OPPORTUNITIES IN THE IoT:

Evolving roles for mobile operators

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Executive Summary

The Internet of Things (IoT) is driving digital transformation and innovation across a range of use cases and sectors. The IoT is enabling organisations to dramatically increase productivity, cut costs, redesign and automate business processes, develop new business models, and fundamentally transform their business and industry.

Mobile operators play a major role in connecting IoT solutions, earning 11 per cent of total global IoT market revenues in 2016, according to GSMA Intelligence. However, GSMA Intelligence forecasts connectivity will decline to five per cent of IoT revenues in 2025. By building on their strong foundation of connecting devices, operators are looking to fulfil new roles providing additional sources of value in the wider IoT ecosystem.

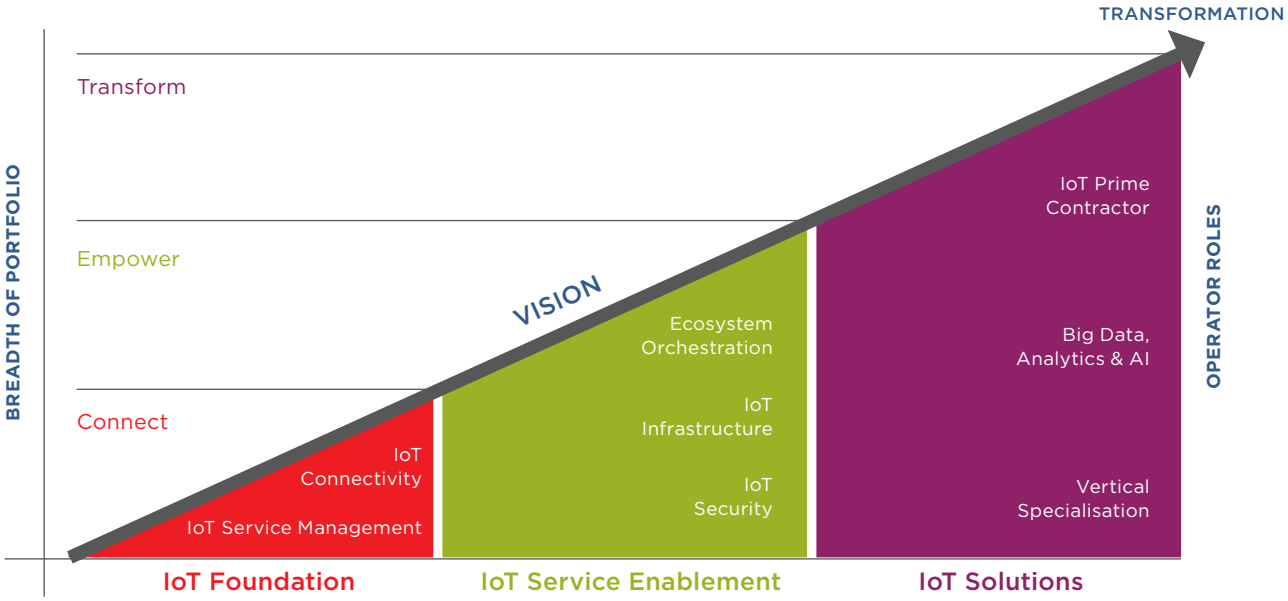
Operators are uniquely positioned to help build the global IoT market. They generally have a local presence, existing relationships, existing sales forces, field service engineers, and capabilities in managed services, solution design, outsourcing and other professional services. At a time when much of the IoT ecosystem is in flux, operators could create significant value.

But what roles should they or, indeed, can they claim in this rapidly evolving ecosystem?

Utilising existing research across mobile operators and wider ICT players, as well as in-depth interviews with operators around the world, IDC and the GSMA have identified a pathway for operators in the IoT encompassing three sets of roles:

- **Foundation IoT roles to CONNECT:** Including the provision of IoT connectivity and IoT service management. These roles support connecting devices and are therefore the bedrock of operator IoT services.
- **IoT service enabler roles to EMPOWER:** Including ecosystem orchestration, delivering IoT infrastructure (cloud and edge) and becoming an IoT security provider; these roles are about providing essential tools and capabilities to ecosystem partners and supporting monetisation and interoperability between IoT solutions.
- **IoT solution roles to TRANSFORM:** Such as becoming an IoT prime contractor, a big data analytics and artificial intelligence (AI) provider and delivering vertical specialisation capabilities; these roles cover end-to-end services where operators take the lead in transforming vertical industries and their customers' businesses.

THE PATHWAY FOR OPERATORS IN THE IOT



Each step in the pathway allows operators to serve customers in increasingly sophisticated ways and thus increase their value in the ecosystem. Some of the roles are already familiar to operators. For example, IoT connectivity is the starting point for mobile operators, and many operators already provide some cloud computing infrastructure or serve as prime contractors in IoT services. By contrast, other roles will be new for many operators, such as ecosystem orchestration and vertical specialisation.

Each role will bring a variety of benefits. They will generate direct revenues for services rendered, and many of the roles (such as ecosystem orchestration, serving as prime contractor, providing IoT security, and vertical specialisation) can expand the customer base by providing services to other IoT ecosystem members, improve competitive positioning and enable the operator to capture value across the entire value chain.

For each role, this paper outlines the opportunity for operators, the routes to market, the essential technology enablers required and examples of where operators are successfully pursuing these roles. It also outlines some of the key strategic considerations operators must address in defining and migrating to these roles.

This study demonstrates that a range of IoT opportunities are open to operators. They need to ensure they make a systematic and logical progression and build on their strengths to move along the value chain beyond connectivity and, sometimes, into vertical markets. Some roles may appear to be removed from the core capabilities and core business of many operators, but the IoT landscape is evolving, offering opportunities in many areas. Starting now with a clear vision is essential to long-term success.

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Introduction

The Internet of Things (IoT) is driving digital transformation and automation at businesses and organisations around the world. Along with other innovation accelerators, such as cloud computing, mobility, robotics and artificial intelligence, the IoT is enabling organisations to dramatically increase productivity, cut costs, redesign and automate business processes, introduce innovative new products and services, develop new lines of business, adopt new business models, and fundamentally transform their businesses and industries.

The IoT is already a very large industry accounting for significant global spending. In an IDC survey of European companies conducted in October 2017[1], 18 per cent claimed they already have full IoT deployments. However, the market is poised for tremendous growth. In the same survey, a further 19 per cent of companies said they were already working on pilot projects, while 20 per cent said they were planning to pilot IoT.

With many companies now in the pilot stage, the IoT market will take several more years to mature, with significant opportunities still to emerge. For example, some key enabling technologies are yet to reach scale or are in development, including 5G and its low power wide area (LPWA) components, edge computing, IoT software platforms, artificial intelligence, robotics, and many others. With the ecosystem evolving rapidly, many parts of the value chain are still lacking clear leaders and feature many companies that are still developing, testing and launching new products and business models.

As a result of this market immaturity, end-to-end solutions are commonly built on an ad-hoc basis, rather than tried-and-tested components, architectures and off-the-shelf solutions. Suppliers have not yet managed to productise and package most solutions. This results in high costs that can put IoT solutions out of the reach of many organisations.

