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Digital Foundations
The Path to People-Centred Smart Cities

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Foreword

Cities across the world are experiencing an era of profound transformation. Nowhere is this more evident than in the rapidly urbanizing regions of Africa and Asia, which together will account for 90% of global urban growth by 2050. This unprecedented expansion brings both challenges and opportunities. On one hand, cities face mounting pressures from climate change, infrastructure deficits, and the need for inclusive service delivery. On the other, digital technologies—when thoughtfully deployed—offer a pathway to resilient, people-centred urban futures.

At the heart of every smart city lies a set of digital foundations: robust connectivity, digital identity, interoperable payments, and open data platforms. These elements are not only technological prerequisites; they are enablers of inclusion, efficiency, and innovation. India's journey with Aadhaar (biometric ID), the Unified Payments Interface (UPI), and the Unified Energy Interface (UEI) exemplifies how digital public infrastructure can drive targeted service delivery, financial inclusion, and rapid innovation. The shift toward open networks and interoperability is a defining trend. Initiatives like the GSMA Open Gateway and the adoption of standardized APIs are making it easier for developers and enterprises to build on top of existing connectivity platforms, accelerating the deployment of new services across sectors such as mobility, energy, and public safety.

Mobile operators are at the centre of this transformation. Their role has evolved from providing basic connectivity to becoming end-to-end digital partners—offering cloud and edge computing, AI-powered analytics, digital payments, and sector-specific platforms for utilities, transport, and public safety. In India, for example, partnerships between operators and utilities have accelerated the deployment of smart meters, reducing losses and improving revenue collection.

The business opportunity is substantial. The addressable market for IoT-enabled smart city solutions in the focus regions is forecast to reach $38.3 billion by 2030, with India alone representing a cumulative $11.5 billion opportunity. Importantly, the value is shifting from basic connectivity to platforms and services, underscoring the need for operators to move up the value chain. Despite significant progress, challenges remain. These include the high initial costs of advanced IoT modules, the need for widespread 5G SA coverage, and the imperative for robust data governance and privacy safeguards. Success will require coordinated policy frameworks, sustained investment in digital skills and infrastructure, and a commitment to inclusive, climate-resilient urban development.

This report is both a testament to the progress made and a call to action. The journey to people-centred smart cities is not a race for technology deployment but a societal transformation. By harnessing digital foundations, open platforms, and cross-sector partnerships, cities can become engines of sustainable growth and opportunity for all. The time to act is now—so that the cities of tomorrow are not only smart, but truly people-centred, resilient, and inclusive.

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Abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
AI	Artificial intelligence
AMI	Advanced metering infrastructure
AMR	Automatic meter reading
API	Application programming interface
ARPU	Average revenue per user
AT&C	Aggregate technical and commercial
CAGR	Compound annual growth rate
CCI	Charter Cities Institute
DPI	Digital public infrastructure
EV	Electric vehicle
FDI	Foreign direct investment
FWA	Fixed wireless access
G2G	Government-to-government
G2P	Government-to-person
GIFT City	Gujarat International Finance Tec-City
ICCCs	Integrated command and control centres
IEA	International Energy Agency
KYC	Know-your-customer
LMICs	Low- and middle-income countries
LPWA	Low power wide area
M/DFIs	Multilateral and development finance institutions
M2M	Machine-to-machine
ML	Machine learning
MNOs	Mobile network operators
MSMEs	Micro, small, and medium enterprises
NFC	Near field communication
NSA	Non-standalone
P2G	Person-to-governmen
P2P	peer-to-peer
PAYG	Pay-as-you-go
PPAs	Power purchase agreements
PPPs	Public-private partnerships
RDSS	Revamped Distribution Sector Scheme
RedCap	Reduced capability
SA	Standalone
SCM	Smart Cities Mission
SCODA	South African Cities Open Data Almanac
SCODP	Smart Cities Open Data Platform
SDGs	Sustainable Development Goals
SEZ	Special economic zone
SPVs	Special purpose vehicles
TAM	Total addressable market
UN-Habitat	UN Human Settlement Programme
UPI	Unified Payments Interface
VC	Venture capital

