are buying these solutions – in other words which business/industry sector the enterprise or customer organization operates in. In some cases, the customer vertical is different to the IoT application vertical. For instance, a car OEM would be classified as a manufacturer in the customer vertical, but they are usually deploying an automotive IoT solution (which means they would appear under the 'Automotive' category in the chart above. Likewise, many different types
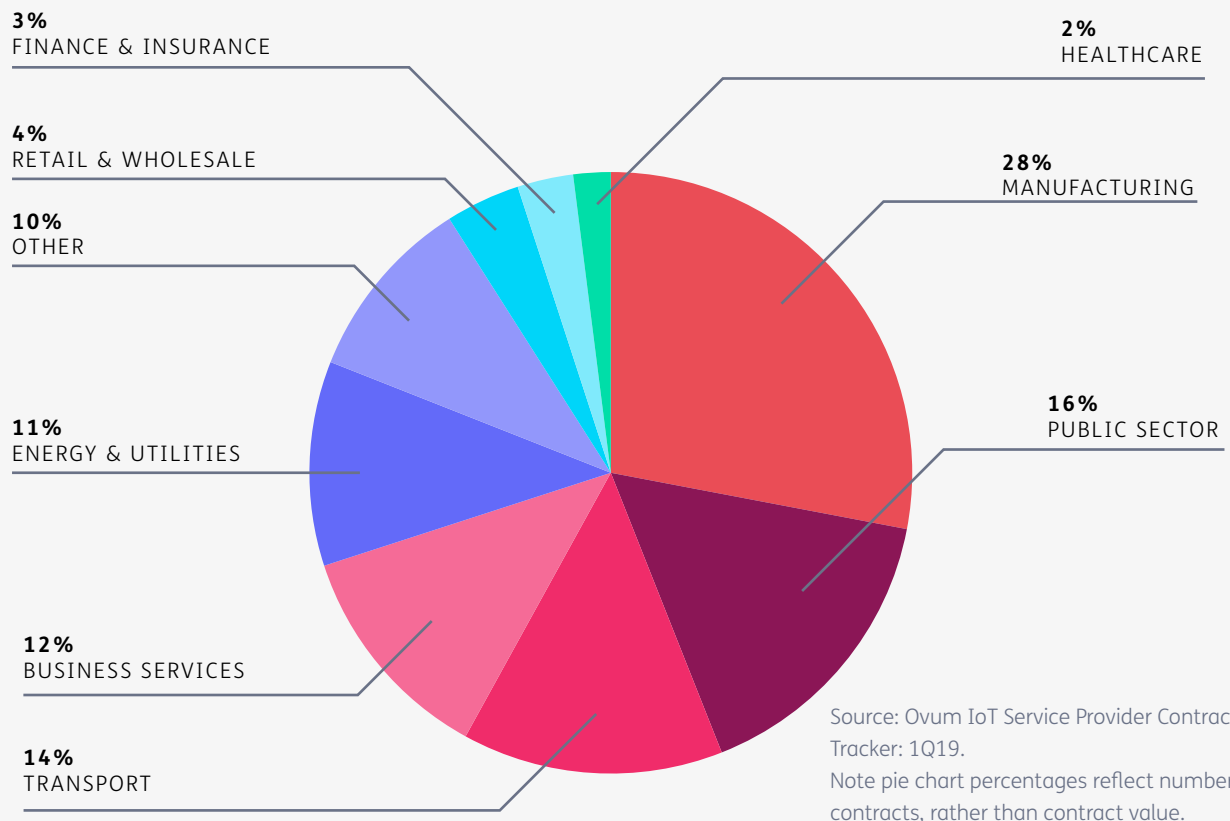
of customers, from a wide range of verticals, are deploying IoT for fleet management and logistics applications.

The manufacturing sector is the largest customer group for CSP IoT contracts (see Figure 4). This reflects the relatively easy fit of IoT solutions into manufacturing and industrial settings, where they can play a key role in delivering automation and efficiency gains, both in the factory setting and all along the supply chain.

As previously mentioned, this category also includes automotive OEMs. Within the tracker we see examples of enterprise customers in the manufacturing vertical deploying IoT solutions from each of the nine application verticals.

Public sector is the next largest customer category, largely driven by driven by the growth of smart cities. Transport sector companies (including airports, ports and railways, as well as road transport) are a close third, with logistics and fleet companies making up most of the companies in this category. Business services is fourth, with contracts coming from a wide range of solution providers not embedded in any one application vertical. Energy and utilities are the next largest customer group. CSPs have seen

FIGURE 4: SHARE OF PUBLICLY-ANNOUNCED CSP IOT CONTRACTS, BY CUSTOMER VERTICAL (2009-2018)

- 3% FINANCE & INSURANCE
- 4% RETAIL & WHOLESALE
- 10% OTHER
- 11% ENERGY & UTILITIES
- 12% BUSINESS SERVICES
- 14% TRANSPORT
- 2% HEALTHCARE
- 28% MANUFACTURING
- 16% PUBLIC SECTOR

Source: Ovum IoT Service Provider Contract Tracker: 1Q19.
Note pie chart percentages reflect number of contracts, rather than contract value.

more limited IoT success with customers who come from retail/wholesale, finance and insurance, and healthcare.

IMPLICATIONS AND RECOMMENDATIONS

In Ovum's recent IoT enterprise survey, when enterprises deploying IoT solutions asked which type of provider they were using, CSPs were named by only 11% of enterprise respondents. This reflects the challenges that CSPs face in winning direct IoT contracts and owning the customer relationship.

Many CSPs aspire to move beyond selling 'just' connectivity, for IoT. While the importance of connectivity shouldn't be underplayed, and it certainly delivers the majority of CSPs' IoT revenue, Ovum estimates that it only accounts for around 10-15% of overall IoT revenue. This means that most CSPs are looking to provide other functions within the value chain, such as device management, applications, analytics, systems integration and project management. However, no CSPs to date can provide a truly end to end solution across all verticals. Some are succeeding by specializing in a

few carefully-chosen key verticals. Smart Cities seems to be one vertical where CSPs are gaining traction, and a few key applications like smart lighting, smart parking and enhanced public security solutions offer compelling business models.

Other verticals we are seeing growth in, such as Manufacturing/Industry 4.0, have a wealth of players who are more vertical specialists (e.g., Siemens and Bosch for manufacturing and industry), as well as many smaller players. To succeed in such verticals. CSPs need to partner with key players, or acquire a vertical specialist that can bring market expertise and market entry capabilities as well as talent. CSPs making vertical acquisitions to support end-to-end IoT solutions is a trend we expect to continue over the next few years, as CSPs look to differentiate their IoT offerings and get closer to customers in the major verticals.

IOT INVESTMENTS HIGHLIGHT AI, SOFTWARE, AND INTERNET PLAYERS

"A broad spectrum of players have invested in IoT-linked AI companies – there is widespread interest in acquiring AI technologies and technical talent."

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SUMMARY

Ovum's IoT team tracks IoT deals and investments made by technology firms in our IoT Investments Tracker. The most recent update brings the total number of investments covered in the tracker to just under 300. Below we discuss some of the key findings highlighted in the update, such as growing activity by software and internet players, the shifting balance between horizontal and vertical investments, and the growing importance of artificial intelligence (AI) in the IoT deal mix.

FIGURE 5: ANNUAL IOT INVESTMENT DEALS, BY INVESTOR COMPANY TYPE
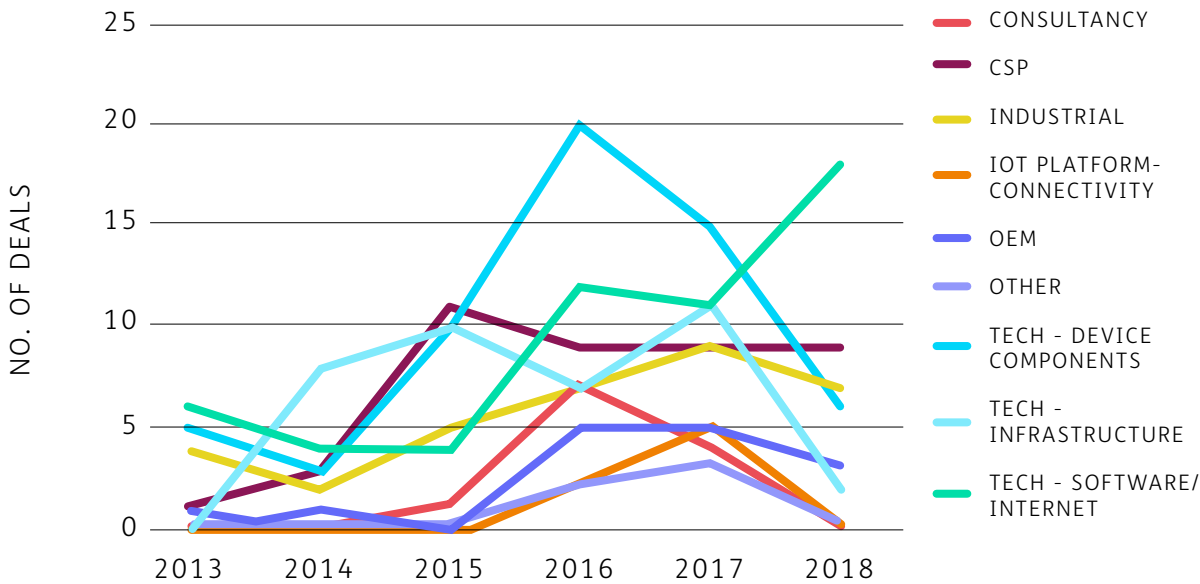
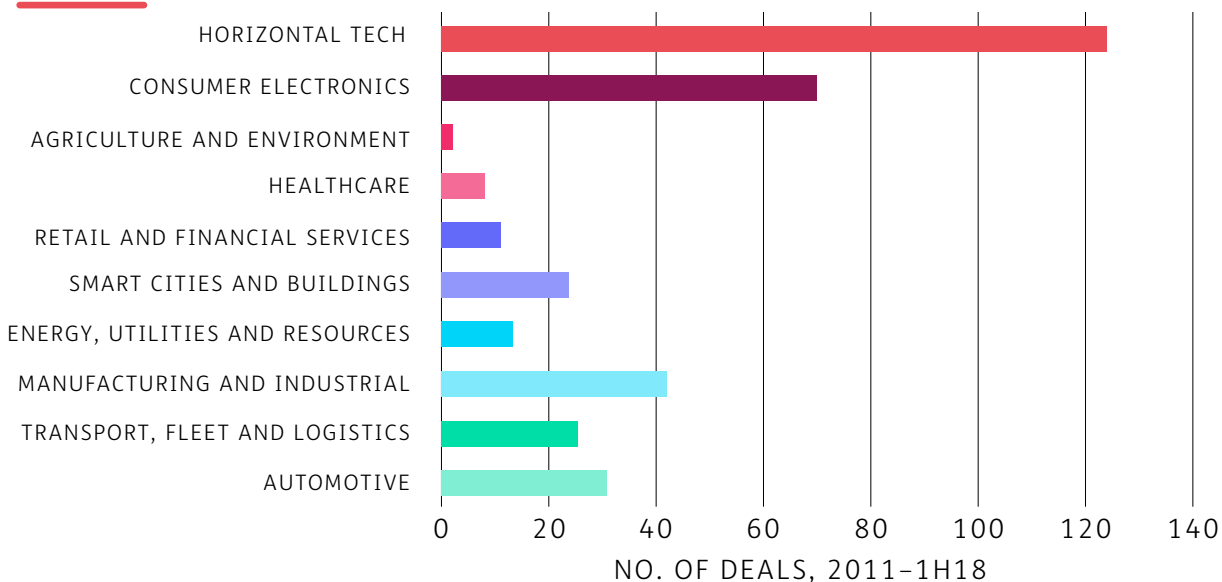Source: Ovum's IoT Investments Tracker: 2H18

SOFTWARE AND INTERNET FIRMS LEAD THE PACK FOR NUMBER OF IOT DEALS

The most recent period (1H 2018) saw a significant uptick in IoT investments by software/internet firms - a category which includes internet players such as Amazon - and a corresponding downtrend in investments by device/components manufacturers (see Figure 5). This reflects the growing importance of the world of applications and software to the IoT, and vice versa. Meanwhile, IoT investments by communications services providers (CSPs) are also increasing, with as many such deals announced or concluded in the first half of 2018 as in all of 2017.

North America continues to be the strongest region for IoT deals, although a significant number of deals took place in Europe in 1H18 as well, notably in the UK, where investors are taking advantage of the depressed value of the pound to acquire innovative IoT firms.

Horizontal technology investments account for the greatest proportion of deals overall, followed by deals related to consumer electronics and manufacturing/industrial (see Figure 6). Looking at specific product types, those related to connectivity, platform, and software are the most numerous.