[4] Source: IDC's European IoT Decision-Maker Survey, October 2017

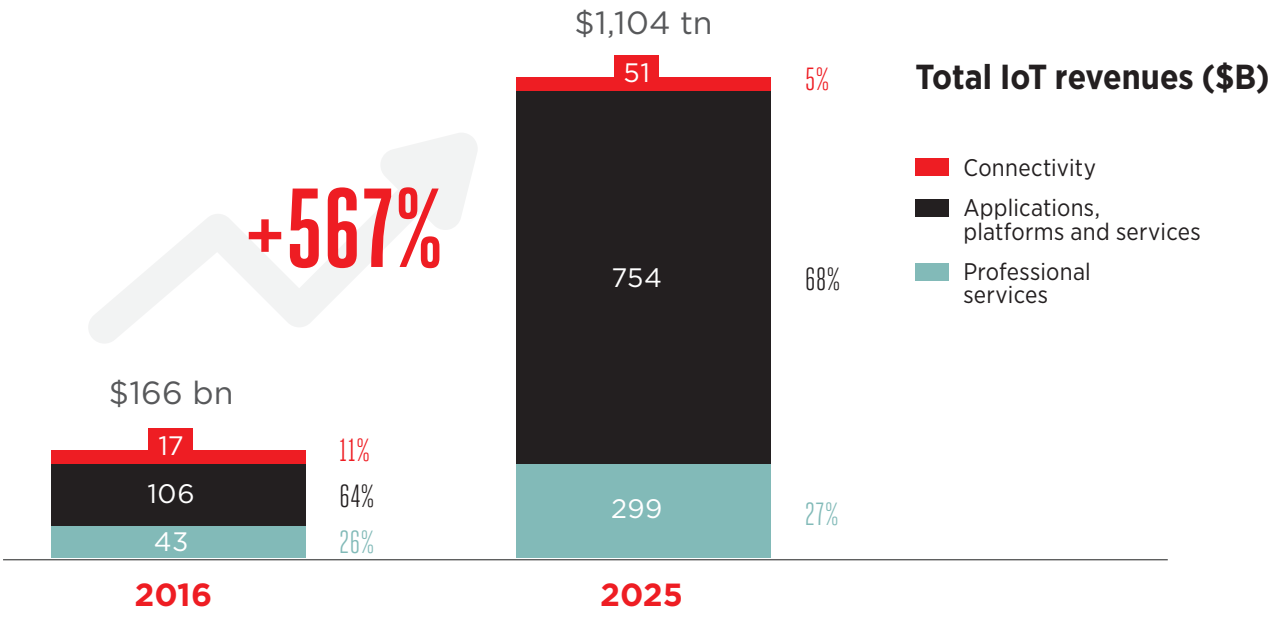
As the market matures, the ecosystem will stabilise, leaders in each area will emerge, standards and best practices will proliferate, interoperability will improve, and customisation will decrease. All of these factors will drive down costs for customers, enable a proliferation of new solutions, and open up far more of those solutions to a vast community of smaller businesses, organisations and consumers. GSMA Intelligence forecasts total IoT spending will reach $1.1 trillion by 2025, increasing from a base of $166 billion in 2016.

TOTAL IoT MARKET

$166 bn 2016

$1.1 tn 2025

GSMA INTELLIGENCE FORECASTS THE TOTAL IOT MARKET WILL BE WORTH $1.1 TRILLION IN 2025



OPPORTUNITIES FOR MOBILE OPERATOR TRANSFORMATION

The IoT market presents tremendous opportunities for mobile operators. First and foremost, operators play a critical role in providing connectivity for many IoT solutions. Though some solutions are on-premises and utilise the building's existing LAN and WAN connections, many others include vast numbers of devices that require a mobile operator's network. Moreover, many IoT devices are mobile, such as automobiles, shipping containers, airport equipment and construction machinery. Many others are geographically scattered and may be on the premises of a third party, such as building security systems, elevators, farm animals, parking sensors or utility meters.

IoT solutions generally perform several functions. They collect data, analyse it, draw conclusions and take actions based on those conclusions. For example, a solution might read utility meter data and automatically send out bills. Another might work with home automation systems to automatically run appliances during off-peak hours. Another might detect unsafe conditions and activate emergency response systems.

In each of these cases, IoT solutions require connectivity, but they also involve substantial spending on IoT devices, applications, back-end computing and storage, analytics, consulting, design, integration and management. As a result, connectivity is only a small part of the total IoT market – in 2025, GSMA Intelligence anticipates that connectivity will account for only 5 per cent of total IoT market revenues.

As operators move towards new roles in the IoT market, they have an opportunity to transform their business and deliver value across the IoT value chain. The roles described in this paper enable operators to address the remaining 95 per cent of the market opportunity, beyond the 5 per cent to be accounted for by connectivity.

The key strategic considerations to support operator transformation into future roles include:

- Building a strategic vision for the IoT and its impact on the wider business portfolio.
- Managing transformation to support future roles in the IoT through either incremental change or new business directions.
- Changing the structure of the organisation to meet the demands the IoT places on the business.
- Ensuring the right mix of skills and talent are in place to support new roles.
- Delivering new IoT business models and charging mechanisms.
- Broadening the portfolio and the way in which operators deliver services and solutions, through partnerships and professional services.

Future Roles for Operators in the Internet of Things

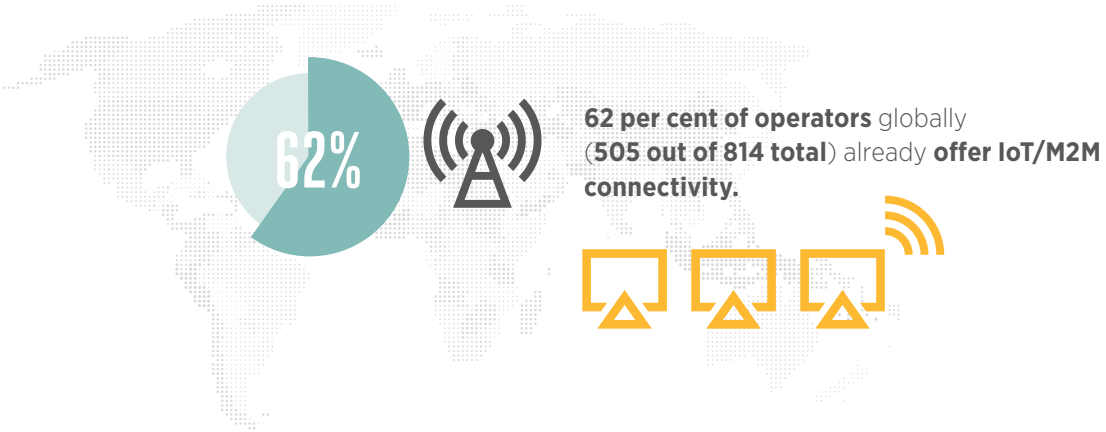
Now is the time for operators to begin to position themselves to capture as much value as possible from the accelerating IoT market. This section describes the most important roles for operators by category, as shown in the table below, and explores the technology enablers required for each, together with examples. Finally, for each category, go-to-market considerations are discussed.