Executive summary

Urban growth to 2050 will be driven by cities in African and Asian countries. Over 2.2 billion of the additional 2.5 billion urban residents will be in those regions, with India, Nigeria and China accounting for a third of the growth. While cities in these regions have substantially lower emissions per capita than high-income counterparts, for the world to achieve net-zero by 2050 urban development in low- and middle-income countries (LMICs) must follow a different path than historic emissions trajectories. At the same time, these cities are often at the forefront of facing climate-related risks, including storm surges, heat stress, extreme precipitation, flooding, and landslides.

Rapid urbanisation and climate change hinder cities' ability to effectively plan and invest in essential services and infrastructure. This is true for both megacities as well as rapidly growing intermediary cities. In response, many local governments are turning to digital solutions to fill critical data gaps, advance climate action, and enhance the accessibility, affordability and reliability of essential urban services.

Mobile network operators are central to delivering smart city solutions, particularly in LMICs where rapid digital adoption is driving faster deployments and scale. Major technological changes have shifted the bounds of what is possible for urban solutions, notably, 5G and network slicing, Low Power Wide Area (LPWA) connectivity, digital payment platforms and developments in artificial intelligence (AI).

This report takes stock of the trends shaping smart city deployments across Sub-Saharan Africa, South and Southeast Asia. The opportunity for mobile operators is quantified through total addressable market forecasts for eight countries — Egypt, Nigeria, Kenya, South Africa, India, Indonesia, Malaysia, and Pakistan — and across regions. The report profiles leading use cases, mobile operator engagement and positioning, and reviews in detail the policy and technology context.

The evolving context

There is an increasingly strong policy foundation for smart city implementation. Smart city objectives are commonly embedded across national urbanisation plans, digital transformation agendas and national visions. Additionally, six of the eight markets reviewed had a specific national strategy. In a UN survey of 250 municipalities, 44% had a dedicated city-level plan, with these notably more prevalent in higher income and Asian countries. Strong national programmes, such as the Smart Cities Mission in India, have been key in driving progress. Beyond financial resources, these programmes provide clear a structure for implementation, enabling public-private collaboration and the creation of centres of expertise within municipalities.

Emerging technologies – IoT, AI, GIS, cloud computing and open data platforms – are framed as critical in strategies. While predictive AI has long been central to smart grids, the advancements in generative AI enhance this capacity. Connectivity and broadband infrastructure are key to the implementation of national strategies, this is often expressed through commitments to expand broadband access through fibre, public Wi-Fi, mobile networks (3G/4G/5G) and fixed wireless access.

A key trend in smart city deployments across LMICs is the growth of 'new' city greenfield projects. Between 2000 and 2020, 159 new city projects were launched worldwide, compared to 126 between 1945 to 1999. In many cases these new cities are focal points for smart city implementation. Retrofitting infrastructure and service provision in existing cities can be up to three times more expensive than planning for infrastructure in

advance of settlement, which is a key reason greenfield approaches can be more favoured.

While greenfield projects attract significant investment, brownfield interventions often have a greater potential for improving service outcomes. Intermediary cities offer an interesting strategic opportunity to reap some of the advantages associated with greenfield projects while safeguarding against brownfield risks and accommodating urban growth. Often overlooked in national urban strategies, intermediary cities play important roles as production, transportation and processing hubs, linking regional and national urban systems.

Operator roles in smart cities

The increasingly rich connectivity offer is expanding the range of use cases for smart cities. The transition to standalone (SA) 5G is set to unlock ultra-reliable low-latency communication, massive machine-type communications, edge computing and network slicing. Crucially, 5G SA architecture enables multiple virtual networks to coexist on the same physical infrastructure, each tailored to specific service requirements. For example, a city can allocate a high-priority slice for emergency response while maintaining separate slices for utilities or traffic management.