FIGURE 6: CUMULATIVE IOT INVESTMENT DEALS BY VERTICAL

Source: Ovum's IoT Investments Tracker: 2H18

DEAL ANALYSIS REFLECTS GROWING INTEREST IN IOT LINKS WITH AI

Notable M&A deals in 1H18 included: Itron's acquisition of Silver Spring Networks; Amazon's acquisition of Ring; SK Telecom's acquisition (with Macquarie) of ADT Caps; and Rockwell Automation's acquisition of applications enablement platform provider PTC.

While these deals were each valued at around $1bn, some were plays for market ownership in a particular area, while others were more about moving into new spaces. The Itron (smart lighting and smart cities) and Rockwell (industrial IoT platforms) acquisitions fall into the former category. Amazon's Ring acquisition and SK Telecom's ADT investment are, interestingly, both focused on the home security and controls market, and were clearly undertaken with a view to strengthening ownership of the home consumer relationship, though coming from somewhat different positions.

We also analyzed deals by technology/use case, to look on a more granular level at which areas are attracting the most investment. The greatest number of IoT deals were seen in the following technology/use case categories: AI, smart home, smart buildings, safety and security (referring to safety and security of people, places or things rather than cybersecurity), and IoT connectivity. AI was the largest of these categories in terms of deal numbers, and also showed the strongest upward trend relative to previous years (see Figure 7).

FIGURE 7: TOP TECHNOLOGY/USE CASE AREAS FOR IOT INVESTMENT
(NO. OF DEALS, % OF TOTAL DEALS)
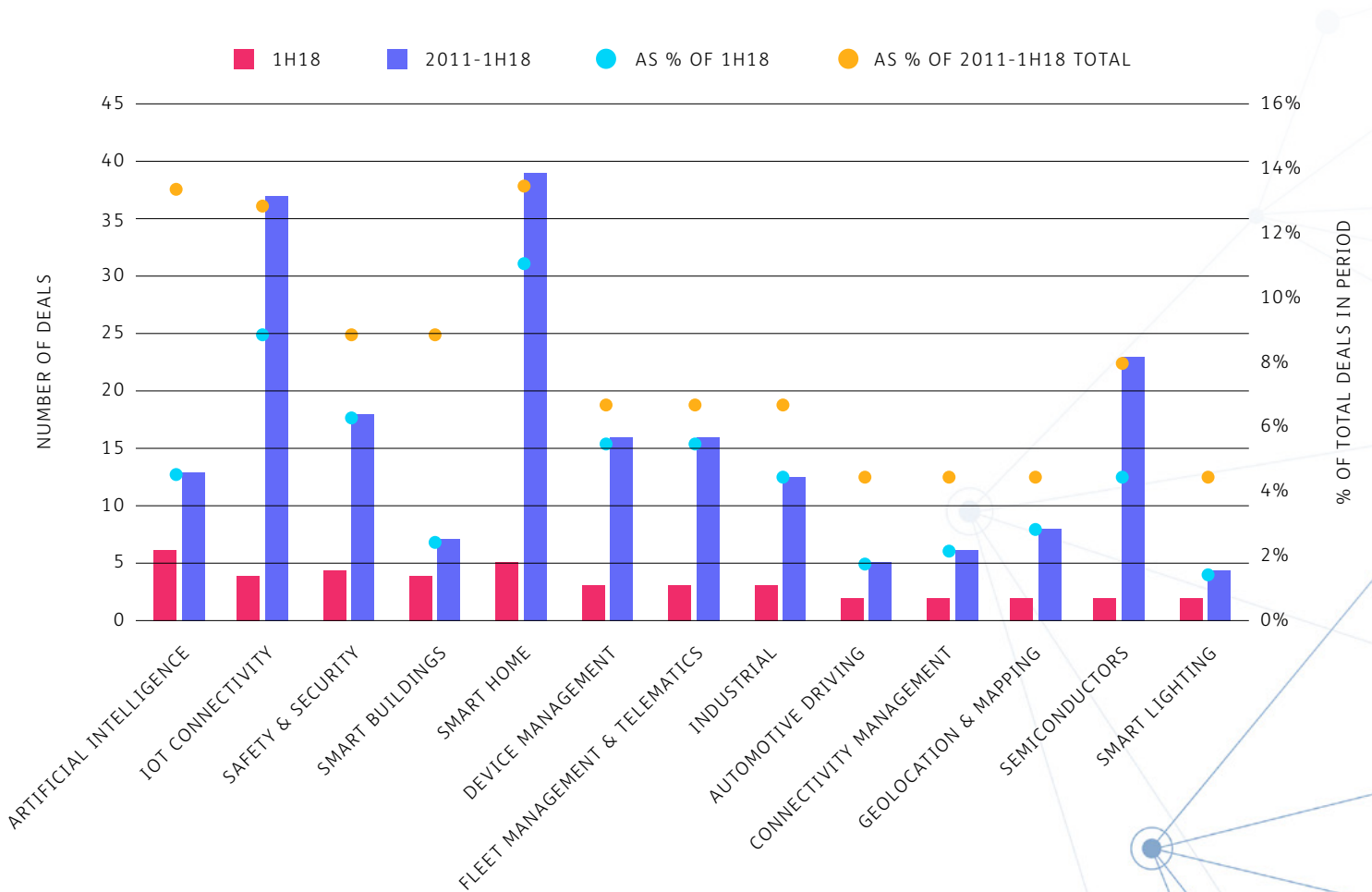
The links between IoT and AI are clear, and it's no accident that market players are looking to AI as an avenue to extract value from IoT data. What's interesting is the broad spectrum of players that have invested in IoT-linked AI companies. In the first half of 2018, this included Microsoft (Bonsai), Software AG (TrendMiner), Nokia (SpaceTime Insight), NTT Docomo (Nbenta), and Samsung (Kngine). Most of these were full acquisitions, indicating the widespread interest in acquiring both AI technologies and AI developer and technical talent.

IMPLICATIONS AND RECOMMENDATIONS

The high growth in IoT investments from software and internet firms is indicative of a broader shift in the IoT market. Now that much of the basic hardware technology development is in place, and devices and components are becoming more widely commercialized, software and applications are taking center stage.

CSPs are also growing IoT investment, but need to make hard choices between focusing more on acquiring horizontal technology players (not their sweet spot), and on acquiring vertical specialists that may bring market expertise and market entry capabilities, as well as talent.

Finally, as AI grows in importance as part of the overall set of capabilities technology and service providers must provide, or at least support, the need for data to feed machine learning engines is growing too – and thus we expect to see the number of AI deals in the IoT-deal mix continue to grow as well. Over time, AI will begin to play a more important role in informing and controlling IoT devices and systems, so these two areas are highly interdependent, and will only become more so; therefore technology firms' investment strategies will increasingly need to encompass both.
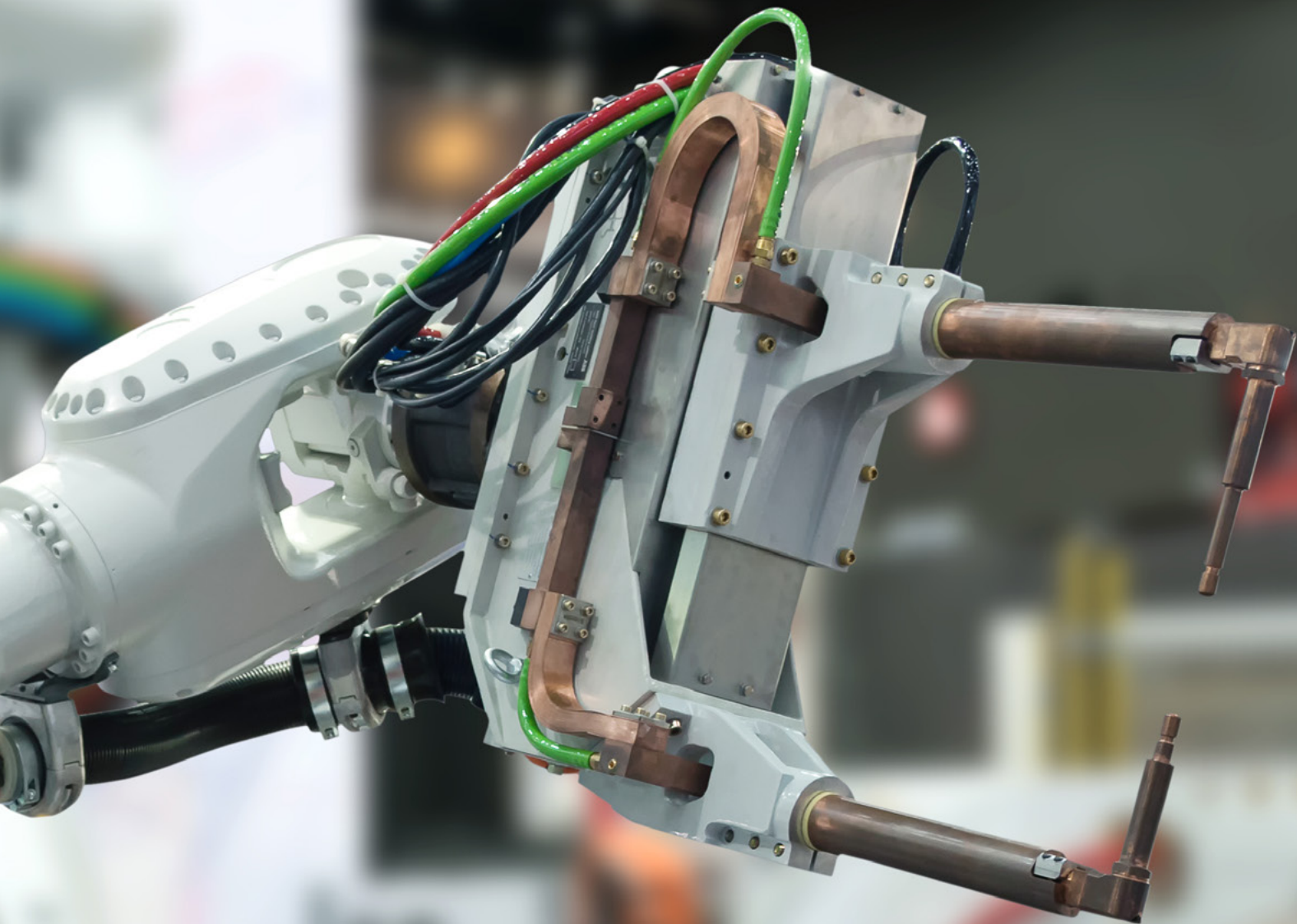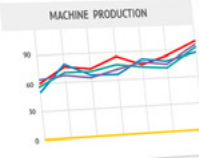
ENTERPRISES DEMAND, REGULATORS DECIDE: SPECTRUM FOR 5G AND THE INDUSTRIAL IOT

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SUMMARY

Delivering the potential of the Industrial Internet of Things (IIoT) requires wireless connectivity on a par with fixed in terms of quality, and better in terms of flexibility. That means deploying infrastructure and assigning spectrum within the enterprise. How regulators respond to this will shape the future IIoT business model and will have significant implications for 5G monetization. Ovum is currently seeing several different approaches to IIoT spectrum allocation taken in Europe, Asia, and the US, with variation in terms of how easily enterprises will be able to access spectrum for their own requirements, and what the likely role of communications service providers (CSPs) will be.

"The whole concept of 5G for industry is predicated on giving the customer more control of true mobile connectivity, and the right spectrum allocation approach can be a key enabler."

TABLE 1: THREE APPROACHES TO 5G SPECTRUM FOR IIOT

TYPE OF APPROACH	ENTERPRISE-CENTRIC	HYBRID	CARRIER-CENTRIC
Commercial model	Self-managed private network	Operator-managed infrastructure	Operator-controlled/ operator-owned infrastructure
Regulatory/Spectrum	Customer-licensed or unlicensed spectrum	Customer-designated spectrum	Operator-designated spectrum
Primary geographic location			

Source: Ovum

AN ENTERPRISE-CENTRIC APPROACH TO SPECTRUM: EUROPE

The most ambitious take on spectrum for the IIoT is that of Germany. The Federal Networks Agency (BNetzA) has reserved the top 100MHz of the 3.4-3.8GHz band for industrial and rural users, minimally regulated on the basis of radiated power at the edge of the facility. This was an explicit ask from a line-up of German industrial companies, led by Siemens CEO Joe Kaeser and including the automakers, chemical industry, engineering, and SME representatives.

Meanwhile, the UK's OFCOM has begun consultations on a similar project, rolling the existing low-power assignments for the former GSM guard bands together with new allocations in the 2.3 and 3.6GHz bands as a potential lightly-licensed industrial and enterprise service. Ovum is further aware of similar projects in Sweden and the Netherlands.

If these allocations happen in their current form, they will make it possible for enterprises to use licensed spectrum very directly, without even relying on an infrastructure like that of the US's Citizens' Broadband Radio Service (CBRS – discussed below). Importantly, this provides for very small deployments right down to single base stations. In effect, the geographical limit of the license is the size of the building. It's worth noting that access for SMEs is explicitly a goal of both the German

and UK projects. If CSPs are involved at all, it will be through managing enterprises' on-premises radio networks for them, providing radio network design, day-to-day operational support, and perhaps leasing the equipment.