Category	IoT FOUNDATION	IoT SERVICE ENABLEMENT	IoT SOLUTIONS
Theme	**CONNECT**	**EMPOWER**	**TRANSFORM**
Description	Supporting general IoT functionality with core capabilities	Adding value to IoT and expanding into new areas	Supporting end-to-end and vertical specific solutions
Roles	↘ **IoT connectivity** ↘ **IoT service management**	↘ **Ecosystem orchestration** ↘ **IoT infrastructure provider (including cloud and edge)** ↘ **IoT security**	↘ **IoT prime contractor** ↘ **Big data, analytics and AI** ↘ **Vertical specialisation**

IoT Foundation Roles

IoT CONNECTIVITY

Connectivity will remain a critical part of operators' competitiveness in IoT and form the foundation on which additional services can be built. According to GSMA Intelligence, 62 per cent of operators globally (505 out of 814 total) already offer IoT/M2M connectivity.



To sustain growth in IoT connectivity, operators should launch low power wide area (LPWA) networks, such as NB-IoT and LTE-M, that are part of the 5G family. These networks enable new use cases, such as those that require a long range or wide/deep penetration of the mobile signal, or a long device battery life. Many operators now think it will be necessary to deploy both NB-IoT and LTE-M technologies to optimally meet the needs of all use cases.

In doing so, they will move a step closer to migrating to a full 5G network and generally optimising the network and services for specific kinds of IoT solutions. Most operators expect new IoT use cases, such as remote control, to drive much of the demand for 5G, so operators need to develop relationships and joint technology with key partners, such as automobile and industrial companies, as well as building out their networks.

Beyond infrastructure, operators must also evolve their IoT connectivity business operations, remain competitive in pricing, and introduce new tariff plans and even new tariff concepts. At the same time, they must adapt and retrain their sales forces to sell IoT connectivity to new kinds of customers.

Operators must also provide tools for customers to manage large numbers of connections. Connectivity management platforms provide a portal or application programming interfaces (APIs) to enable customers to manage fleets of potentially millions of devices. Nearly all operators providing IoT connectivity currently offer such a platform, and these platforms can be a competitive differentiator.

To support IoT connectivity, operators also need to work on alliances and partnerships with other operators and industry associations to ensure they can deliver the necessary global coverage and support.

Technology Enablers for IoT Connectivity

There are several key technology enablers for IoT connectivity. First are the new LPWA network technologies optimised for IoT, especially NB-IoT and LTE-M. By the end of August 2018, operators had launched 66 commercial LPWA networks in 33 markets, according to the GSMA.

As well as encompassing the LPWA technologies supporting massive IoT, 5G will support critical IoT with additional innovations in virtualisation, network slicing, small cells, millimetre wave bands, massive MIMO and many others. These network innovations will enable an operator to offer far more diverse connectivity options and support new IoT use cases.

The mobile industry has long sought to eliminate fraud by securely authenticating SIM cards. As the industry implements embedded SIMs, it enables over-the-air selection of network providers without requiring replacement of the hardware SIM. In so doing, the industry still ensures secure SIM authentication, but it now also enables manufacturers to embed SIMs at the factory and ship devices globally, as there is no longer any need to know in advance which market a device will operate in.

Continuing development of connectivity management platforms is another key enabler. Operators and platform vendors are adding additional security features, such as real-time traffic visibility, policy-based traffic filtering, device authentication and fraud detection, often utilising data analytics capabilities. Other helpful features include real-time cost monitoring, simplified provisioning and traffic segmentation by application. In general, visualisation and analytics tools are critical for enabling management of large volumes of devices and data.

Examples of IoT Connectivity

There are many examples of operators innovating in IoT connectivity. One of the first operators to deploy NB-IoT in Europe, Vodafone is testing network innovations, such as massive MIMO, has developed its own IoT platform, offers global SIMs to ensure easy connectivity around the world, and entered the automotive sector in 2014 to supply electronics and connectivity for connected cars.

Having launching LTE-M networks in the United States and Mexico in 2017, AT&T plans to deploy NB-IoT networks in the two countries in 2019[2]. The company considers NB-IoT to be complementary to LTE-M. NB-IoT's lower data rates are ideal for devices with basic data needs, such as smoke detectors and parking meters, while LTE-M's higher data rates are better suited to use cases with more data requirements, such as fleet tracking and patient monitors.

Deutsche Telekom (DT), which is deploying NB-IoT across its footprint and is a leader in IoT connectivity, is innovating in IoT tariff packages. DT also is exploring new ways of charging for IoT services that include building and operating IoT solutions on a customer's premises and sharing revenues with the property owner or even taking a share of cost savings.

China Mobile is also a major supplier of IoT connectivity. In the first half of 2018, China Mobile added 155 million IoT connections, bringing the total number of IoT connections to 384 million. Revenue from its IoT business recorded year-on-year growth of 47.6 per cent. "We are building out a high-quality NB-IoT network and will realise continuous coverage to areas at town level and above across the country by the end of this year," China Mobile said in a statement[3]. "At the same time, we will continue to promote our self-developed IoT open platform OneNET, as well as constructing a high performance IoT smart service system, in order to provide quality one-stop service for our extensive IoT customer base."

> *"We are building out a high-quality NB-IoT network and will realise continuous coverage to areas at town level and above across the country by the end of this year"* **China Mobile**

[2] Source: https://www.mobileworldlive.com/featured-content/top-three/att-expands-cellular-lpwa-options/
[3] Source: https://www.chinamobileltd.com/en/media/press/p180809.pdf

IoT SERVICE MANAGEMENT

IoT solutions require control systems to enable an organisation to deploy and manage their fleet of devices, connectivity, data and applications. These functions are often delivered through one or more IoT platforms. In an IDC survey in October 2017 of European companies using or planning to use IoT[4], 38 per cent said they plan to use a connectivity management platform, 24 per cent planned to use a platform for device and infrastructure management, and 47 per cent planned to use a platform for data management and analytics.

For mobile operators, IoT service management starts with connectivity management. Once an operator offers basic connectivity management, they are well positioned to add features in adjacent areas. They can extend their role more broadly by adding device management, data security, data routing, application enablement and other features. However, they need to move quickly, either by developing features internally or offering products from other platform providers.

Technology Enablers for Service Management

To establish a strong service management position, operators need to build additional functionality into their platforms. In device management, operators can provide device security and authentication, detect and remotely troubleshoot problems, and manage software and firmware updates.

Another key enabler is advanced analytics and artificial intelligence utilised to enhance network operations and device management. These tools are creating new opportunities for operators to add value on top of the basic routing of data, providing better management capabilities, security, monitoring and analytics of device behaviour, as well as to ensure network efficiencies are maximised.

[4] Source: IDC's European IoT Decision-Maker Survey (October 2017)

Examples of IoT Service Management

Deutsche Telekom has developed its own connectivity management platform, called the Telekom M2M Service Portal (TMSP). The company also offers Cloud of Things platforms for device management, data management, and analytics. In device management, the platforms enable remote device updates and configuration.