Across markets operators are transforming from connectivity providers to end-to-end technology partners. With slowing growth in traditional revenues, it has become essential for operators to reposition themselves as digital service providers. Operators are doing this through expanding platform offerings – often built on mobile money, dedicated sector-specific offerings, and partnerships with cloud providers, analytics firms, and device manufacturers. Between 2020 and 2024, smart city IoT connections increased from 173 to 271 million, and will increase another 222 million to 2030. Across the four regions reviewed this equates to a cumulative revenue opportunity of $38 billion.

Key drivers for smart city adoption

Strong national leadership is essential for developing the smart city ecosystem. Clear national policies that offer blueprints for implementation have been a catalytic for market development. In countries with a more nascent ecosystem, there is a clear need to strengthen institutional capacity across all levels of government. Smart cities require both technical expertise, as well as administrative skills, including project coordination, in government and the private sector.

Municipalities and local bodies are at the centre of urban development and guide a city's strategic vision. Local governments, supported by national government, can build internal expertise or collaborate to establish common frameworks for regulating the technical, legal and ethical aspects of smart city projects. City-level staff are key in ensuring solutions are impactful and delivered equitably and should be a focus in any capacity building initiatives.

Operators have an opportunity to increase their value offering beyond connectivity in smart city initiatives. This includes network upgrades or forming partnerships to expand into other value chain layers. In many cases, there are opportunities to invest in in-house expertise and capacity building. While it may not be necessary to establish dedicated smart city divisions, it is essential for operators to cultivate a team of specialists throughout the organisation.

Local tech startup ecosystems are key in developing new and tailored smart city offerings. Harnessing the potential of the local tech startup ecosystem for smart city development may entail active investments and incentives provided by governments, fostering industry collaborations – including with operators - and encouraging their participation in sandboxes designed for smart city solutions to promote innovation.

Smart city approaches create options to advance inclusive development and climate resilience. While the risk of smart city projects becoming high-cost, high-tech, elite enclaves detached from wider national development challenges is present, smart city solutions – when thoughtfully applied – can be transformative. Accelerated efforts are needed to close the digital divide and ensure smart solutions are inclusive and respect data privacy. Broad inclusion also safeguards vulnerable residents and enhances the overall resilience of cities. To realise the potential gains, it is important to go beyond the hype and big project announcements to focus on specific interventions and use cases and rigorously evaluate their development and climate impact.

1
The emergence of smart cities

1.1 Introduction

Urbanisation to 2050 is a predominantly African and Asian story. Countries across Africa and Asia have already experienced significant urbanisation in the past few decades, with an additional 1.2 billion urban residents in these regions since 2000. Between 2018 and 2050 the world's urban population is expected to grow by another 2.5 billion people, with African and Asian cities accounting for 90% of this growth. Together, India, China and Nigeria will account for more than a third of this growth.[1,2] The number of cities in low-income countries is expected to increase by 76% between now and 2070, compared to 20% in lower-middle-income countries and 6% in upper-middle-income countries.

Beyond rapid population growth, cities in low- and middle-income countries (LMICs) are also increasingly vulnerable to the impact of climate change, including rising sea levels and storm surges, heat stress, extreme precipitation, inland and coastal flooding, and landslides. Cities are also significant contributors to climate change, accounting for 70% of global carbon emissions. While cities in LMICs have the substantially lower emissions per capita, if the world is to achieve net-zero emissions by 2050 these cities must grow without following the historic emissions trajectories of cities in high-income countries. The concurrent challenges of rapid urbanisation and climate change make it difficult for cities to plan and invest effectively in essential services and infrastructure. This is true for both megacities as well as rapidly growing intermediary cities. In response, many local governments are turning to digital solutions to fill critical data gaps, advance climate action, and enhance the accessibility, affordability and reliability of essential urban services.