APAC REMAINS CARRIER-CENTRIC

The spectrum position in Asia-Pacific is very different. Given the large share of global industrial CAPEX and growth this region accounts for, we should logically expect the industrial IoT future to play out here first. So far, only Hong Kong and Australia are considering carving out spectrum for the enterprise. At the same time, a lot of effort is going into enterprise 5G and LTE trials. The two factors – heavy investment in 5G (especially its enterprise and industrial applications), and a carrier-centric spectrum policy – suggest that regulators here are either deliberately trying to create a carrier-centric IIoT business model, or don't mind if one emerges.

In this case, the CSP role is likely to be more important than anywhere else. CSPs will need to either create a substantial enterprise function if they didn't have one, or else partner with someone capable of creating complete solutions for enterprises. Alternatively, they could delegate or lease spectrum to customers or channel partners, moving in the direction of a European spectrum model.

The whole concept of 5G for industry is predicated on giving the customer more control of true mobile connectivity. The question in the carrier-centric business model is whether the CSPs - not organizations known for their flexibility - can provide their customers with this degree of control.

CBRS – THE US'S COMPROMISE SOLUTION

CBRS itself was first out of the blocks back in 2015, but as the name ("Citizens' Broadband Radio Service") suggests, it was originally seen as a way of providing community broadband. The decision to make the 3.5GHz band available in very small geographical areas – originally, US census tracts – and with permissive licensing, essentially optimized it for non-traditional users, especially enterprises and campus networks. Industrial companies, led by GE, were particularly interested in the possibility of broadband cellular that could be set up almost as easily as WiFi.

However, it took time to get the spectrum database service that underlies CBRS up and running, and in the meantime, the 3.5GHz band emerged as the closest to a globally harmonized 5G band there is. As a result, US telcos became increasingly interested in the band as an addition to their general-purpose spectrum portfolios, pushing the FCC to reallocate it into bigger geographies. Eventually, they compromised on the 3,200 US counties as the basic units of allocation for the specially protected Priority Access element of CBRS, which guarantees access to the same specific frequency range.

This sets a fairly big industrial plant, port, or airport as the minimum unit size unless multiple enterprises share a common infrastructure, whether owned jointly, by a local government, or indeed by a service provider. As such, CBRS is turning out to be a compromise between the European pure enterprise spectrum model and the Asia-Pacific pure carrier one.

That said, the county vs. tract issue can be overstated. By default, 80MHz of General Authorized Access (GAA) spectrum - a subset of the CBRS spectrum segment - should be available everywhere in the U.S., with the proviso that users have to consult the database to find an open channel and may have to change frequency in some circumstances. And as Ruckus Wireless representatives said to us at MWC, unlike the Priority Access CBRS spectrum, GAA spectrum is free.

OUTLOOK AND RECOMMENDATIONS

This year's MWC was marked by a surge of enthusiasm for LoRaWAN on one hand, and industrial LTE and 5G on the other. We believe that the demand for IIoT is solid, and the availability of spectrum – through the new assignments in Europe and through the CBRS infrastructure coming on line in the US – will precipitate real deployments. Carriers need to understand that enterprises interested in using the IIoT to transform their businesses want precisely the freedom to innovate that LoRaWAN's unlicensed nature gives them. Both the European direct spectrum assignment approach and the U.S.'s CBRS sharing model provide for this. The question for the two Western models is whether enterprises can really take advantage of them without specialist support, and whether CSPs can position themselves to provide that support, especially in the midmarket and below.

The question for the APAC carrier-centric model is whether CSPs can provide the innovation and flexibility needed to drive IIoT take-up through their internal structures and market-facing offers; or more likely, whether they can (and are willing to) delegate a high degree of control to their customers. Enabling high levels of customer control and flexibility when it comes to spectrum and infrastructure is not historically a carrier strong point, and our view is that this type of regulatory approach may hamper IIoT and 5G innovation.

SERVICE PROVIDERS' INNOVATIVE IOT PARTNERSHIPS CAN ENHANCE AND EVEN SAVE LIVES

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SUMMARY

Amid the enormous number of IoT initiatives being trialed and deployed in the market, it's hugely encouraging to see some service providers launch IoT services that address real life issues to create social benefit. Two examples of this are AT&T's network-connected device for prosthetics, and SK Telecom's installation of earthquake-detecting sensors on the telco's radio station clusters. In both cases, the service providers are working with a key partner to deploy and deliver the IoT service, maximizing their ability to understand and address the problem effectively while leveraging their own technology and infrastructure.

IDENTIFY REAL-WORLD PROBLEMS AND USE EXISTING TECHNOLOGY TO ADDRESS THEM

SK Telecom's earthquake sensor initiative is a great example of a telco identifying how it can bring tangible benefits to critical real-life situations that impact safety and livelihoods. The sensors, which are the size of a smartphone, are being deployed to detect the intensity of seismic waves and earth shaking, and gravity load, in order to communicate warnings and collect data in real time. SKT is working with the Korea Meteorological Administration (KMA) on the initiative, which launched in August 2018. SKT's end-to-end approach covers the sensors themselves, installation, and analytics initiatives to ensure data from the sensors can bring additional new value to KMA. At the initial stage of installation, SK Telecom's earthquake-detecting sensors have been deployed at 300 radio stations in earthquake-

> "To succeed in IoT, service providers need to find partners that can help them address real-world opportunities and challenges, while leveraging their own telco expertise."

prone cities, with plans to expand the number of locations to more than 8,000 base stations by 2020.

South Korea was hit by over 200 earthquakes last year, including a major quake in the city of Pohang in late 2017 which may have been linked to fracking activity. Worker safety as well as protection of key infrastructure in case of earthquakes is thus becoming a critical area of interest, and the sensor project can help to ensure timely evacuations as well as providing ongoing data that may help meterologists to better understand earthquake causes and predict future quakes.

Meanwhile, AT&T has been working with orthotic and prosthetic services provider Hanger to develop a proof of concept for what they claim is the industry's first standalone, network-connected device for prosthetic limbs. The prototype designed by AT&T and Hanger attaches to below-the-knee prostheses and syncs directly to the cloud via AT&T's network without relying on Wi-Fi, Bluetooth, or a separate mobile device. The prototype is designed to collect data on prosthetic use and mobility in near real time. The device combines an accelerometer, gyroscope, magnetometer, and LTE-M modem, and users interact with it through a mobile app.

The initiative was developed at one of AT&T's Foundry innovation centers, which are based in six countries. The Foundries are a key element of AT&T's IoT strategy, offering a ready-made technology testbed for working with IoT partners.

PARTNER WITH EXPERTS TO MAXIMIZE CHANCES OF SUCCESS

By partnering with experts in relevant areas, both SKT and AT&T (and other service providers that have adopted similar approaches) have demonstrated best practice in the realm of IoT: address real-world opportunities and challenges, partner with relevant experts to leverage telco expertise, and identify where the service provider can most effectively play a value-creating role in the value chain.

In AT&T's case, it provides connectivity and jointly-developed technology to allow Hanger Clinic, the patient care subsidiary of Hanger, to receive data on patients' prosthetic use beyond the clinical setting. Using these insights, Hanger Clinic clinicians can contact patients to address potential issues impacting prosthesis use.

Meanwhile, SKT's end-to-end approach leverages its own national infrastructure to physically 'host' the sensors. Data collected from the sensors on SKT's base stations will be combined with the national weather and disaster service's archive data for earthquake forecasts and analysis. SK Telecom will use its IoT networks to deliver KMA's early-warning service. SKT's earthquake sensor initiative shows how telcos can maximize their expertise around mobile technology for the benefit of a specific partner as well as for broader social benefit.

Table 2 highlights other recent service provider-partner IoT initiatives with clear social and/or sustainability benefits.

TABLE 2: SELECTED CSP IOT INITIATIVES WITH PARTNERS 4Q 2018

COMPANY	COUNTRY	APPLICATION	DESCRIPTION
AIS	Thailand	Tracking	AIS, in partnership with HIP Global and the Metropolitan Police Division 1, launched an NB-IoT Motor Tracker to track and provide data on police motorcycles.
SK Telekom	South Korea	Smart agriculture	SK Telecom, in partnership with Semtech, launched LiveCare, a cattle health care service.
SK Telekom	South Korea	Smart city	SK Telecom, in partnership with QVOSS, installed a network of new smart city kiosks based on Zytronic's touch sensors. The kiosks are part of the disaster management infrastructure.
SmartLife	Switzerland	Healthcare/Smart home	SmartLife Care launched Allegra, a voice activated emergency call device. SmartLife Care is a joint venture of Helvetia and Swisscom.
Telefonica	El Salvador	Smart agriculture	Telefonica, in partnership with the UN Food and Agriculture Organization, launched smart agriculture pilots in September. Crops include cucumber, bell peppers, papaya and tomato. This will be followed by two cotton projects in Peru, a potato project in Colombia and projects to cultivate avocado and plantain.
Touch	Lebanon	Corporate responsibility	Touch partnered with Fabricaid to collect second-hand clothes for underprivileged people through smart bins. The smart bins don't require electricity and help Fabricaid to know the location of bin and level of clothes.
Vodafone	Qatar	Fleet management	Vodafone Qatar introduced a smart bus system including video-surveillance and fleet management for disabled people at Shafallah Center.
Vodafone	Spain	Smart water	Vodafone is implementing an NB-IoT water monitoring project to provide information on water consumption in the city of Gandia (Valencia), with partner Global Omnium.

Source: Ovum

OUTLOOK AND RECOMMENDATIONS

IoT is already being used by service providers and their partners to develop services that are bringing tangible benefits to people's daily lives. Although the industry is rightly focused on "generating revenues from IoT", assessing the possibilities of IoT services doesn't have to begin and end with how much money they make, nor how many users they might sign up. Service providers can't be expected to offer loss-making services. But the AT&T and SKT examples demonstrate that when service providers start to develop an IoT proposition by identifying real-life problems, the usefulness and value of the service is all-but guaranteed. This contrasts with approaches that offer "solutions" to problems that don't really exist for consumers or society, or approaches that struggle to offer meaningful and tangible benefit that justifies the initial outlay. Service providers that take the lead in establishing partnerships for such initiatives will also have the opportunity to leverage the lessons learned, as they continue to develop more commercially-focused IoT propositions.

"Enterprise buyers want to influence supplier roadmaps, and alternative IoT service providers tend to be more flexible than MNOs in accommodating customer requests in a timely manner."

IOT-MVNOS CONTINUE TO GROW, BUT REMAIN NICHE PLAYERS

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SUMMARY

Until recently, enterprises wanting to deploy IoT solutions had few options in terms of IoT service providers. The cellular IoT market is, in global terms, dominated by a few players: these are usually infrastructure-based mobile network operators (MNOs) such as Vodafone, China Mobile and AT&T. But Ovum is seeing the emergence of alternative international IoT connectivity suppliers that do not own mobile spectrum or related network infrastructure, but instead source connectivity directly from mobile operators using a combination of mobile virtual network operators (MVNO) and international roaming agreements, aiming to build an end-to-end IoT proposition.

Ovum's report, Market Landscape: Alternative IoT Network Operators, examines how players such as Tata Communications, Cubic Telecom, Transatel (recently acquired by NTT Communications), Twilio, Aeris, BICS, Sierra Wireless, Telit, Truphone and others are establishing themselves as credible players in cooperation with traditional MNOs, but are often competing with them as well. These players, while relatively small compared to their infrastructure-based competitors, continue to grow market share (see Figure 8). They often use eSIM technology, together with multiple wholesale connectivity agreements or vertical specific solutions, in order to differentiate from MNO IoT offerings.

## ALTERNATIVE IOT PROVIDERS HOLD SMALL BUT GROWING MARKET SHARE

Most alternative (MVNO) IoT operators started life as IoT technology providers, a typical path being a platform or hardware provider that has moved into the connectivity space. Many have experience as MVNEs (Mobile Virtual Network Enablers) and are used to running platforms both for other MVNOs and for their direct customers. This means that although the IoT MVNOs are reliant on connectivity as the core of their solution, they are often less commercially focused on direct monetization of the connectivity and, as such, less concerned when it comes to commoditizing that element of the solution.

There is a demand-side explanation for the growing market share of these players. In many instances, enterprise buyers want to have more influence on the roadmap of their suppliers, and alternative IoT providers tend to be more flexible than MNOs in accommodating requests in the timely manner that is requested by enterprises. MVNOs are typically more receptive to ad hoc requests too. For instance, an enterprise automotive buyer might want to have a stronger say on who is designing user interfaces and experiences for in-car entertainment: in such scenarios, MVNOs tend to be more malleable than MNOs are, mainly because they have very little interest in promoting their brands to the end user the way MNOs do.

Connectivity is a central, yet commoditized element of an IoT offering. The commoditization of connectivity has allowed companies whose strength is in producing devices, for instance, to package their modules with some embedded and managed connectivity offering.