Vodafone has developed a platform, called the Global Data Service Platform (GDSP), offering connectivity management, device management and application enablement. It includes a self-service portal for easy management, as well as APIs to enable straightforward integration with third-party analytics platforms.

Rather than developing its own platform, Swisscom offers access to the platforms developed by other vendors. For connectivity management, the operator offers Ericsson's platform, as well as Vodafone's platform, while offering Telit's deviceWISE platform for device management capabilities.

Similarly, Telia's IoT platform starts with connectivity and device management, then manages the data storage and analytics, and finally delivers business intelligence.

IoT Foundation Roles: Go-To-Market

In delivering IoT connectivity and IoT service management, operators go to market in several ways. First, they sell directly to end customers that are deploying a solution internally or adding connectivity to their own products and services. Whereas connectivity can mostly rely on the broad enterprise and SME sales forces, service management will require more specialist consultative and technical sales skills, akin to those skills needed for selling IoT enablement and solutions (see subsequent section).

Importantly, operators also sell through channel partners, such as consultants, integrators, IoT service providers and vertical specialists, that develop and install those solutions for end customers. Their service management platforms can overlap with some features of other suppliers, but they can also be complementary to the services sold by business and technology consulting companies, vertical-specific platform providers and others. Operators can develop partnerships throughout the ecosystem to ensure that their service management features integrate smoothly with the components and services sold by other vendors. In so doing, they can make it easy for those other vendors to pull the operator into projects.

Many operators will initially sell their IoT connectivity as their core offering. However, as their service management capabilities grow, these capabilities will be a stronger part of their value proposition and will take greater prominence in their sales pitch.

Finally, operators can also sell connectivity and service management as parts of larger bundles of services for IoT enablement and solutions. The go-to-market approach for these roles is discussed in a subsequent section of this paper.

IoT Service Enablement Roles

ECOSYSTEM ORCHESTRATION

At this early phase of maturity, established players and new entrants throughout the tech industry and individual verticals are jockeying for position in the IoT ecosystem. They are developing hundreds of new use cases to address diverse business needs in different verticals and market environments.

Mobile operators are uniquely positioned to help the ecosystem take shape and to orchestrate it in ways that are good for customers, partners and for operators themselves. They are already critical to the ecosystem, supplying networks, service management and billing services. They increasingly offer other services across the IoT value chain and work with partners to develop and deliver full solutions. Many operators also already play an important role in enabling the device market, through their testing and certification of devices to operate on their networks.

In an interview for this report, an Asian operator touched on its move from connectivity into ecosystem orchestration, saying: "The operator's role in IoT will remain founded on the provision of communications and connectivity services. However, adjacent technologies, such as management of the edge, deployment of large-scale sensor farms and devices, which supplement the mobile edge infrastructure, will be key. Telcos will be a key enabler of these solutions, bringing together platform providers, data sources, analytics etc. into marketplaces driven by vertical use cases."

There are many activities operators can undertake to further develop the ecosystem. These can be divided into the following categories:

- **Building a collaborative culture:**

  To stimulate IoT development, operators can build a collaborative IoT culture. Many are holding numerous workshops, networking events, casual meet-ups and hackathons. They are also supporting start-up communities, establishing innovation labs, and providing access to hardware and software development kits.

- **Establishing standards and norms:**

  In this area, operators are working within industry associations, establishing new associations and alliances, supporting standards development, pushing for the development of open APIs, supporting certification schemes and promoting best practices.

Building technical supporting infrastructure:

For the ecosystem to work efficiently, it needs some supporting infrastructure. That can include the operator's service management tools and billing systems; marketplaces for efficiently buying and selling solutions, components and data; and mechanisms

Operators should leverage these activities for ecosystem orchestration in a strategic manner. They should think about what shape they would like the ecosystem to take, identify key roles and stakeholders, and establish an incentive structure that encourages the key players to work towards the same goal.

> *"Telcos will be a key enabler of these solutions, bringing together platform providers, data sources, analytics etc. into marketplaces driven by vertical use cases."*
>
> **Asian operator**

Technology Enablers for Ecosystem Orchestration

Many operators are supporting the development of scalable solutions through IoT labs. Mobile operators and network equipment vendors generally set up IoT labs to help IoT service providers to test their device prototypes, fine-tune their IoT services and provide technical support in preparation for commercial deployments. The labs typically give access to specialised teams of experts and to laboratory equipment able to provide measurements and logs. Users of the labs include IoT platform, chipset and module vendors, IoT device manufacturers, vertical partners and system integrators. The labs are also used to perform compliance tests for customers who wish to deploy new devices and services on mobile operators' existing networks. The GSMA provides a public searchable database of these IoT labs and promotes them to the IoT community via the GSMA website (www.gsma.com/IoT). At the end of August 2018, there were 40 labs listed on that site.

Distributed ledgers, which underpin blockchains, are another technology driver with significant potential. Having proven their value with 'crypto-currencies', distributed ledgers are now being applied in other areas where there is a requirement for trust, without reliance on a centralised controlling organisation. In the IoT, distributed ledgers can help to authenticate devices, complete smart contracts, support micro-payments, share information and support key verticals, such as supply chains. For example, a distributed ledger can be used to record the origin of goods, progress through transportation channels, wholesalers, customs and supply to the end customer, along with supporting information, such as geo location and environmental monitoring data, to make the whole process more efficient, transparent and resistant to fraud.[5]

Another key enabler is an application development platform. These platforms make it easier and faster to develop and manage new IoT applications, enabling the ecosystem to experiment faster, quickly develop proofs of concept and get solutions to market.

[5] Source: https://www.gsma.com/iot/opportunities-distributed-ledger-in-iot/

Examples of Ecosystem Orchestration

There are abundant examples of operators working to orchestrate the ecosystem. For example, KPN has held hundreds of industry workshops to build awareness and train developers. AT&T, Telenor and others have held IoT hackathons to stimulate interest among students and start-ups. Many operators have also developed innovation labs.

Many operators are also active in industry bodies to establish standards and norms, including working with the GSMA on LPWA roaming and a consistent approach to IoT big data.

To help establish the fundamental infrastructure needed for the ecosystem to function, Deutsche Telekom has created a marketplace, called the Data Intelligence Hub, to make analytical tools and data streams available for sale to third parties.

China Mobile's OneNET platform is an integrated, cloud-based IoT connectivity, device, data and application management platform that is used by more than 8,000 enterprises and 80,000 developers in China. The platform offers connectivity and device management functionality, such as device provisioning and update management, but also more advanced functionality, such as cloud storage management, an application development platform, real-time data processing, data analytics and visualisation. It is all tied to a community of developers and customers who are able to work together to create new IoT ecosystems. The customer solutions that have been deployed on the platform include smart metering services, air pollution monitoring, supply chain management and remote vehicle monitoring. The result is a reduction in R&D, operation and maintenance costs for customers deploying IoT services on China Mobile's network.