Emerging in the 1990s but gaining prominence in the 2010s, the smart city agenda sets out the elements of digital transformation in the context of city-level services. A loose concept, "smart city" has no formal definition, with priorities and focus areas usually guided by national policy frameworks. Notably, India and China have large national smart city programmes with accompanying definitions.[3,4] In 2023 the United Nations adopted a resolution defining "people-centred smart cities", and the United Nations Human Settlement Programme (UN-Habitat) and their partners have flagship smart city programmes that support activities under this framework.

> *A smart city is "an innovative city that uses information and communication technologies and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.*
>
> UN Resolution HSP/HA.2/Res.1, 6 July 2023[5]

1. UN DESA. (n.d.). Around 2.5 billion more people will be living in cities by 2050, projects new UN report. Press release.
2. UN-Habitat. (2022). World Cities Report 2022: Envisaging the Future of Cities. Report.
3. Huang, K. et al. (2021). Characteristics and Problems of Smart City Development in China. *Smart Cities*.
4. Ministry of Urban Development, Government of India. (2015). Smart City Mission Statement and Guidelines. Policy document.
5. United Nations Habitat Assembly. (2023). Resolution HSP/HA.2/Res.1. Policy document.

Although the smart city concept has been in use for the past 30 to 40 years, in many contexts the digital foundations are only now in place. In a global survey of 250 municipalities the UN found that, on average, there was a national smart city plan in 54% of countries surveyed and 44% of municipalities.[6] Asian countries had the highest number of national plans (75%) while African countries had the least (36%). National plans were also more prevalent in upper-middle-income (70%), and lower-middle-income countries (56%) than in high-income countries (48%), and the least prevalent in low-income countries (29%). These strategies are supporting an increasingly wide range of use cases, and while cities in high-income countries continue to dominate smart city indices, more diverse and innovative use cases are being documented in LMICs.[7,8]

Mobile network operators (MNOs) play a central role in delivering smart city solutions. Since the emergence of the smart city concept, major technological changes have shifted the bounds of what is possible. Notably, 5G and network slicing, Low Power Wide Area (LPWA) connectivity, digital payment platforms and developments in artificial intelligence (AI) and digital twins. While the smart city agenda has been a high- and upper-middle-income country phenomenon, the rapid pace of digital adoption across LMICs has enabled smart city solutions to be deployed and scaled more widely, with operators playing a central role. With the growth in voice and data revenues slowing, it has become essential for operators to reposition themselves as digital service providers.[9] With the strong potential for growth across AI, the Internet of Things (IoT), cloud and edge computing, and digital payment-enabled use cases.[10]

Scope, structure and objectives of this report

This report takes stock of the trends shaping smart city deployments across Sub-Saharan Africa, South Asia and Southeast Asia. It aims to quantify the opportunities for mobile operators in these regions and highlights some of the approaches taken by governments to advance the smart city agenda. It also aims to demystify the hype around smart cities, providing examples, use cases and perspectives that clearly highlight how smart city interventions can support positive development outcomes and advance climate action, while also paying attention to risks such as data privacy, exclusion, inequality and capital intensity. Eight case study markets (Egypt, Nigeria, Kenya, South Africa, India, Indonesia, Malaysia, and Pakistan) anchor the discussion in national policy and implementation contexts.

- **Chapter 1 outlines some of the key trends shaping smart city projects.** This includes the digital foundations, the policy context, smart city development paradigms and financing considerations.
- **Chapter 2 presents new total addressable market forecasts to 2030** for key smart city solutions utilising IoT devices. This chapter also discusses how operators in LMICs are positioning themselves strategically to benefit from smart city market opportunities, and the business functions, use cases and themes they are prioritising.
- **Chapter 3 features eight market case studies with smart city developments and national market forecasts.** This chapter provides a deeper analysis of smart city market dynamics, growth forecasts and examples of MNO-led initiatives.
- **Chapter 4 summarises key insights into the evolution of smart cities in LMICs, and identifies important considerations for governments at the national and local level.** This chapter also draws conclusions on how smart cities can be harnessed to drive development and climate action, and how policymakers can navigate some of the trade-offs and risks associated with smart cities.