FIGURE 8: MVNO SHARE OF CELLULAR IOT CONNECTIONS, 2014-2017
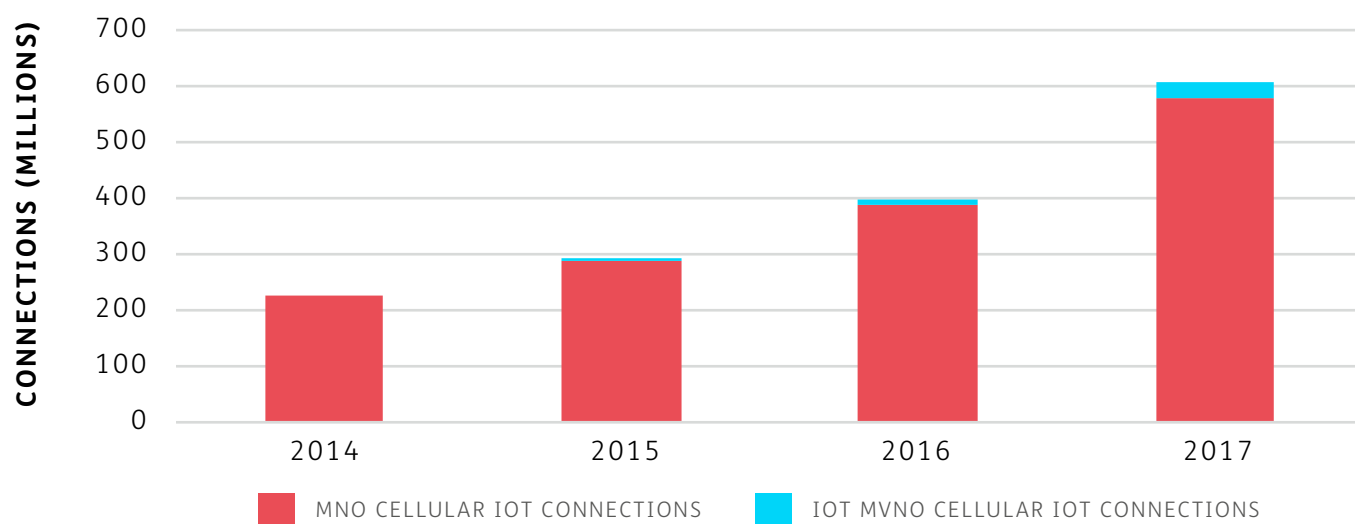
Source: Ovum

EUICC (ESIM) SUPPORT HELPS ALTERNATIVE IOT OPERATORS TO WIN DEALS

Connectivity management plays a critical role in the IoT connectivity market, mainly because it helps resolve some real practical and commercial hurdles of building an IoT-reliant business. As an example, the automotive sector now tends to work only with companies supporting GSMA specification for remote SIM provisioning for IoT.

From a practical point of view, international supply chains of (potentially) connected IoT devices require flexible options for connectivity. IoT devices are produced and assembled in a specific location - often China - but most commonly will be activated for the first time in a different country. And during its lifetime, the device may be moved to several different countries.

An effective way of managing connectivity and minimizing the level of manual intervention needed in this scenario is the adoption of eUICC (eSIM) technology for remote provisioning, which removes the need to access the device and physically change the SIM card. Commercially, eUICC and other technologies supporting remote provisioning of SIM management, including vSIM (virtual SIM) - and to a lesser extent, multi-IMSI - are valued by enterprise buyers because these technologies can be used to avoid vendor/MNO lock-in. Connected IoT devices can have a lifetime spanning up to ten years, which can exceed the length of the contract signed with an MNO for IoT connectivity. Using eUICC can help enterprise buyers retain negotiation power at contract renewal.

OUTLOOK

In future, the cellular IoT market will see a proliferation of alternative operators. Inevitably there will be new players, and some of the existing ones will grow in scope (in terms of geography and capabilities) and size, but there will also be casualties and M&A, as the growing market is highly competitive, attracting interest from virtually every player in the mobile ecosystem.

As access options for IoT services increase, market dynamics linked to diversifying technology options will also come into play. Licensed spectrum access network options such as 5G, NB-IoT, and LTE-M will strengthen the position of MNOs, as they hold the gates to these networks. But other unlicensed spectrum options, such as LoRA and SigFox, can play in favor of alternative operators. It is worth mentioning that connectivity options for IoT also include fixed and satellite connectivity, as well as short range technologies such as WiFi, Bluetooth, Zigbee and Z-wave – technologies that are accessible to virtually everyone.

RECOMMENDATIONS FOR MNOS AND IOT-MVNOS

- **Positioning: Friend or foe for MNOs?** From an MNO perspective, the business rationale for working with alternative IoT operators is the same as that of a traditional MVNO relationship. Alternative IoT operators will either work with MNOs and complement their IoT offering, or fight for mobile access – once the latter is secured, they become direct competitors. There is a lack of regulatory support for alternative operators, as mobile wholesale IoT access is rarely mandated for MNOs, while commercial terms for IoT MVNO access are individually negotiated between MNOs and each IoT MVNO. MNOs should be wary of very specialized IoT MVNOs if they compete directly for high-ARPU vertical-specific customers, for instance in the telematics or automotive space. But on the whole most IoT MVNOs have connectivity at the core of their offer, and therefore should be

seen by MNOs more as a potential additional wholesale revenue source. It's worth noting that at this stage we are not generally seeing LPWA being made available at the wholesale level; instead MNOs are choosing to retain this for their own commercial offerings. Similarly, we don't expect to see 5G wholesale offers within the next five years.

- **IoT MVNOs must differentiate and become vertical-specific.** Alternative IoT operators must find more differentiating elements, as their offerings too often mirror those of MNOs. Positioning on nimbleness and commercial flexibility as the sole USP is a risk for MVNOs, because MNOs are becoming more agile and flexible themselves, especially when it comes to capturing IoT revenue. Alternative IoT operators must identify vertical-specific opportunities and become more specialized, or risk being squeezed between telco-scale and web-scale operators as the IoT connectivity business commoditizes.

- **IoT MVNOs should move beyond 'just connectivity'.** Alternative IoT operators must develop the ability to manage the ecosystem by developing SI and professional service capabilities, if they truly intend to offer end-to-end IoT solutions. Connectivity continues to be commoditized and margins will come under pressure, especially when the business case requires the alternative operator to buy airtime wholesale. This will make it less attractive to be a connectivity-only IoT player, in the long term.

SYSTEMS INTEGRATION IS THE KEY TO SUCCESSFUL IOT STRATEGIES

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"SIs have to move their IoT value propositions beyond simply being able to knit together enterprise systems."

SUMMARY

Investments in IoT aim to improve customer engagement, develop new products and services, monetize existing assets, and improve operational and process efficiencies and service delivery by leveraging data. However, the full benefits can only be reaped when this data is integrated with enterprise applications, allowing for better and more meaningful analysis that can guide decision making. Systems integrators (SIs) play a crucial role in enabling the integration of data, applications and analytics through which enterprises can reap the optimum benefits of their IoT investments.

ENABLING INTEROPERABILITY IS KEY FOR DERIVING VALUE FROM IOT

Businesses are introducing a new wave of products that are IoT-compatible, and work on newer platforms requiring a more flexible IT architecture. However, older versions of these products already exist in the market, and often have generated a good deal of data from on-board, non-connected sensors that can be used to guide future product development. In many cases, these older models are incompatible with newer systems and architecture and are retrofitted with technology to enable interoperability that will allow data to be retrieved – like the dongles used by auto-makers to collect data from older-model vehicles. This is where an SI can be invaluable, bringing in the technical know-how to integrate data from old and new systems, modernize legacy IT architectures, add

in a layer of analytics to extract actionable information from the data, and ensure that all existing and future systems run smoothly.

Major challenges that enterprises face in IoT projects include accelerating the adoption and usage of IoT technologies, quickly converting them into incremental revenue streams, and ensuring the security of the data being collected via connected devices. Enterprises also have to deal with the complexity of implementing, integrating and maintaining newer technologies with existing legacy systems, and need all the help they can get to ensure their IoT investments deliver adequate returns. An SI can bring in the expertise for managing complex integrations, stitching together the different elements needed to ensure interoperability.

The opportunity for SIs to help address these challenges is reflected in the fast-growing volume of SI business being generated by IoT services. Ovum's IT Services Contracts Analytics database shows that the number of IT services deals with an IoT component in the requirements has doubled each year since 2014 (see Figure 9). Though this growth is from a low base and is still just a fraction of the deal volume in IT outsourcing, its accelerating rate is pushing SIs to make significant investments in developing a portfolio of IoT related offerings.

FIGURE 9: IOT REQUIREMENT IN IT SERVICES CONTRACTS

SHARE OF IT SERVICE DEALS AND VALUES THAT INCLUDE IOT

Source: Ovum
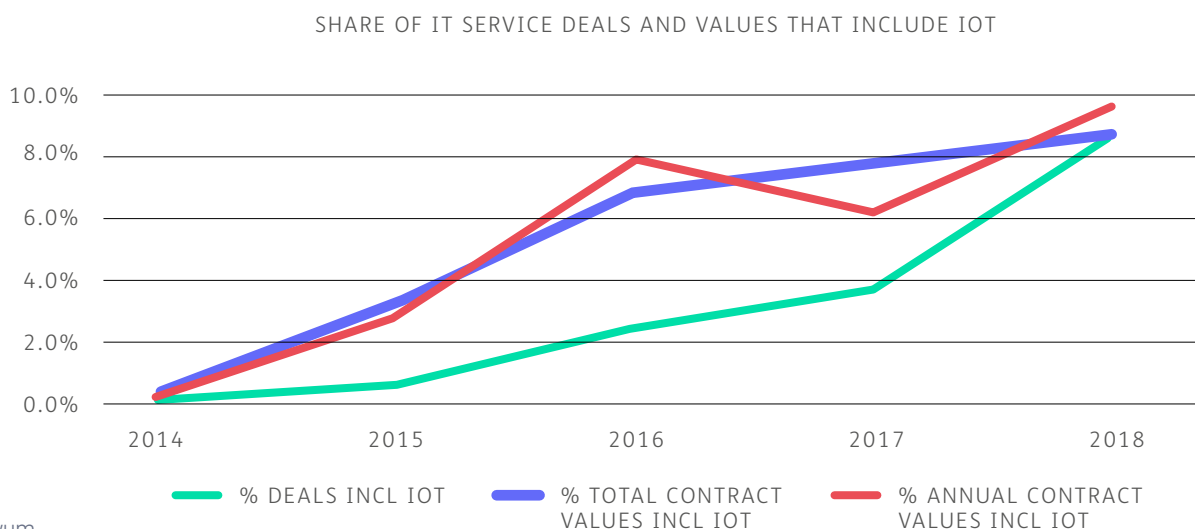
SUCCESSFUL IOT IMPLEMENTATIONS MUST ADDRESS SEVERAL CHALLENGES

Despite the hype and glamour of consumer IoT devices such as self-driving cars, wearable fitness monitors and home automation systems, most enterprise IoT investments continue to be in the B2B space. Companies like Pitney Bowes, Schneider Electric, and Toyota are investing in IoT as a means to deliver better services, save on costs, and explore new service-oriented business models. Only the tip of the IoT iceberg has been explored, and the vast majority of the data being captured by connected devices still remains in silos, unexplored and unexploited. Netting maximum benefit from IoT implementations requires an understanding of which data from which systems need to be linked to unlock the real value in the mass of information being generated.

This requires addressing a set of issues, including interoperability and integration, concerns around data security and privacy, building in robust analytical capabilities and, naturally, lowering costs. Enterprises are increasingly expecting SI partners to take a leading role to implement these solutions due to their experience with legacy systems, their end-to-end solutions, and their knowledge of the IoT landscape and players. The SI's role is rapidly evolving to fill the gap between solution providers and targeted market

verticals as they understand enterprise pain points and issues, as well as specific applications and the business as a whole.

SIs are making significant investments in IoT offerings. Examples include HCL's DRYiCE automation platform, that has a component for IoT; Atos' Codex portfolio; Accenture's investments in IoT analytics; and the investments most of the large SIs are making in partnerships, innovation labs, and involvement in IoT thinktanks and associations.

SIS CAN HELP BRING TOGETHER MULTIPLE PARTS OF THE COMPLEX IOT ECOSYSTEM

IoT is an ecosystem play and multiple agencies are involved in any IoT implementation. These include chip and sensor makers (like Intel), original equipment manufacturers or OEMs (such as GE), network providers (such as Cisco), telecoms operators (such as Verizon), IoT platform providers (such as Amazon Web Services) and a plethora of solutions and services providers (such as IBM and Accenture) who offer the software and services to help enterprises incorporate IoT technologies

across their business. The role of the systems integrator gains prominence as they work extensively with all of these parties.