IoT INFRASTRUCTURE PROVIDER (CLOUD AND EDGE)

To run an effective IoT solution, data must first be collected from IoT devices, before being analysed and acted on. In many cases, data is aggregated centrally, enabling large-scale analysis across thousands or millions of devices. Weather analysis is one example. In such cases, the data must be collected in one or more central locations, analysed, processed, stored and made available to selected applications.

This central infrastructure can exist in public cloud, private cloud, hybrid cloud or in private data centres. It can also be distributed across multiple clouds and data centres, with data storage, applications and analytics tools all existing in different interconnected clouds. The strengths of cloud-based infrastructure, combined with service management platforms, are leading more and more companies to choose the cloud. For example, 51 per cent of European companies using or planning to use IoT said they would use only cloud-based infrastructure, while 23 per cent said they would use hybrid infrastructure[6].

Operators can play a key role in providing this infrastructure. First, operators could supply the connectivity to the infrastructure and between the different sites. Second, operators can provide the cloud infrastructure services themselves. Operators cannot rival the largest cloud service providers in scale and total features, but they do enjoy some advantages, especially in being close to the end customers in their markets and adhering to sovereign data regulations.

Many IoT solutions need to analyse data and make decisions close to the end device to achieve low latency. For example, in the case of an autonomous device, any analysis and decision making must be done locally to ensure that the device responds to the inputs quickly. As an example, local traffic conditions can be determined at the edge by aggregating data from nearby vehicles, analysing results and quickly pushing advice or instructions back out to the vehicles, without requiring all the data to be sent to a central hub. Mobile operators can address this need for data storage and computing power close to the device by locating servers in a variety of edge locations between the IoT device and the cloud.

The edge for IoT can reside in several different locations under operator control, depending on the customer requirement for low latency, in particular. The edge could be hosted in the operator's local data centre, at the base station site or on a dedicated gateway close to the device. Operator-led network-edge computing has not yet been widely promoted, but many customers are already thinking about edge computing for IoT. In a recent survey, 25 per cent of European companies planning to use IoT analytics noted that they planned to do at least some of the data analysis on edge gateways[7].

[6] IDC's European IoT Decision-Maker Survey (October 2017)
[7] IDC's European IoT Decision-Maker Survey (October 2017)

Operators also need to ensure they can provide connectivity to cloud infrastructure and platforms operated by other companies. Even the most effective operator will not fulfil all their customers' infrastructure and platform needs. They should also aim to fill gaps in the market where their positioning gives them advantages, rather than try to compete with the largest cloud players head-on. For example, operators may provide edge infrastructure to platform providers to enable processing close to end devices. This balancing of their own services with those of other key players is an important part of the operator's role in ecosystem orchestration.

Technology Enablers for IoT Infrastructure Provision

The computer servers required to implement cloud services need to be hosted in data centres. Most operators control a large estate of secure data centres, which could be used to enable edge services close to where they are needed.

Network infrastructure is another key enabler of edge computing. Operators have infrastructure throughout their geographic coverage, and they can place edge computing capabilities at a base station. If the use case requires processing closer to the device, then investment in dedicated gateways and/or on-site equipment is required. That will enable new kinds of use cases that depend on ultra-low latency.

Examples of IoT Infrastructure Providers

To accommodate customers' different preferences, Swisscom offers its own cloud infrastructure and platform, with the data staying within Switzerland, while also offering AWS and Azure for those who prefer the global players. The operator also offers cloud connectivity via a VPN and leased lines to ensure the data stays off the internet.

Deutsche Telekom has moved aggressively into cloud services, including infrastructure, platforms and software-as-a-service. It operates its own cloud, hosting other cloud platforms on its infrastructure. DT believes IoT will be one of the biggest drivers of cloud services in the coming years.

IoT SECURITY

Operators are well positioned to create new roles centred on IoT security, and many operators are beginning to establish themselves as security experts. IoT security is a broadly defined role that can span the whole solution, including organisational processes, hardware, network services and software features to manage security of the devices, the data in motion, and the data at rest in front-end and back-end systems.

As IoT connectivity providers, operators already play a key role in IoT security. At a minimum, operators need to ensure secure data transmission across their network, and valid subscription authentication. Beyond these basics, some operators will also offer additional IoT security services, including subscription management, management of security credentials, security analytic services and security operations centres for their IoT service provider customers. KT noted in an interview for this report that "analytics and security across IoT data is a major part of delivering IoT solutions."

The opportunity for operators to offer security across an IoT solution arises from the immature nature of the market at present. In the future, many more security services and tools will be available from specialist vendors. However, today, it is not always clear whom enterprises should turn to for advice and technology to ensure secure IoT solutions. Operators need to incorporate security advice and design principles into their activities, while developing end-to-end solutions. As such, operators need to demonstrate familiarity with security best practices in IoT. That includes security features and functions in specific parts of the solution, as well as holistic security expertise across the entire solution. They should also demonstrate expertise in secure IoT solution design.

Technology Enablers for IoT Security

The GSMA and the mobile industry have established common security guidelines that operators should implement to ensure secure IoT deployments. To date, 15 operators have declared that they will adopt the GSMA's IoT security guidelines across their IoT ecosystems. More information on the guidelines and their 85 detailed recommendations can be found on the GSMA website.[8]

Specific enablers for IoT security provision include the use of the SIM to secure IoT devices; use of analytics to guard against security risks such as denial-of-service attacks and Trojan horses; IoT subscription management to enable customers to 'lock-down' and monitor their own IoT connections; and security assessments in which the operator audits their customers' implementations and offers advice on how to mitigate any weaknesses.

As with most parts of the IoT value chain, security is benefiting from developments in artificial intelligence (AI). Operators can apply AI to enhance their data analytics to provide security services to customers.

Examples of IoT Security Solutions

KT in Korea leverages network security capabilities within its own network, while also using partner solutions from other vendors to ensure secure and reliable IoT solutions for its customers.

Vodafone promotes security as a core consideration across its IoT offerings. The company claims its solutions are secured at every level, built in from the ground up. That includes ensuring secure devices and data transmission all the way to the back-end infrastructure.

In the Tecnoport 2025 project, led by the University of Seville, the Port Authority of Seville and Telefónica, the GSMA IoT Security Guidelines and GSMA IoT Security Self-Assessment helped to highlight some important security features and led to the incorporation of new security measures that had not previously been considered. Overall, the project highlighted the importance of using common tools and adopting a common approach to IoT security[9].

[8] https://www.gsma.com/iot/future-iot-networks/
[9] For more detail, see the case study at: https://www.gsma.com/iot/securing-port-future/

IoT Service Enablers: Go-to-Market

As an ecosystem orchestrator, operators need to shift perspective. They will focus less on linear value chains and rigid transactional relationships, and more on working within a dynamic ecosystem. They will form and reform arrays of partnerships to suit specific opportunities. In some cases, they will sell directly to end customers and manage the project, while in other cases, they will be brought in as subcontractors. And in still other cases, they will work collaboratively with multiple providers and the customer to co-create innovative solutions.

In this dynamic environment, operators will need skilful and consultative salespeople to sell both to customers and to the ecosystem. They will need to be recognised as expert partners with valuable contacts throughout the industry.