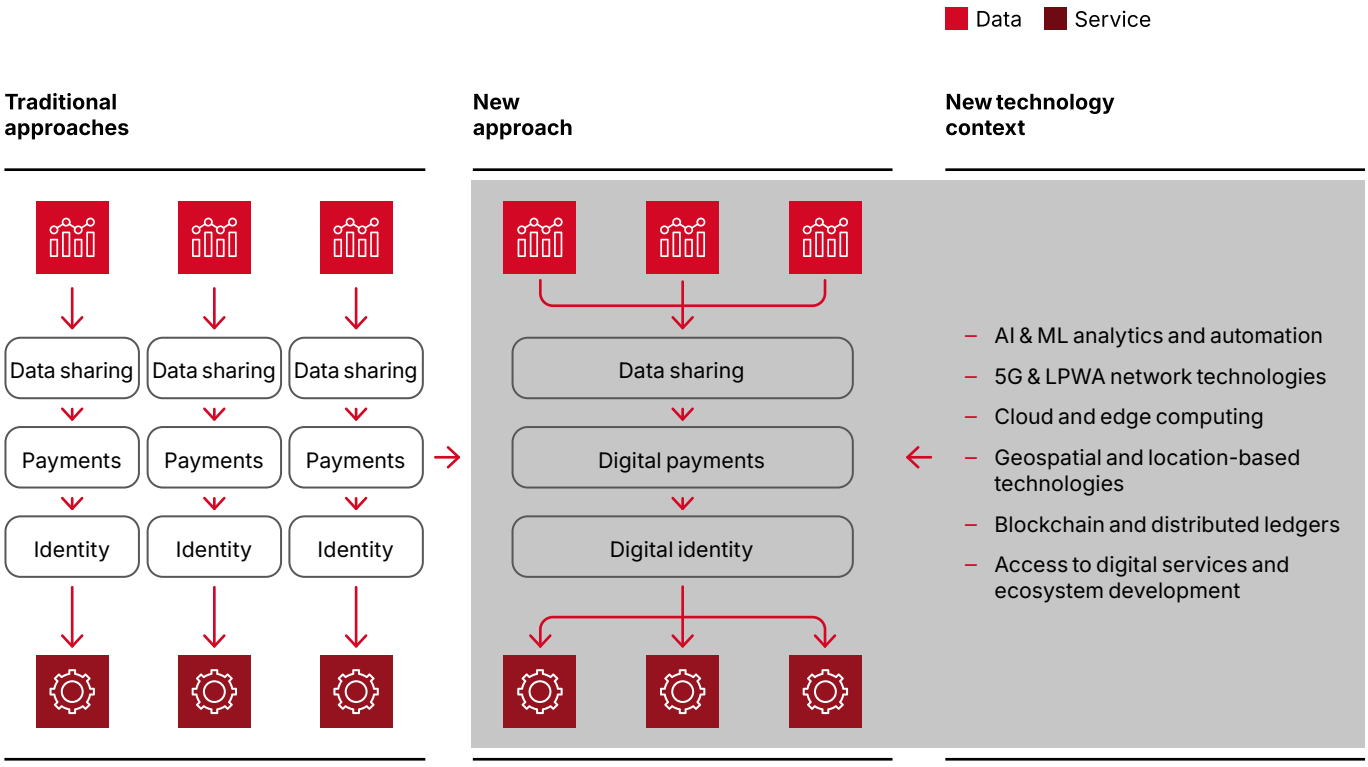
6. UN-Habitat. (2022). Global Review of Smart City Governance Practices. Report.
7. IMD. (2024). Smart City Index. Report
8. UN-Habitat. (2024). World Smart Cities Outlook. Report.
9. GSMAi. (2022). The changing shape of smart cities: new trends and new roles for operators. Report.
10. GSMA. (2023). IoT and Essential Utility Services: Opportunities in low- and middle-income countries. Report.