SIs also participate in many of the organizations and consortia established for building IoT standards, and have deep vertical and technology partnerships that can be leveraged across their offerings. For instance, IBM, Accenture, Infosys, HCL Technologies, Genpact, Tech Mahindra, Wipro, TCS, L&T Infotech, Dell, Deloitte are all members of the Industrial Internet Consortium (IIC) and work with other member companies – including telecom operators, chip makers, industrial equipment manufacturers, consumer electronics companies, technology start-ups, universities and think-tanks – to develop solutions for IoT applications in industry. There's also some evidence of a horizontal services blueprint emerging out of IoT-related activities. Using Ovum's SI contracts data, we have segmented the types of SI IoT-enabling services being sold and the leading SI players offering these services successfully, to arrive at the five pillars of horizontal IoT service activity shown in Table 3.

TABLE 3: SI SERVICE FOCUS IN THE IOT ECOSYSTEM – HORIZONTAL SERVICES AND LEADING PROVIDERS

	CONSULTING	DIGITAL BUSINESS TRANSFORMATION	HOSTING	MANAGED SERVICE	TECHNOLOGY PARTNER
PURPOSE	Dedicated to IoT projects	Platform design & build	IoT services or data resource management	IoT outsourcing	Emerging technology planning
FEATURES	Industrial IoT initiatives	Vendor systems management	Hybrid IT management incl. cloud	Customer systems management	Center of Excellence
ADVOCATES	CGI, Capgemini	Accenture, Cognizant, TCS	DXC Technology, IBM	Atos, Infosys	IBM, EY

Source: Ovum

OUTLOOK AND RECOMMENDATIONS

Dealing with the complexity of IoT systems and keeping pace with the speed of technology change is where the challenge lies for businesses, and SIs who can help enterprises address these will be in demand. This requires SIs to:

- **Stay abreast of the latest technology.** SIs must have the ability to identify IoT technologies which will have most impact on client enterprises, and sufficient vertical expertise to identify potential monetization opportunities. SI capabilities should ideally extend to cross-vertical integration of systems and data analytics, as that is where the real value of IoT resides. This is where memberships of of industry organizations can help, providing the SI with access to the latest technology, and introducing new technology partnerships and trial opportunities.

- **The traditional approach to systems integration needs rethinking.** SIs have to move their IoT value proposition beyond simply being able to knit together enterprise systems. Greater focus has to be given to building consulting capabilities that bring together IoT, vertical and business process expertise, to help clients devise a blueprint for strategic integration of IoT applications and data.

- **Build true differentiation in service and technology portfolios.** Most SIs currently attempt to differentiate offerings through combining vertical expertise with reusable frameworks, accelerators, and proprietary tools such as single-view dashboards for project management. Though these provide quick wins, they cannot offer the benefits that investments in large scale solutions and IP can bring; neither can they replace the requirement to build an understanding of cross-vertical applications of IoT investments. This can be a key differentiator.

- **Combine collective knowledge within the SI organization.** The SI needs to find a way to bring together its own vertical, mobility, analytics, user experience, digital marketing and traditional SI practices – along with their tools and frameworks – to deliver offerings that can be adapted to the IoT needs of the client enterprise.

CONNECTED CARS: TECHNOLOGY SHIFTS AND SERVICE GROWTH

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"2018 saw the tipping point – when over half of new cars sold have embedded connectivity – in the US, with Europe following in 2019 and China in 2020."

SUMMARY

The automotive sector is one of the vertical industries most impacted by IoT. Progress is being driven by interest and investment from a broad ecosystem of players including automotive OEMs, communications services providers, infrastructure and Internet players, insurers, rental and shared car services companies, and media and content giants. Governments and regulators are also key stakeholders, looking to the connected car's impact on sustainability, the environment and smart cities, as well as ensuring safety standards and protection of car and consumer data.

Ovum's recent connected car forecast predicts 29% annual growth in the number of connected passenger cars on the road globally, over 2017-2022. This includes both cars with embedded connectivity, and those with "aftermarket" connectivity (excluding smartphones) – primarily in the form of plug-in OBD-II connected dongles. Over this period, the market will see important shifts in regional take-up, cellular connectivity technologies, and service monetization opportunities.

ASIAN CONNECTED CAR MARKET TO OVERTAKE NORTH AMERICA

The connected light passenger vehicle market is growing rapidly, from a total of 115 million vehicles on the road worldwide at the end of 2018, to an expected 308 million by 2022 (see Figure 10). Growth is largely concentrated in three regions. North America is currently the largest region in terms of connected cars in operation, but will drop to second place by 2021. Asia (Oceania, East, and Southeast), where the bulk of growth will come from the Chinese market, will become the region with the largest number of connected cars from 2021. Western Europe will also see significant growth, due in part to the regulatory mandate for eCall services in passenger vehicles across the EU. These three regions together account for about 90% of the overall connected car market through 2022.

FIGURE 10: CONNECTED CARS IN OPERATION, BY REGION, 2016-2022
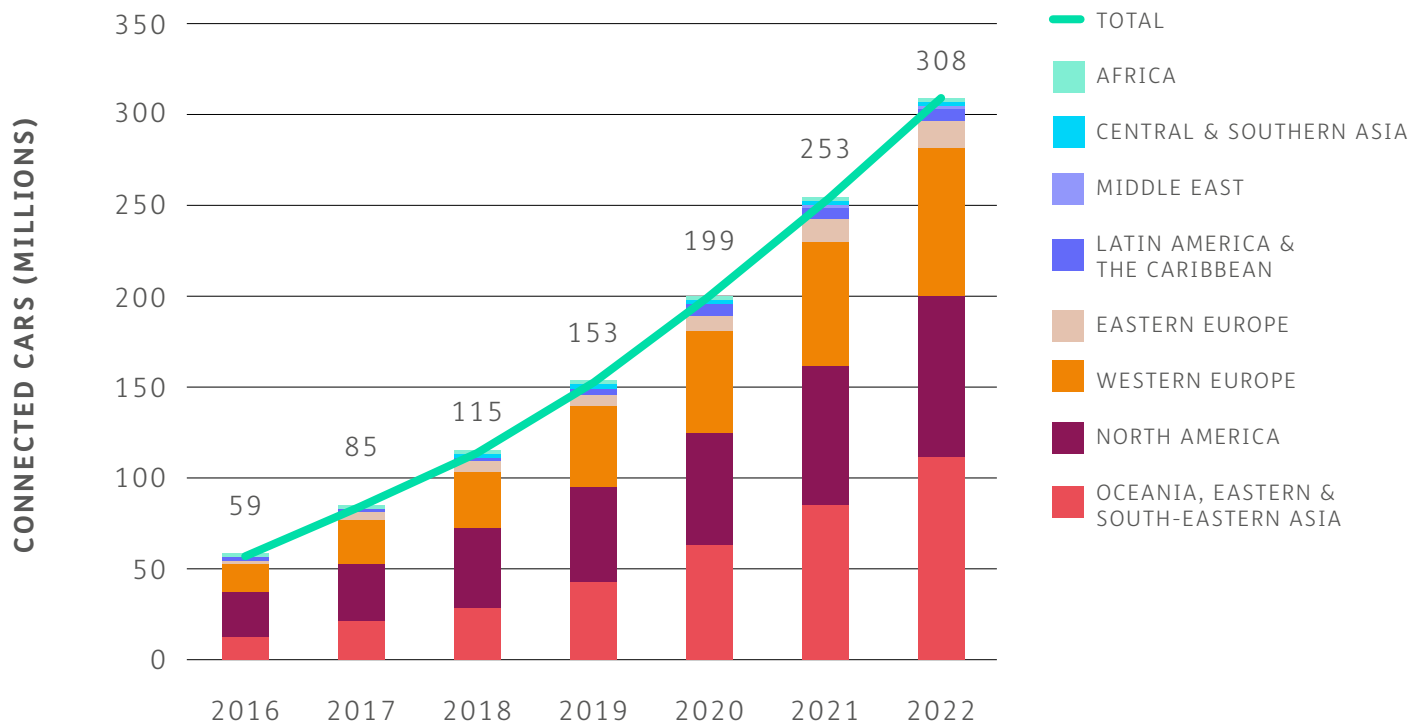
Source: Ovum IoT Forecast: Automotive 2017-2022

At country level, China will see by far the highest growth over the coming five years. China's share of connected cars on the road globally will grow from 15% in 2018 to 26% by 2022. A greater number of new cars will be purchased there relative to more developed markets, where much of the take-up will rely on replacement of older vehicles.
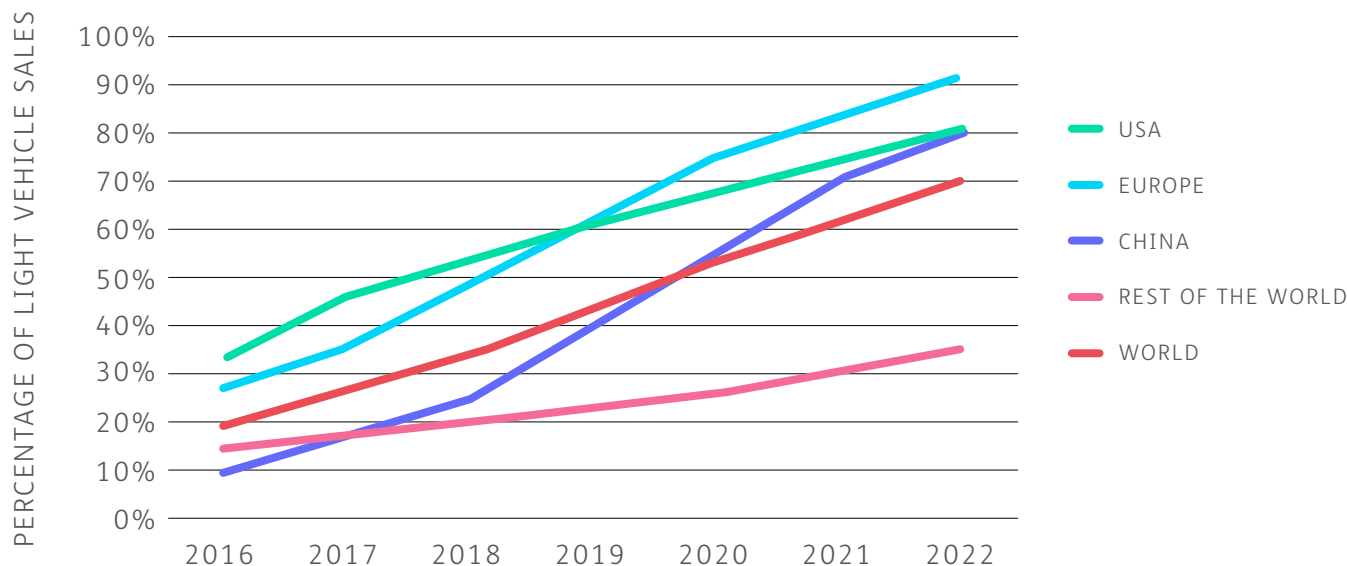
CONNECTED CAR TECHNOLOGY SHIFTS ON THE WAY

The balance between embedded car connectivity and aftermarket device-provisioned connectivity will shift toward embedded over the forecast period, although there will still be significant opportunities for aftermarket devices as providers look to address the large market of unconnected vehicles already on the road. Catalysts for growth in embedded connectivity include the growing prevalence of telematics platforms and connected navigation systems in new cars, regulatory mandates for driver safety features (e.g.,

eCall in the EU), and availability and take-up of discretionary consumer-facing connected features and services integrated with in-car platforms. Over the forecast period, electrification and elements of autonomous functionality will also become more common in new car models, driving up embedded vehicle connectivity penetration.

As shown in Figure 11, cars with embedded connectivity will account for a rapidly increasing share of new cars sold each year. 2018 saw the tipping point (when over half of new cars sold have embedded connectivity) in the US, with Europe following in 2019 and China in 2020. By 2022, 69% of new cars sold worldwide will have embedded connectivity. Developing markets will lag well behind the three market-leading geographies; however, much of developed Asia will show adoption rates similar to Europe and the US.

FIGURE 11: EMBEDDED CAR SALES AS % OF ANNUAL LIGHT VEHICLE SALES, MAJOR REGIONS, 2016-2022

Source: Ovum IoT Forecast: Automotive 2017-2022

As mobile networks evolve over the forecast period, embedded car connectivity will follow suit. The connected car market will not make the shift up to new cellular technology generations as quickly as the consumer smartphone market, because cars have a significantly longer life and the cost of replacing them is high. In addition to cost considerations, there is lag time before OEMs begin introducing new cellular technology into vehicles, and then for these vehicles to reach the market.

2G cellular still dominated connections in the connected car market through 2018. The technology is widely available, relatively inexpensive, reliable enough for most basic connected car services, and offers widespread global coverage. Ovum expects 2G to continue to support a significant number of connected car subscriptions through 2022; however, its share of the market will decrease. 4G/LTE will overtake 2G from 2019 and will account for 63% of all connected car subscriptions by 2022. Active 5G connected car subscriptions are only a minor factor in the market during the forecast timeframe, as networks will still be in the process of build-out and integrating 5G modules into OEM designs and new models will take several years. We expect significant growth in 5G for this market to start from 2023.