Operators will sell their infrastructure and security services through their existing enterprise and SME sales forces, as well as through IoT-specific sales teams. Generally components of a wider solution, these services will generate additional revenue and make the solution development and deployment easier, faster and more secure. Those operators that develop broad IoT offerings, including acting as consultants and prime contractors (see next section), will be best positioned to assemble IoT solutions that incorporate the operator's infrastructure and security services.

IoT Solutions Roles

IoT PRIME CONTRACTOR

Operators have large workforces of salespeople, support and field service engineers distributed across their markets, where they already have relationships with most major customers and diverse technology partners. They can also provide network connectivity and connectivity management. As a result, operators can play a key role in developing the IoT market.

As they do so, operators can assume the role of technology leaders and prime contractors. They can work directly with enterprise customers, understand their needs, help to define solutions, recruit partners (subcontractors) and take responsibility for the full solution.

This prime contractor role can serve many purposes for the operator. It helps to build the market. It also positions the operator as a trusted expert and thought leader in this key technology area. At the same time, it serves as a profit centre, generating revenues for consulting, design, integration, project management and other functions. And finally, it serves the crucial purpose of helping the operator to develop expertise and skills throughout the value chain. With that expertise, the operator can choose which other parts of the value chain it might enter itself.

To fulfil the prime contractor role, operators need to demonstrate that they are among the best in their market at designing end-to-end IoT solutions, at least in a few selected areas. The leaders will need to understand strategic and operational business challenges in customer industries, discuss these challenges with senior executives and recommend solutions that will deliver real business value in many ways, whether it be efficiency, new lines of business, operational transformation or entirely new business models.

Technology Enablers for Prime Contractors

A key technology enabler is the IoT platform. With any significant volume of connected devices, customers will need a connectivity management platform. That platform then positions the operator to deliver additional functionality to manage devices, security, data and analytics. As it becomes clear that the operator can address many of the complex challenges involved in establishing an IoT solution, customers are more likely to see the operator as an IoT leader and seek out the operator early in their IoT journey.

Examples of Prime Contractors

Swisscom considers itself a strong general contractor for IoT. The company provides many key functions, but it is also good at bringing together all the partners needed to assemble the full solution, and to implement it. The company offers a wide range of services in telecoms, IT and cloud, and it continually invests in leading-edge technologies to be able to understand their impact and leverage them on behalf of customers at an early stage. Swisscom also works with technology partners to ensure it has visibility on what is possible, or soon will be, and to ensure it can incorporate partners' technologies into customer solutions.

Orange's enterprise unit, Orange Business Services, is a long-established major player across ICT services. The company provides a wide range of ICT services that leverage the network, but also includes extensive IT consulting, design, integration, cloud, and managed services. As such, the company already acts as a prime contractor in many customer engagements. The company applies that role to IoT as well. Orange Business Services works with enterprise customers to identify opportunities to deploy IoT solutions to create business value. It then leverages internal and external suppliers to design and deploy tailored solutions.

BIG DATA, ANALYTICS AND ARTIFICIAL INTELLIGENCE

As billions of new devices are deployed to generate data for various purposes, the IoT is one of the factors driving the expansion and evolution of big data. The data generated by these devices can be leveraged for many applications, both within an organisation and by external users, combined with other data sources, and used to generate new insights far beyond the original objectives.

To make use of the huge volumes of new data generated, IoT suppliers must become adept at using analytics tools. Increasingly, these tools use machine learning or artificial intelligence to analyse data and derive new insights. Among the most common uses of machine learning to date have been in image analysis, natural language voice analysis and predictive maintenance. AI and other analytics tools give operators the opportunity to provide much more value, analysing data and developing intelligence out of it. If they do that, they will be able to provide much greater business value to customers, and also extend their own activities to help customers to make use of that intelligence.

Over the next few years, analytics and AI will become prominent tools throughout the IoT value chain. Mobile operators need to develop or procure these tools and leverage them in most of their IoT activities. There is a rich ecosystem of analytics software tool suppliers, so operators will mostly look to leverage these existing tools as they run IoT deployments for their customers.

Big data, analytics and AI techniques can be utilised for both horizontal and vertical use cases. Some of the horizontal applications have already been discussed in earlier roles, such as monitoring device behaviour, security, battery levels and maintenance needs under IoT service management.

Moving down the IoT service chain and addressing the IoT payload data itself, another horizontal service is big data preparation and brokerage, such as data cleansing, checking for accuracy, missing values or anomalies, and converting the data to a usable standard format ready for analytics or \for exchange in a data marketplace. A further significant opportunity lies in operators offering big data, analytics and AI services for specific vertical use cases, such as agriculture, environmental monitoring and industrial IoT, often based on their areas of vertical specialisation (see next section). Example use cases include:

- Predictive maintenance is valuable in many vertical sectors, including industry and agriculture. This involves analysing the data from sensors attached to machines to determine when they will need maintenance to avoid breakdown.

- Analysing video for movement or facial recognition can support the needs of a range of vertical sectors, such as home security, environmental monitoring and smart cities, or license plate recognition for smart transport.

- The analysis of sensor data, environmental data, weather forecasts, pest data and other information can support smart agriculture.

- Operators can analyse the proprietary data generated by their networks to provide useful market data about people and things, such as flows of pedestrians and vehicle traffic. This is relevant to many vertical sectors, including smart cities, health and transport.

Technology Enablers for Big Data, Analytics and AI

For operators to thrive in this field, they need to develop many new skills and tools. They may start by focusing internally and applying analytics and AI to the vast volumes of data being generated by their networks, traffic flows, customer behaviour and customer experience. The tools developed internally can then be leveraged and further developed to analyse IoT data and support external customer use cases.

Operators need to deploy new technologies and tools for collecting, storing and analysing different streams of data and applying the insights derived. They will need to develop or obtain big data warehouses; data ingestion tools; real-time analytics; machine learning systems, such as computer vision and speech recognition; data discovery tools for use in data lakes; dashboards and visualisation tools; and various other systems.

Operators will have to distinguish between network analytics (horizontal), device analytics (horizontal), IoT big data preparation and brokerage services (horizontal) and insight analytics (vertical), and use these to differentiate their offering. Network and device analytics were covered earlier in this report under IoT Foundation roles. For big data preparation and brokerage and insight analytics, different operators will opt for different routes based on their capacity to commit to short- and medium-term investment.

- **IoT big data preparation and brokerage** requires a low level of investment as it involves providing cleansed and prepared data collected through the network and devices to third parties (such as customers or partners), sometimes in an aggregated way, but without analysis or recommendations on top. Still, investments may be needed in data ingestion, aggregation and processing tools, as well as provision of, or participation in, data marketplaces.

- **Insight analytics**, relevant to the vertical specialisation role, would require greater investments and commitment, as it involves analysing the data in order to provide specific reports and recommendations to end users and to automated applications, based on the data gathered through the various IoT networks and devices, along with relevant contextual data. Although this option also offers greater differentiation for operators, it requires vertical specialisation and investment in technologies, such as advanced analytics, AI and machine learning in order to provide detailed high-value insights and recommendations.