1.2 The digital foundations of smart cities

Regardless of the use case or service, there are fundamental building blocks and technology trends driving smart city deployments. All digital solutions rely to some extent on digital identity, digital payments and data exchange systems – all of which rest on connectivity. A key trend is for these to be deployed as interoperable, modular and reusable systems operating across an ecosystem, either in the form of digital public infrastructure (DPI), open networks, or through interoperable private services operating at scale.[11] These systems are fundamental to smart city deployments but particularly important for use cases related to tax or utility bill (person-to-government, P2G) payments and social security (government-to-person, G2P) payments. For most other smart city solutions (see Figure 3), AI, connectivity technologies and a well-developed digital ecosystem are often more significant drivers of adoption, particularly for solutions that require upfront investments in hardware for data acquisition of the automation of services. Although the drivers will vary between cities, sectors and countries, these changes are combining to create a new paradigm for smart city solutions.

Figure 1

Digitalisation for smart cities



Source: Authors, adapted from the World Bank Digital Progress and Trends Report 2023.

11. World Bank. (2025). Digital Public Infrastructure and Development: A World Bank Group Approach. Report.

The shift to open networks and platforms

There has been a major push in the past few years to enhance interoperability and data sharing for identity and payment use cases. DPI has been a major focus for many governments, with inspiration taken from India's national digitalisation project, India Stack. Beginning in the 2010s, the Government of India began rolling out a national biometric ID programme, Aadhaar, and today and as of 2025 the Government of India claim 99% of the adult population have been enrolled.[12] These IDs can be used in the banking sector for know-your-customer (KYC) verification, and are the main means by which government targeted payments are delivered to individuals. The second layer of the India Stack is the Unified Payments Interface (UPI), a platform that allows real-time payments between banks and fintech providers powered by an open-source API, as well as peer-to-peer (P2P) transactions. As of 2024, the UPI accounted for more than 80% of digital transactions in India.[13] Taken together, this combination of ID and payments enables targeted delivery of social payments and subsidies, usage-based pricing models and rapid distribution of disaster relief.

The UCL Institute for Innovation and Public Purpose is tracking DPI adoption globally and has identified 57 countries rolling out national ID systems and 93 countries with digital payment systems. It is also important to note that implementing DPI initiatives, and particularly national ID programmes, are not without risks. Especially where they become central to accessing government services, or digital services more broadly. With fraud, exclusion, identity cloning, and data leaks among some of the chief concerns. All of which were, at least partially, realised in the rollout of Aadhaar. With the growing prominence of DPI the UN recently published the first version of The Universal DPI Safeguards Framework which aims to provide countries with guidance on identifying and managing the risks.

Open networks are beginning to be deployed in certain sectors. India is again a leader in this area, with examples like the Unified Energy Interface (UEI) – an open network built on the Beckn Protocol that allows multiple energy producers and users to communicate, share data, and transact. The International Energy Agency (IEA) has highlighted that, in the context of more decentralised energy and the integration of renewables in grid power, combining information, payments and energy flows on digital networks like the UEI will be key for future energy systems.[14] These systems are particularly important for use cases like electric vehicle (EV) charging or ride hailing, where having access to a variety of service providers is key to building city-wide services.[15] Kochi's Open Mobility Network is an example of public and private transport integrated on a single network, while Yatri is a company using open networks for ride hailing. Use cases such as these promote interoperability while also preventing any single platform provider from dominating the market, empowering both consumers and individual service providers with access to a wider range of choices. With DPI gaining traction among policymakers in LMICs, there will be ample opportunities for cities to explore other DPI-enabled use cases, such as targeted subsidies for utility services, usage-based pricing models, and the rapid distribution of disaster relief. The trend of wider interoperability – whether through DPI, open network protocols like Beckn or opening existing networks through standardised APIs like the GSMA Open Gateway – is building new foundations for networked services.