SERVICE REVENUES TO GROW BY SEVEN TIMES

Annual service revenue from connected car services (excluding revenue from smartphone-connected services consumed in the car) will jump by over 700% between 2017 and 2022, reaching nearly $29.5bn in 2022, excluding any content- or advertising-related revenue.

Ovum segments connected car services revenue into six segments: telematics platform, safety and security, Wi-Fi hotspot, premium consumer services (e.g., concierge, find-my-vehicle, etc.), connected navigation and routing services, and usage-based insurance services (UBI). Of these, telematics platform revenue is the largest ongoing stream of connected car service revenue, accounting for nearly half of service revenue in 2018, with this share dropping to 38% by 2022 as other types of services start to find traction. Services that are purely discretionary and/or easily substituted by smartphone-connected services are expected to generate lower revenue. For example, built-in Wi-Fi hotspot services, while they can be high-value, will be paid for by only a relatively small percentage of connected car owners in the period to 2022, and may only be used intermittently.

OUTLOOK AND RECOMMENDATIONS

Connected car growth will present important opportunities for CSPs and their OEM and vendor partners, given the requirement for mobile connectivity and the potential for revenue from platforms and applications. A clear understanding of where to play in the value chain and which service areas beyond connectivity are realistic opportunities for add-on revenue at scale are needed. To succeed, a proactive and open approach to partnering is a key requirement.

It is also important to cut through the hype around further-off opportunities like autonomous vehicles. While autonomous vehicles are the subject of both heavy investment and heavy media coverage, the reality is that mass market availability for Level 4 and Level 5 autonomous passenger vehicles is many years off. Regulation, safety concerns, the need for integration with road and built environments, and significant required shifts in OEMs and business models as well as consumer purchasing plans are all challenges for autonomy. The market for autonomous passenger vehicles will grow more slowly initially than that for other segments such as trucks or public transport. Ovum forecasts that growth in this market will begin picking up significantly in 2022, but the numbers over the short-to-medium term account for a tiny percentage of the overall connected car market.

SMART CITIES CONNECTIONS ARE GROWING RAPIDLY, BUT MONETIZATION REMAINS ELUSIVE

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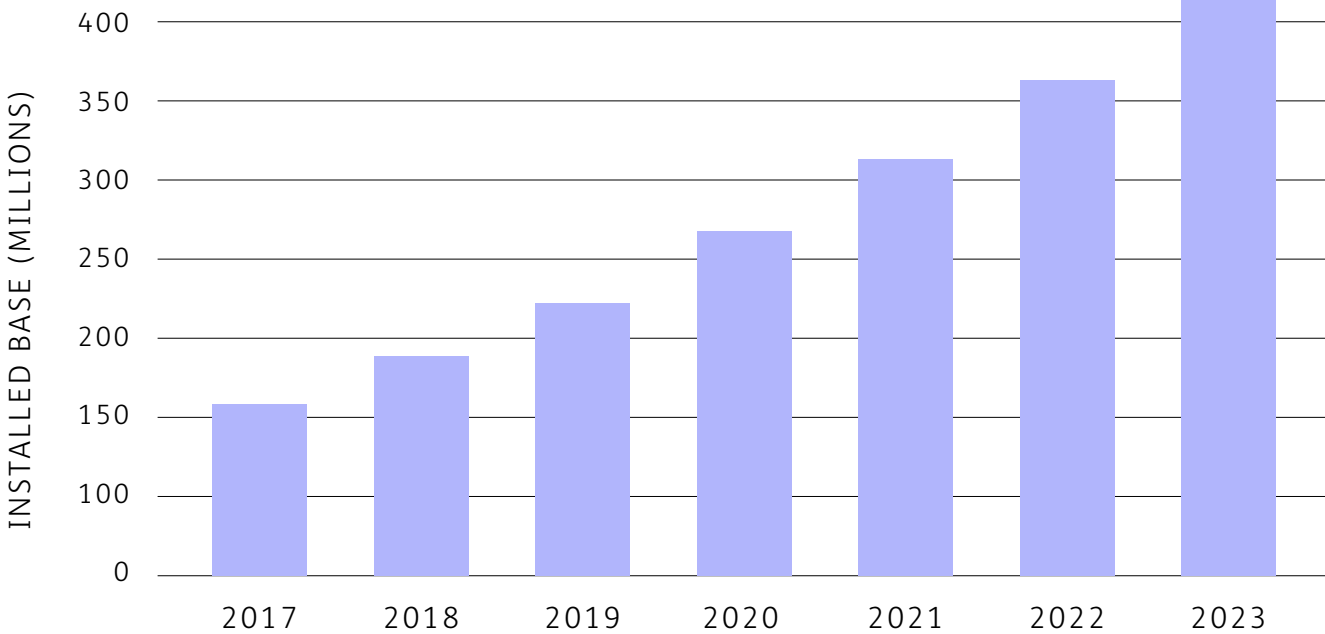
"With security and public order high on the agenda of most cities, public security and CCTVs are the largest contributors to the number of IoT devices in smart cities, accounting for 56% of connected smart cities devices in 2018."

SUMMARY

Smart cities are proving to be one of the strongest areas of interest for IoT deployments, driven by the need for cost savings, environmental protection, and improved citizens' lives. Ovum's ongoing research on smart cities shows significant growth in the number of IoT connections and devices in smart cities, with a handful of applications finding the most traction. Five key applications (public security, smart lighting, smart parking, traffic management and environmental and infrastructure monitoring) will account for over 80% of smart city connections by 2023. However, actually making money from this sector remains a challenge. To really profit from smart cities, CSPs will have to move beyond connectivity and provide additional services like data analytics, digital consulting, systems integration, and professional project management services.

FIGURE 12: INSTALLED BASE OF SMART CITIES DEVICES, 2017-2023

Source: Ovum forecasts

OVUM FORECASTS HIGH GROWTH FOR SMART CITIES DEVICES THROUGH 2023

Ovum's predicts that there will be 368 million connected smart cities devices by the end of 2023 (see Figure 12). These devices will use cellular, low power wide area networking (LPWAN), short-range or mesh technologies (such as RF-mesh, ZigBee, etc) or even wireline connections. Overall smart city devices will grow by 236% from 2017 to 2023, with a CAGR of 22%.

With security and public order high on the agenda of most cities in the developed world and China, and increasingly in developing countries, public security and CCTVs will remain the largest contributor to the number of smart cities IoT devices in smart cities. An estimated 56% of smart cities IoT devices fell into that category in 2018, and this proportion will remain relatively high - at 40% - even by 2023.

The applications which will see the highest growth rates for connected smart cities devices are smart parking and environmental and infrastructure management, which will have CAGRs of 55% and 49% respectively from 2017 to 2023. The business cases for both types of applications

will be significantly improved by the emergence of low power wide area networking (LPWAN) technologies, whose low cost will make it commercially viable to equip bins with fill sensors, parking slots with tarmac occupancy sensors, and bridges with vibration sensors.

Smart street lighting also continues to be a leading smart city application. The business case for moving to LED is a big driver for smart lighting, as adding the additional 'smart' element is a relatively small cost compared to the cost savings delivered by LED. While this application will see significant growth, smart lighting's contribution in terms of number of devices will remain at a relatively stable 10-12% of the total throughout the period.

Smart lighting is also a cornerstone for the development of other smart cities solutions. A connected street lightpole can enable many other smart city applications, by sharing its connectivity and power supply with other connected services (e.g., public WiFi, CCTVs, digital billboards).

NUMBER OF PUBLICLY ANNOUNCED DEPLOYMENTS
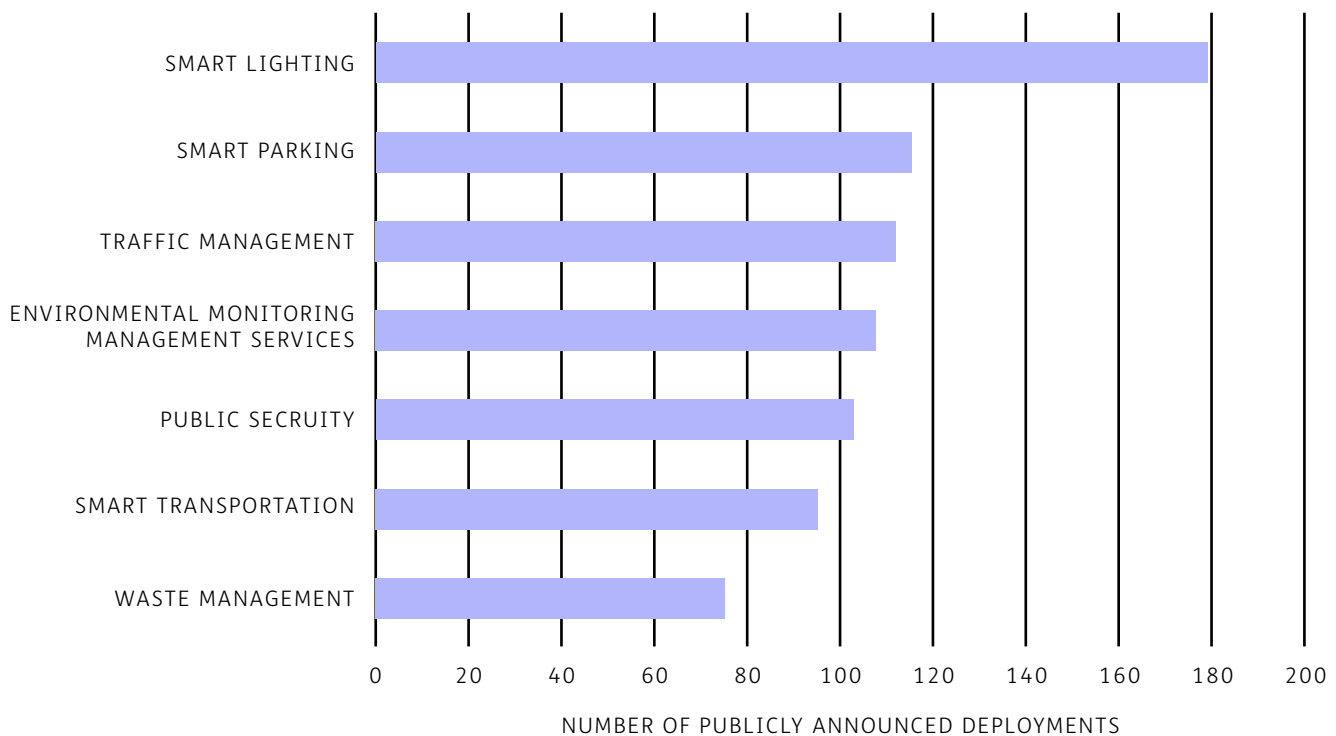
Source: Ovum Smart Cities IoT Projects Tracker: 3Q18

Lightpole locations also make them the ideal hosts for other sensors, e.g. smart parking or pollution sensors, if the light is sited near a road. Therefore, it is common to see a city first introducing street lighting and then following on with a range of other services, at reduced incremental cost and with reduced interruption. Many cities across the world have taken this approach; examples include Eindhoven (Netherlands), Madrid, Birmingham, Chicago, Atlanta, Adelaide, Jakarta, and Bloemfontein (South Africa).

CLEAR ROI, SUSTAINABILITY AND PUBLIC SAFETY NEEDS ARE DRIVING DEPLOYMENT

Funding for smart city IoT projects is often procured in a patchwork fashion, with pools of money from multiple grants, departments or schemes, rather than a single funding source. Business cases for projects funded by public money are often founded on cost savings, and therefore the return on investment must be clear and measurable.

This is reflected in the distribution of the top smart city application deployments globally, by project, based on Ovum's ongoing smart cities project tracker (see Figure 13).

It's no surprise that smart lighting continues to be the most popular service in terms of number of projects, with the potential for both cost savings from upgrading street lighting to LED, and additional revenue from or usage of smart light poles for a multitude of other services, maximizing RoI opportunities. For similar reasons, smart parking is the second largest category of smart city application deployments. It too has a clear business case: in most cities, citizens pay for parking, meaning there is an additional revenue stream beyond what can be obtained through public funding (indeed a number of private smart parking service providers have sprung up).

Traffic management and environmental management services are the third- and fourth-largest categories in terms of smart city deployments. When cities seek external funding for projects, this is often sourced via grants for environmental or sustainability projects. These may come from multi-country bodies such as the EU's Horizons 2020 project or the UN Environment program, or through smaller grants procured from federal or local government bodies. Cities are often able to access public funds for IoT projects that measure and ultimately reduce congestion, transport and fuel emissions, which in turn improves air quality and reduces health risks to citizens.

Lastly, public security applications are increasingly being given priority by cities, and have moved up into the top-five applications group in 2018. Advances in video and computer vision, combined with concerns about public safety and the willingness to use technology to both augment and fill gaps in police and first responder resources, mean that these applications are seeing healthy demand and should continue on a strong growth trajectory in future.