Examples of Big Data, Analytics and AI

Telefónica has created a big data business unit, called Luca, which offers a portfolio of services to help companies shift toward being data-driven companies. Luca offers consulting, strategic assessments and corporate transformation planning, as well as implementation of the transformation by applying specialist tools, infrastructure, data science and business insights. Key platforms include Luca's Smart Steps which uses anonymised and aggregated data to provide insights to companies in retail, transport, outdoor media, financial services and other sectors. Telefónica's Smart Digits platform provides a set of secure REST-based API services that allow access to data insights that can be used by service providers to enhance and transform their customer experience and user journeys[10].

Deutsche Telekom offers a range of analytics services, including consulting and specific analytics tools. One offer is Smart Monitoring which uses AI to observe device behavior, detect early warning signals and provide root-cause analysis. It enables a company to identify anomalies before breakdowns occur, and to optimise maintenance schedules. The company has also launched its Data Intelligence Hub, which is an analytics marketplace, enabling customers to select from third-party analytics tools and easily incorporate them into their solutions.

[10] Source: https://luca-d3.com/index.html

VERTICAL SPECIALISATION

In an interview for this report, China Unicom noted that "the biggest area of transformation for operators will be those related to vertical capabilities." That sentiment was echoed throughout the research. Nearly all operators will develop some vertical-specific specialisations and solutions. Automotive, transportation, logistics, utilities, asset tracking, smart cities, agriculture and building security are common choices. In the short term, vertical specialisation helps operators build a market for the IoT services they offer, such as connectivity, platforms and infrastructure. In most use cases, there are few existing solutions available, so an operator can help to build the market by gaining vertical expertise and developing key solutions. At the same time, developing vertical expertise and solutions will generate substantial value, allowing the operator to generate new revenue streams. In that way, vertical specialisation will be vital for the long term.

Operators that choose this path will work closely with customers and develop a keen understanding of the customer's organisation, technology, challenges, benefits, requirements and expectations. They will also develop expertise and relationships throughout the vertical ecosystem. And they will gain visibility on what other parts of the value chain present competitive opportunities. They can use this knowledge to resell their solutions or develop packaged solutions, to improve their capabilities to support other companies, to sell vertical solutions, to develop visionary leadership in IoT and to choose other markets to enter.

> *"The biggest area of transformation for operators will be those related to vertical capabilities"*
>
> **China Unicom**

Technology Enablers for Vertical Specialisation

One of the most critical innovations driving vertical-specific solutions is the development of application enablement platforms. These platforms offer developers a key set of functionalities required to connect, manage, and visualise IoT devices and data. Application development frameworks and tools, sophisticated visualisation tools, and advanced analytics are highly complementary. Cumulatively, these tools enable far more developers and companies to design vertical-specific solutions.

Big data, analytics and AI are key enablers of vertical specialisation. Delivering complete vertical solutions often requires specialist analytics tools and skills. An operator that has developed such skills in their own business should be able to bring those skills to new sectors.

Edge computing and low-latency networks will enable several new vertical-specific use cases. Self-driving vehicles is the most commonly cited example, and other automation and precision-control use cases, such as smart factories, will also be enhanced by these innovations.

System integration capabilities will be extremely valuable to deliver successful IoT implementations, particularly across vertical solutions. Although most operators today already have some systems integration capabilities, in many cases these remain as a centralised function with limited capacity. Ensuring that these skills are replicable and available at local level and in an agile environment will enable operators to provide a truly global IoT service to specific verticals, as well as a differentiating capability.

Examples of Vertical Specialisation

One of the best examples of vertical specialisation is Vodafone, which decided to target connected cars by acquiring an auto electronics supplier in 2014. The operator has continued investing in that unit, making it a significant supplier of automotive technology.

Telefónica is targeting retail, developing industry expertise, close relationships with customers and suppliers, and solutions that address specific industry requirements.

After analysing vertical markets to identify those with the potential to generate high revenues, LGU+ in Korea is targeting the smart home and industrial IoT sectors. In the smart home market, the company wants to prepare complete end-to-end packaged solutions in partnership with appliance and technology vendors.

IoT Solutions: Go-to-Market

If they are to deliver full IoT solutions, operators must sell directly to large enterprise customers. They need a consultative sales force that can reach the top levels of management and discuss business needs, as well as technology solutions that meet those needs.

In an immature market, operators must focus a great deal of attention on market education and building awareness of IoT. That includes extensive marketing activities, such as the promotion of IoT benefits; sponsoring conferences and networking events; offering access to open IoT labs for developers to experiment and learn; demonstrating sample use cases; promoting case studies of successful deployments; and developing proofs of concept for customers. This is largely an investment in the future, but it will pay off when customers think of the operator as the first choice to discuss their IoT needs.

Though direct sales are critical, operators will also sell through channels. If they demonstrate the capabilities to consult with customers, collaborate and integrate with partners, and take responsibility for complete solutions, operators will be prized partners. Other consultancies, integrators and technology specialists will know the operator can be relied on to meet obligations and creatively solve challenges. Thus the ability to deliver the complete solution will enhance the operator's ability to also sell through channels.

As they move into individual verticals, operators must work closely with the existing ecosystem of suppliers in that field. For example, the healthcare sector has very different specialist vendors from the industrial sector. And the customers' needs, organisational structures, business processes and legacy technologies are very different. Operators must develop close relationships within the ecosystem and with customers, and work over time to build expertise and trust.