OUTLOOK AND RECOMMENDATIONS

Bearing in mind the wide range of smart cities applications being adopted, and the challenges of both obtaining funding and driving take-up, Ovum recommends that CSPs take a modular approach to building smart city solutions, allowing cities to deploy one application and then to build on that with further projects.

Those CSPs who aim to profit from smart cities will have to offer solutions beyond just connectivity. Ovum's report IoT Strategies: How CSPs Can Succeed in Smart Cities identifies five common success factors amongst operators we consider to be leaders in the smart city vertical. These are:

- **Organizational vertical support.** To succeed, CSPs need a dedicated smart city vertical team, with vertical-specific products and sales teams.
- **Clear GTM strategy.** A focused, clear and easily understandable go-to-market (GTM) strategy for the CSP's smart cities proposition (both technical and commercial).
- **Modular approach.** CSPs should look to develop a horizontal connectivity (and platform) play, layer on basic offerings around asset monitoring and tracking, and then add more customized solutions where the CSP has either developed its own applications or brought in specialist partners for key smart city use cases.
- **Investment.** CSPs need to commit not only to internal investment in their vertical capabilities, but ideally to further investment in the form of relevant acquisitions, shared smart cities project funding, and setting up of testbeds (e.g., 'living labs') in cities.
- **Offerings beyond connectivity.** Beyond basic smart cities applications, these may include data analytics, digital consulting and business case development, systems integration work and other professional project management services.

SMART HOME VENDORS SHOULD ENCOURAGE USER FEEDBACK, NOT FEAR IT

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Mariana covers the smart home market from a consumer perspective, engaging with the vendor and service provider smart home business models that are emerging.

"To stand out, smart home vendors need to face the music and assume a truly customer-centric market approach, enabling and encouraging users to share their experiences."

FEW SMART HOME VENDORS TRULY UNDERSTAND THEIR CUSTOMERS

There are many factors that contribute to the success of any business, and customer satisfaction is among the most important. Excellent customer experience is key not only for brand differentiation, but also for upselling and cross-selling. Conventional wisdom suggests that it is important to pay attention to what customers like and dislike, responding to their needs and improving whatever seems to be driving them away.

In the smart home industry, however, enabling users to provide feedback is still far from a widespread practice (Figure 14). Few smart home device vendors really know what their customers think about their brand, products and services. Nor are vendors making it easy for customers to directly share their feedback when something is not working as expected.

FIGURE 14: PERCENT OF SMART HOME DEVICE VENDORS PROVIDING USER FEEDBACK PLATFORMS

YES (PROVIDE)   NO (DO NOT PROVIDE)

74%

52%

26%

48%

PRODUCT RATINGS

USER COMMUNITY
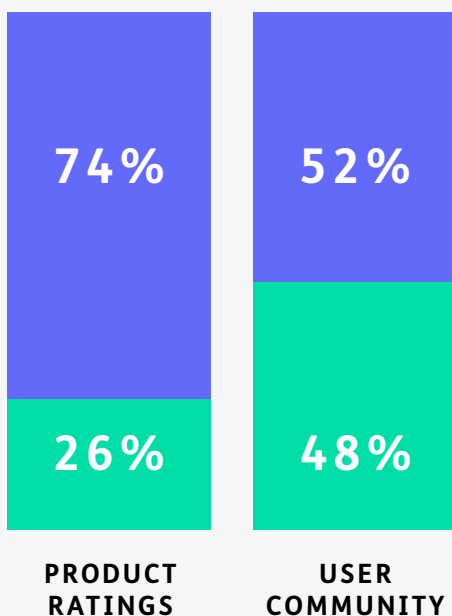
Source: Ovum's Smart Home Vendor Tracker: 2018 (n:23)

For example, a recent Yale mobile app blockage left many users in the UK unable to arm or disarm their smart locks and alarms for 24 hours. During this incident, many customers had to use social media not only to report the problem, but also to complain about the lack of proper communication mechanisms to inform users about the faulty app functionality and what was being done to fix it. This case illustrates that Yale - like many other vendors in the smart home space – is still not communicating effectively with customers, a situation that weakens the overall customer experience.

From a customer journey perspective, the fact that many vendors have not yet opened formal feedback channels for users to provide product reviews and ratings makes it harder for other potential customers to make informed decisions before buying smart home devices. For the smart home to go mainstream, consumers need to better understand how smart devices would fit into their lives and homes, before purchasing.

Trustworthy testimonials - even negative ones - are important for consumers to make informed purchase decisions, as well as helping vendors to drive product roadmaps. Understanding what can go wrong in a worst-case scenario is also the type of help users need from vendors. In addition, potential smart home device buyers are looking for more information on price, product functionality, portfolio breadth, post-sale support, etc. to make a final purchase decision.

Smart home vendors have been slightly more proactive with regard to setting up user communities and forums. For example, Samsung SmartThings and Arlo have established discussion forums for users to learn, explore and connect with other customers and experts. However, these platforms tend to focus more on providing product support and help, rather than offering customers an instrument to rate their experience. It is true that customers can share their experiences in these forums, but they do not ask the customer is to specifically rate the perceived quality of a product, or to rate different elements of their customer experience in using it.

OUTLOOK AND RECOMMENDATIONS

Why are so few vendors in the smart home industry keen on listening to the voice of the consumer? Ovum's view is that vendors are simply scared of negative reviews, and of public feedback that isn't good for business. Revealing details of what buyers really think is not desirable if there is a chance such feedback might not be glowing, especially in an increasingly crowded market where vendors are looking to build a good reputation and gain a competitive edge.

Ovum believes smart home device product ratings should not be demonized as a marketing tool. To stand out, smart home vendors need to face the music and assume a truly customer-centric market approach, enabling and encouraging users to share their experiences. This will require more vendors in the industry not only to initiate this practice, but also to make it easy for users to provide feedback. Streamlining the process to write reviews on smartphone apps and online should be the first step. Similarly, vendors need to explore alternative channels such as voice assistants to gather feedback. Voice ratings have the potential to reduce the friction of submitting product feedback and encourage users to interact more with vendors.

THE VISION IS GETTING CLEARER FOR SMART AUGMENTED REALITY GLASSES
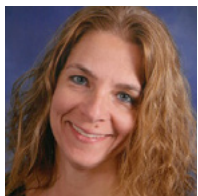
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"High-end and medium range mixed reality glasses are likely to be used in both enterprise and consumer settings. Lower-end assisted reality headsets with their glanceable interfaces are ideal for industrial usage, where full-screen augmented reality can be a distraction."

TRACTICA VIEW: AUGMENTED REALITY GLASSES SHOW A MARKET IN TRANSITION

The global market for smart augmented reality glasses is currently in transition, as the product moves away from a being a niche offering to becoming an enterprise problem solver. However, there have been growing pains, as some augmented reality headsets have not delivered on their promise. Some companies that have been in the industry for a while have exited, and smaller players are entering. Shipments remain low, but Tractica is seeing evidence that the market is moving out of the pilot stage towards a broader take-up scenario, albeit slowly at the moment. Tractica expects an inflection point to occur in the

2020-2021 timeframe. At that point, different parts of the ecosystem will start to come to maturity, a number of manufacturing barriers will be removed, and price points will come down to a more comfortable level.

ASSISTED REALITY VS. MIXED REALITY

Within the augmented reality glasses market, products typically fall under assisted reality or mixed reality (see Table 4). Assisted reality includes monocular and binocular glasses that layer digital information over a user's vision, like a screen, map, video, or images. The most common form factors for assisted reality are monocular lens attachments or binocular spectacles, and information is placed either on the corner of the user's vision or in front of the user. Assisted reality does not have the ability to track the user's viewpoint, also known as visual tracking, or provide depth sensing of objects or movement in the real world. Some assisted reality glasses have image recognition capabilities. They typically use a tethered pod to interact with the digital environment, and some support voice and head gestures.

TABLE 4: FEATURES OF ASSISTED REALITY VS. MIXED REALITY

FEATURES	ASSISTED REALITY	MIXED REALITY
Field of Vision	Corner of eye, glanceable	Center of vision; can be distracting for task at hand
Depth Sensing	No	Useful in certain applications like architecture and construction
Positional Tracking	No	Useful in certain applications like product design, training, architecture, and animation
Cost	$500 to $1,500	$2,300-$12,000
Ergonomics	Light and can be worn for long durations	Heavy – but improving – and ideal for short durations
Gestural Inputs	Does not support gestures in glasses; use of touchpads possible in some cases; voice supported	Supports hand and air tap gestures; voice supported

Source: Tractica

The market momentum for smart augmented reality glasses is shifting toward mixed reality headsets that offer a much more compelling user experience. This version of augmented reality feels more like virtual reality, where it is not just digital information that is layered on top of a user's vision. Rather, the glasses perform visual tracking and depth sensing of the real-world environment. These capabilities provide an enhanced immersive experience, as the holograms used to deliver visual information and context are stationary and are seen relative to the user's location and the surroundings, allowing them to walk around and experience their surroundings as real-world objects. Most mixed reality headsets support hand gestures to interact with the digital holograms. For example, using a mixed reality headset, the user can place a hologram object on top of a table in the real world.

There is space in the global market for both assisted and mixed reality devices, as each offers a different benefit proposition and entry point into the smart augmented reality glasses market. High-end and medium range mixed reality glasses are likely to be used in enterprise and consumer settings. Lower-end assisted reality headsets with their glanceable interfaces are ideal for industrial usage, where full-screen augmented reality can be a distraction.

BARRIERS ARE LIFTING, THANKS IN PART TO PARTNERSHIPS

Market adoption has been slow, but many of the challenges that smart augmented reality glasses have faced are starting to lift. Mass manufacturing and the infrastructure to support volume production are still in the early stages, but much further along than when Tractica first looked at this market two years ago. Technologies are also starting to mature. For example, waveguide technology is now widely accepted. Waveguides use a thin sheet of glass to guide light through multiple reflections, also known as total internal reflection (TIR). Technology options are expanding quickly and include diffractive, reflective, and holographic types.

Meanwhile, technology providers in this market have formed manufacturing partnerships that will allow lens manufacturers to scale more easily. For example, DigiLens is partnering with its investor Mitsubishi Chemicals to provide core materials

for its technology, while Young Optics is lined up for manufacturing. Likewise, smart glasses display manufacturer Lumus has a manufacturing partnership in place with components supplier Quanta. Providers are developing techniques during fabrication that will help lower costs, such as using printing versus etching in the process.

While some headsets still struggle with weight and comfort, form factors are quickly evolving to be lighter and more stylish. Soon, it might not be readily apparent if someone is wearing smart augmented reality glasses. The ecosystem to support these glasses is growing as developers create appealing content for consumers, as well as productivity enhancing software for the enterprise and industrial markets. In the enterprise space, companies such as Vuforia, Upskill, Scope AR, and Atheer are providing software that can be used with smart augmented reality glasses and headsets. For instance, Atheer AIR Enterprise is being leveraged by Toshiba's dynaEdge augmented reality glasses to offer workers capabilities such as step-by-step task flows and remote subject matter expert assistance.

COMPELLING BENEFITS OR PASSING FAD?

Smart augmented reality glasses will find their place in supporting a variety of interesting and practical use cases across many vertical markets, including consumer, enterprise, industrial, public safety, healthcare, and sports. Large companies such as Boeing, DHL, and Toyota are trialing the use of these devices, and those that have implemented pilot programs have reported productivity gains.

According to stakeholders Tractica has interviewed, an application known as remote assistance – where remote workers can collaborate hands-free and share what they are seeing with others

– is expected to be a bright spot in the market. Companies such as Rokid have been deploying glasses for this use case, and startups such as ThirdEye Gen have also been demonstrating it. Last year, General Electric's aviation group piloted using Vuzix's M300 smart glasses in conjunction with Vuzix Basics Video to link up field technicians with remote experts.

The software ecosystem supporting the healthcare use case for augmented reality glasses has also grown, and hospitals around the world are trialing the devices for a myriad of uses ranging from access to electronic health records to providing digital images and data during surgery. Meanwhile, universities are using them to train students. Consumer adoption of smart augmented reality glasses will start to take off when engaging immersive content is produced for these glasses, including mixed reality games and movies that blend virtual reality and augmented reality in living rooms and outdoor public spaces. Price points are falling to a more comfortable range for the general public, although they are still high – averaging around the cost of a mid-high range mobile phone.

While the smart augmented reality glasses market is in a state of transition, Tractica believes the global market will firm up over the next two-three years, and then show strong growth as manufacturing processes become optimized. Powerhouse consumer players such as Apple and Facebook are expected to enter the market and shake things up. While we do not expect smart glasses to replace smartphones any time soon, they are likely to become a significant feature of both the consumer and industrial technology markets over the medium term.

ROBOTICS IN THE ENTERPRISE MARKET: SOLVING PROBLEMS AND SAVING MONEY

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Aditya is a research director at Tractica, with a primary focus on artificial intelligence and robotics. He also covers blockchain and wearables as part of his research. Kaul has more than 12 years of experience in technology market research and consulting.

"Logistics robots will account for the largest proportion of enterprise robot shipments, with agriculture the next largest category. Together, these segments will account for over 95% of shipments through 2025."
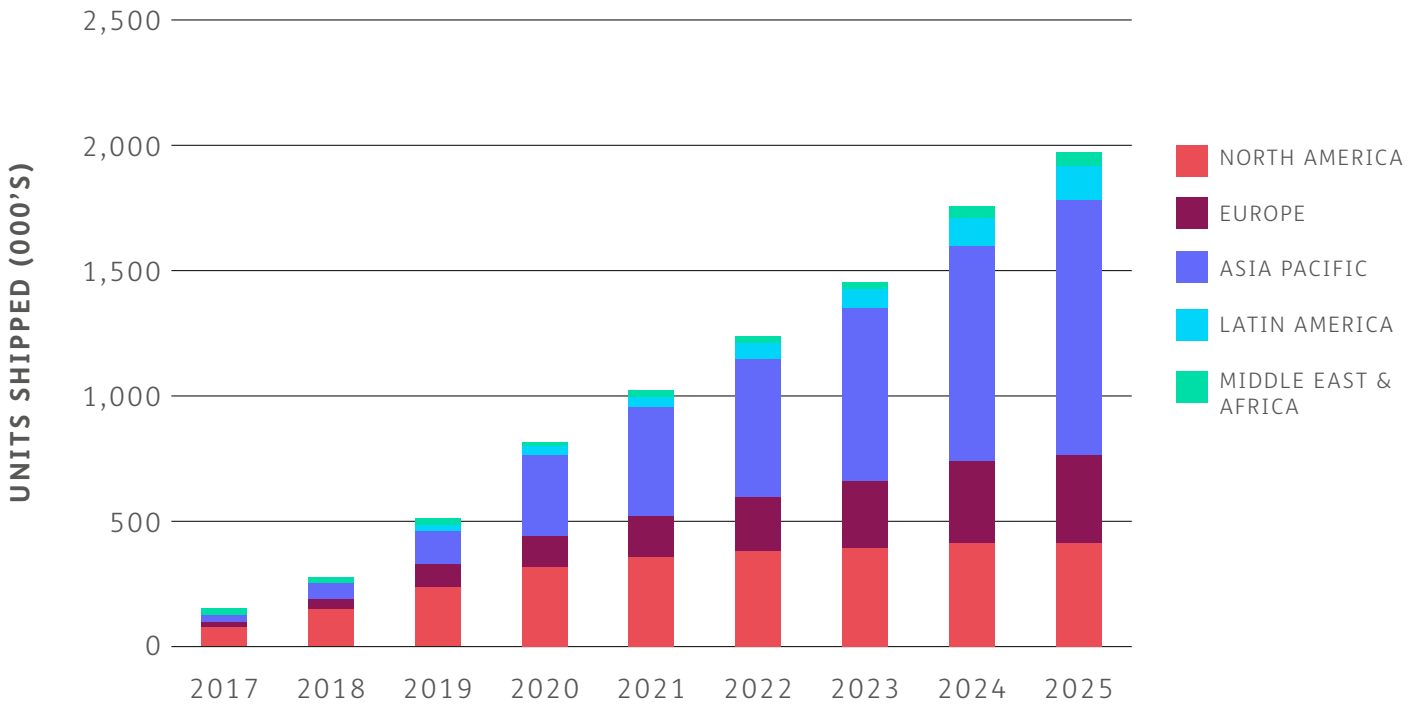
TRACTICA VIEW: ENTERPRISES ARE INVESTING IN ROBOTS

Enterprises around the world are looking to use robots to cut costs and increase profits, while trusting them to solve challenges and close productivity gaps caused by issues with human workforces. As robotics technologies have advanced significantly in the past few years, robots for global enterprise markets have become more affordable, productive, and smarter. The result is a significant increase in the number of enterprises within the agriculture, construction, warehousing and logistics, telepresence, customer service, and other sectors willing to invest in robots. The logistics and agriculture sectors will be the leading industries for robotics adoption through 2025.

Total enterprise robotics device revenue is expected to grow from $16 billion in 2018 to $121 billion by 2025. Annual unit shipments are forecast to increase from 275,000 units in 2018 to 1.96 million by 2025 (see figure 15). Overall unit shipments are projected to increase at a healthy compound annual growth rate (CAGR) of 38% between 2018 and 2025.

Source: Tractica

BREAKING IT DOWN: MARKET DYNAMICS AND SEGMENTS

Robotics is revolutionizing many aspects of work and changing how enterprises view their operations. Robot-led processes are affecting today's workplace as dramatically as the machines of the Industrial Revolution changed the factory floor. Stakeholders will need to seek out new operating models that fit with rapidly evolving robotics solutions, and encourage the growth of technically-viable robots with quick paybacks that can serve the needs of enterprises – even those with minimal robotics know-how.

Examples of enterprise robot applications that Tractica has identified as important in each sector include:

- **Agriculture:** Driverless tractors, unmanned aerial vehicles (UAVs), material management robots, field crops and forest management robots, soil management robots, dairy management robots, and animal management robots

- **Construction:** Bricklaying robots, demolition robots, and mobile drilling robots

- **Warehousing and logistics:** Mobile robot platforms, shuttle automated storage and retrieval systems, industrial robotic manipulators, and gantry robots

- **Telepresence:** Telecommuting robots, teleconferencing robots, tele-education robots, telemedicine robots, and remote monitoring robots

- **Customer service:** Humanoid robots and non-humanoid robots

- **Others:** Professional cleaning robots, rescue robots, underwater robots, inspection robots, etc.

THE CASE FOR IMPLEMENTATION: VERTICAL USE CASES

Key objectives for companies deploying enterprise robots are cutting costs and increasing profits. Demand for enterprise robots is largely being driven by end user industries which suffer from the lack of a skilled human workforce, complex repetitive and/or physically difficult job tasks, and the need to mitigate risk of accidents, while also seeking potential productivity gains.

The issue of labor shortages applies across a number of industry verticals. Both skilled and unskilled workers in the farming industry are aging or leaving the industry, and a huge gap exists between the demand for and supply of farm workers. The construction industry is heavily dependent on the available skilled workforce. Construction companies are struggling to find new skilled tradesmen such as carpenters, plumbers, and electricians. In the United States, private warehousing and storage centers desperately need to fill positions. All three of these vertical industries - agriculture, warehousing and logistics, and construction – may also have particularly hazardous working conditions. The deployment of robots could potentially prevent injuries or even save lives.

Productivity gains are also a general driver for robotics deployment; robotics has had a dramatic impact on manufacturing productivity, and could do the same in the construction sector. Until now, using robots in construction has been limited due to the inherently unpredictable and unstructured nature of construction projects. However, a few highly repetitive and predictable activities, such as tiling, bricklaying, concrete paving, demolition, and concrete recycling, have started to incorporate robots in order to accelerate onsite execution. Companies such as FastBrick Robotics and Construction Robotics are allowing construction companies to realize masonry productivity gains by using bricklaying robots. Construction Robotics has reported its end users see labor savings of more than 50%, while the productivity of masons has increased by three to five times.

In a fast-moving consumer-driven economy, the warehousing and logistics industries are looking for robotics solutions to remain globally competitive. The supply chain is growing, which demands more people. In addition to the growing labor shortage, warehouses are also suffering from a very high rate of turnover. Even with the availability of advanced automation today, most warehouses still rely heavily on people for picking and putting items away. In addition, as more companies compete for the available trained workforce, pressure on

wages is building – and has become a major supply chain risk. Demand for robots to optimize logistics processes will propel logistics robotics shipments from just under 200,000 units in 2018, to 1.14 million by 2025.

Another robotics development that will impact multiple industries is the telepresence robot. These robots usually take the form of remote-controlled, wheeled devices that are managed using wireless connectivity. In most cases, such robots use tablets for video and audio capabilities. Telepresence robots such as those offered by Suitable Technologies (Beam) or the startup Ava Robotics can save on employment costs, as well as potentially reducing the costs of travel and time for companies when used as workplace collaboration tools. With pricing ranging from $1,000 to $3,000, telepresence robots could prove a sensible option for mid-large sized companies.

Finally, customer service robots can be used to perform basic customer interactions that are repetitive and time-consuming for human employees. LG has experimented with putting service robots in airports, and Savioke has deplyed its robots in hotel locations such as Hotel EMC2 in Chicago.

FIGURE 16: ENTERPRISE ROBOTICS SHIPMENTS BY APPLICATION MARKET, WORLD MARKETS: 2017-2025
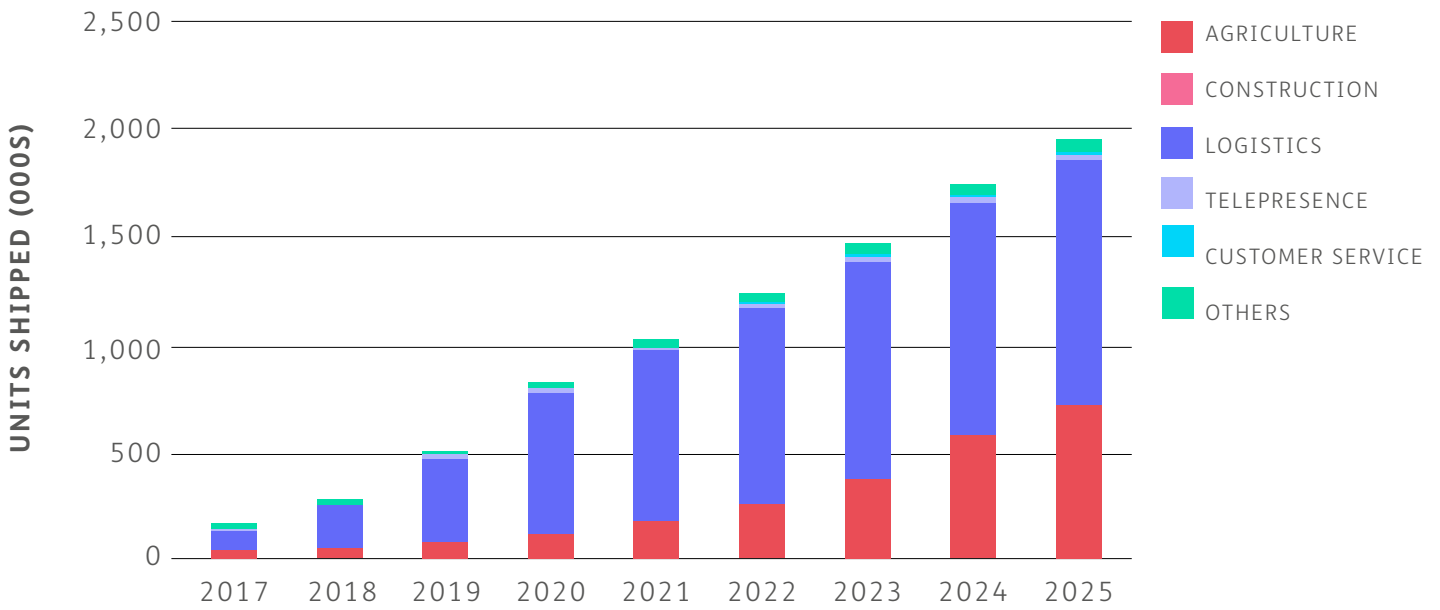
Source: Tractica

SEGMENTING BY APPLICATION

Figure 16 shows Tractica's forecast for enterprise robotics shipments by application type. Logistics robots are expected to account for the largest proportion of enterprise robot shipments, with agriculture anticipated to be the next largest category. Together, these segments will lead in terms of enterprise robotics shipments.

The big drive to robotize the warehousing and logistics sector has attracted the slow-to-move traditional logistics industries, as well as a completely new set of players triggered by the rapid growth of the consumer-based e-commerce economy. Both of these factors will continue to drive logistics robotics growth in the future. The agriculture sector is expected to experience a momentous shift in market demand, acceptance, and usage of robots for various agricultural applications, over the forecast period, significantly driving growth.

ENSURING AN OPTIMISTIC FUTURE FOR ENTERPRISE ROBOTICS

Tractica is optimistic about the future of enterprise robotics. China is embracing robotics with the same intensity that has made it a force in manufacturing and renewable energy. This will be an important driver for the overall global market as well as a factor in the leading position of the Asia Pacific market in the later part of the 2017-2025 forecast period. As the initial (or capital) and operational costs decrease, existing enterprise users will be able to invest in fleets of new robots, and more businesses will join the early adopters. However, non-cost barriers still exist in the market, including awareness and adoption, training of the human workforce, and infrastructure issues.

Currently, competition in the enterprise robotics market is limited, but Tractica expects to see new entrants over the forecast period. Potential enterprise robotics market entrants should focus on determining the real savings end customers can realize from 'robotizing', developing clear value propositions for end users, and building capabilities that align to the needs of their enterprise customers.

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For more details on Tractica's research and capabilities, please contact info@tractica.com.

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