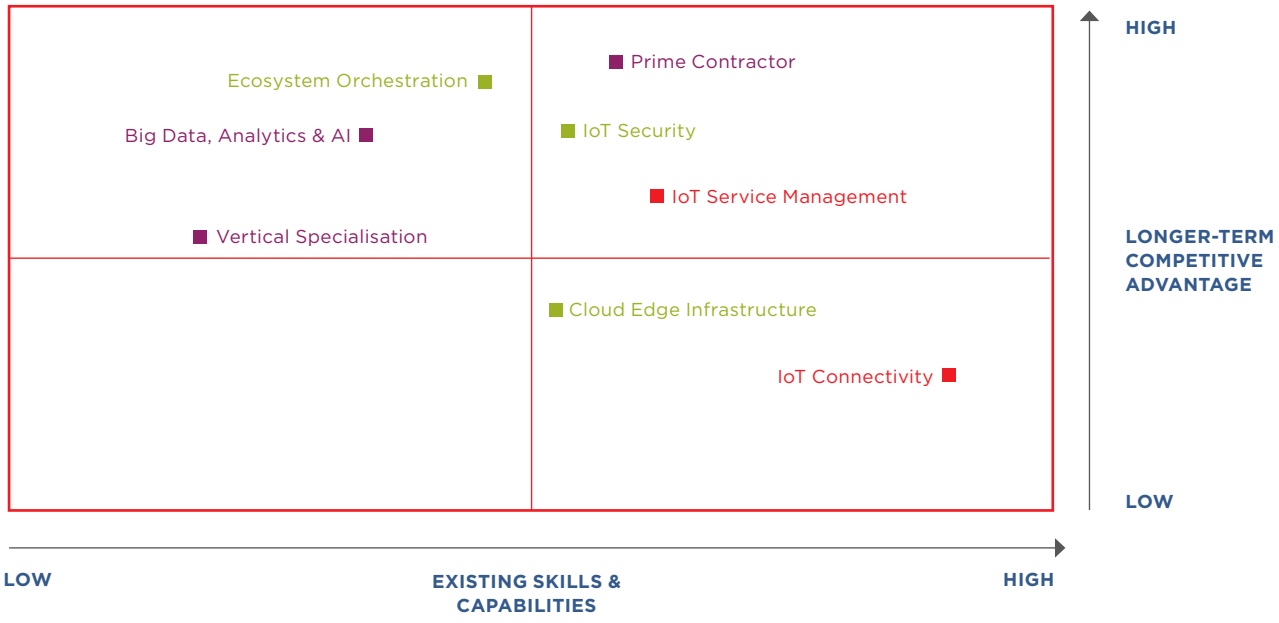
Conclusions and Recommendations

STRATEGIC OPTIONS MATRIX

The options-based grid below categorises the potential roles and opportunities for mobile operators in the IoT space. The grid takes the key 'future roles' outlined in the sections above and sets them against the longer-term competitive advantage such a role will provide to operators; and against a view on the existing skills and capabilities that operators hold in these option areas. The roles marked with a red X are foundational roles, while a green X denotes a service enablement role and a purple X a solution role.

As a result, the grid provides a snapshot view of where operators should invest in skills and capabilities, as well as which areas may or may not be of most strategic interest.

FUTURE ROLES FOR OPERATORS IN IoT: STRATEGIC OPTIONS MATRIX



Source: IDC, 2018

As the chart indicates, IoT connectivity is not a major driver of longer-term competitive advantage on its own, but it is a critical foundation for operators in their efforts to address the other roles. As they extend to serve the other roles in IoT, they will build stronger competitive differentiation and be able to capture value from the full IoT value chain.

Operators may take very different pathways to build their IoT services, but there are common themes that operators should pursue. These themes should reflect the service pathway – Connect, Empower, Transform – utilised earlier to describe operator roles in the ecosystem.

Connect - Starting with a clear vision to steer the organisation towards new IoT opportunities, operators need to think about how they will connect their organisation with their vision, whether it be through transforming their IoT business with internal resources and building incrementally or reaching out and creating an ecosystem. Each of these roles will have a limited window of opportunity, and operators need to decide what is their best route to maximising the opportunities available to them.

Empower - A mix of skills from inside and outside the organisation, acquired through partnerships or acquisition, will likely be needed to pursue new business models and markets. Equipped with a strong set of partners and technology enablers, operators will be in a position to drive new business models forward and create new products and services which will help customers meet their ambitions through the use of IoT.

Transform - The operator must use the new strategies, skills and revenue streams to continually improve and diversify the IoT business to ensure a competitive advantage is retained. Having a clear route through the roles and the ambition to continually improve and apply new learnings and skills will ensure that operators are able to establish themselves in the ecosystem. They will also be in a strong position to identify new roles that offer opportunities to grow the business further as they emerge.

RECOMMENDATIONS

Drawing on the analysis in this report, IDC and the GSMA have distilled the following key recommendations and next steps:

Build a Long-Term Strategic Vision Beyond Connectivity

Connectivity provides a firm foundation on which operators can move up the value chain to pursue both revenue and influence in the wider IoT landscape. It is essential that operators build a long-term vision for IoT.

Bring IoT Into the Core Business

It is essential that an operator's IoT vision does not become the sole preserve of senior management: it should be cascaded throughout the organisation. While IoT departments could be spun-off or separated from the core business (for very good reasons), they should not be annexed from the overall business direction and influence. They need to build on the associated solutions and strengths of the core business. Bringing IoT into the organisation is essential, but it must be managed closely through structured KPIs to measure progress and success to ensure it does not become absorbed into current cultures and business models.

Develop Short-Term Capabilities Quickly

Short-term capabilities need to be built quickly if operators want to gain market share. This is about taking the lead in logical roles and in clear opportunities for the benefit of the business, but it is also critical to showing both management and the wider business what IoT can offer. Picking 'quick-wins' is an essential starting point (and one that this document supports), as is ensuring the right skills and capabilities are in place to maximise and build on the early wins. Knowing the next steps and logical progression is, therefore, also essential.

Build Partnerships with Something to Offer

Partnering in the wider ecosystem and in a close and localised context is central to success in the IoT, now and in the future. Building a partner strategy and a logical portfolio of partnerships should be the starting point for any operator serious about becoming a major player in the IoT.

Too many organisations, however, go out to build partnerships without ever really considering what they themselves are bringing to the party. Without a clear value proposition, they will find themselves in the familiar role of the 'connectivity partner' with little in the way of access to wider solutions, nor to contracts that touch on future roles. Operators need to build real and lasting value beyond connectivity and take this to partners in order to establish a clear role in the ecosystem.

Address Business Model Transformation

At a basic level, delivering business model transformation involves deploying new tariff structures to support the billions of IoT devices designed to fulfil very different requirements in very different circumstances.

Beyond this, operators could be charging for new sources of value, such as connectivity management, access to an application enablement platform or a commitment to service reliability, QoS (quality of service) and SLAs (service level agreements). They should also explore new types of services, such as device management and edge computing, and the delivery of a range of 'as-a-service' solutions, including analytics, professional services and response centres. Another key transformation opportunity in IoT is charging for business value rather than the technology itself, such as having revenues tied to increases in customer productivity or value generated from an IoT-enabled service.

Become the Glue That Binds the IoT

Operators need to position themselves as the glue that sticks all the other players together. Such an approach will prove invaluable to customers, especially if this is done in conjunction with ecosystem enablement, vertical capability or a specific focus on SMEs, for example. Furthermore, providing visionary leadership in the IoT market will help operators become central to delivering IoT solutions and IoT-related business outcomes for customers. The heritage of connectivity is one to build on and evolve, but operators will need to play a far broader role in future.

Appendix

IDC used both primary and secondary research to develop this future roles document. IDC conducted more than 10 in-depth interviews with leading IoT representatives from mobile operators across the globe. These included representatives from EMEA, North America and the APAC regions. Discussions centred on where operators are now in their IoT strategies, where they are heading and why, the main challenges they are encountering, where they feel new roles for operators will be in the wider IoT landscape, how they are looking to monetise these, as well as insight and understanding of operators' priorities.

Respondents performed a mix of job roles and functions, from those responsible for the strategy and deployment of IoT initiatives, to those working within innovation and planning departments. IDC took a judgement view on the level of organisational structure targeted: either global or group level, regional level or country level, and conducted a range of interviews across these organisational structures.

In addition to this, IDC utilised existing research on IoT and mobile operator strategies, including use-case analysis, ecosystem analysis, technology stack and wider technology-related drivers, as well as research undertaken in the wider IoT ecosystem.

Throughout this document there are examples of mobile operators addressing specific roles. Unless otherwise referenced, these examples stem from the interviews conducted as part of this report, other IDC research and interviews with operators or publicly available information from the operators.

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