Payments as a platform

In 2025 the mobile money ecosystem processed $1.68 trillion in transactions from 2.1 billion registered mobile money accounts.[16] In African countries in particular, mobile money is driving financial inclusion and enabling smart city use cases, providing secure digital payments between governments, citizens, utilities and private service providers. In the past 10 years, mobile money providers have shifted away from the "walled garden" approach to platform offerings and used open APIs to allow developers to access integrations. Many are built using the GSMA Mobile Money API, which provides a harmonised API specification for common mobile money use cases. Easy to use and secure, open APIs have been critical in improving interoperability and adoption of mobile money as a platform service.[17] This provides a strong foundation for third-party use cases by lowering the barriers to integration and giving users more choice. The implications for smart city use cases are discussed in more detail in Section 2.2.

12. Government of India. (n.d.). Approximately 99% of adult population has been enrolled in Aadhaar: UIDAI CEO. Press release.
13. The Digital Fifth. (2025). Crafting the Future of Real-Time Payments: From Less Cash to Cashless. Blog.
14. Foundation for Interoperability in the Digital Economy. (2025). Digital Energy Grid: A vision for a unified energy infrastructure. Report.
15. Government of India. (2024). White paper on EV: Catalysing Technology-led Ecosystem for e-Mobility. Report.
16. GSMA. (2025). The State of the Industry Report on Mobile Money 2024. Report.
17. GSMA. (2024). Open APIs for Mobile Money. Report.

Spotlight 1

GSMA Open Gateway

GSMA Open Gateway is a global framework of common network APIs that simplifies access to mobile operator networks. By providing developers and cloud providers a single point of access to the world's largest connectivity platform, Open Gateway accelerates service deployment and fosters innovation. It supports application portability and seamless user experiences, helping the telecom and tech industries realise the full potential of 5G. As of 2025, a memorandum of understating (MoU) supporting Open Gateway has been signed by 69 MNOs representing 79% of global mobile connections.

The full list of APIs under development or reaching maturity are on the CAMARA project website. CAMARA is an open source project within the Linux Foundation to define, develop and test the APIs.

Successful examples under Open Gateway include all four of Sri Lanka's network operators launching industry-wide network APIs, enabling developers and enterprises to reach more than 21 million Sri Lankans regardless of their operator.[18] In 2023, South African operators Cell C, MTN and Telkom used two universal network APIs to combat fraud and digital identity theft in sectors including banking, finance, insurance and retail.[19] Recently, the GSMA and Automotive Edge Computing Consortium (AECC) signed a formal agreement to work together to help the automotive industry bring new connected vehicle services to market faster, utilising the full functionality of 5G mobile networks. The two industry organisations will ensure interoperable and compatible technologies across a diverse range of connected vehicle platforms, enabled by the GSMA Open Gateway initiative. The collaboration aims to unlock the full potential of connected vehicle services and accelerate the adoption of next-generation automotive technologies. By ensuring common technology standards are in place, developers can more easily access MNO networks and edge computing functionality, wherever they are in the world.[20]

Connectivity: the core enabler

Smart city connectivity has evolved significantly from early systems when sensors transmitted data via SMS, to today's multilayered network environments that enable real-time data management. Connectivity options can be broadly understood as three overlapping layers of short-range, local and wide-area networks, each serving specific functions based on their range, energy efficiency and bandwidth requirements. Whether a network technology is appropriate for a use case depends on three factors: range and roaming (if devices move or are located over wide areas), bandwidth and latency (the amount of data and how quickly it needs to be transferred) and cost (access to devices and their battery requirements).

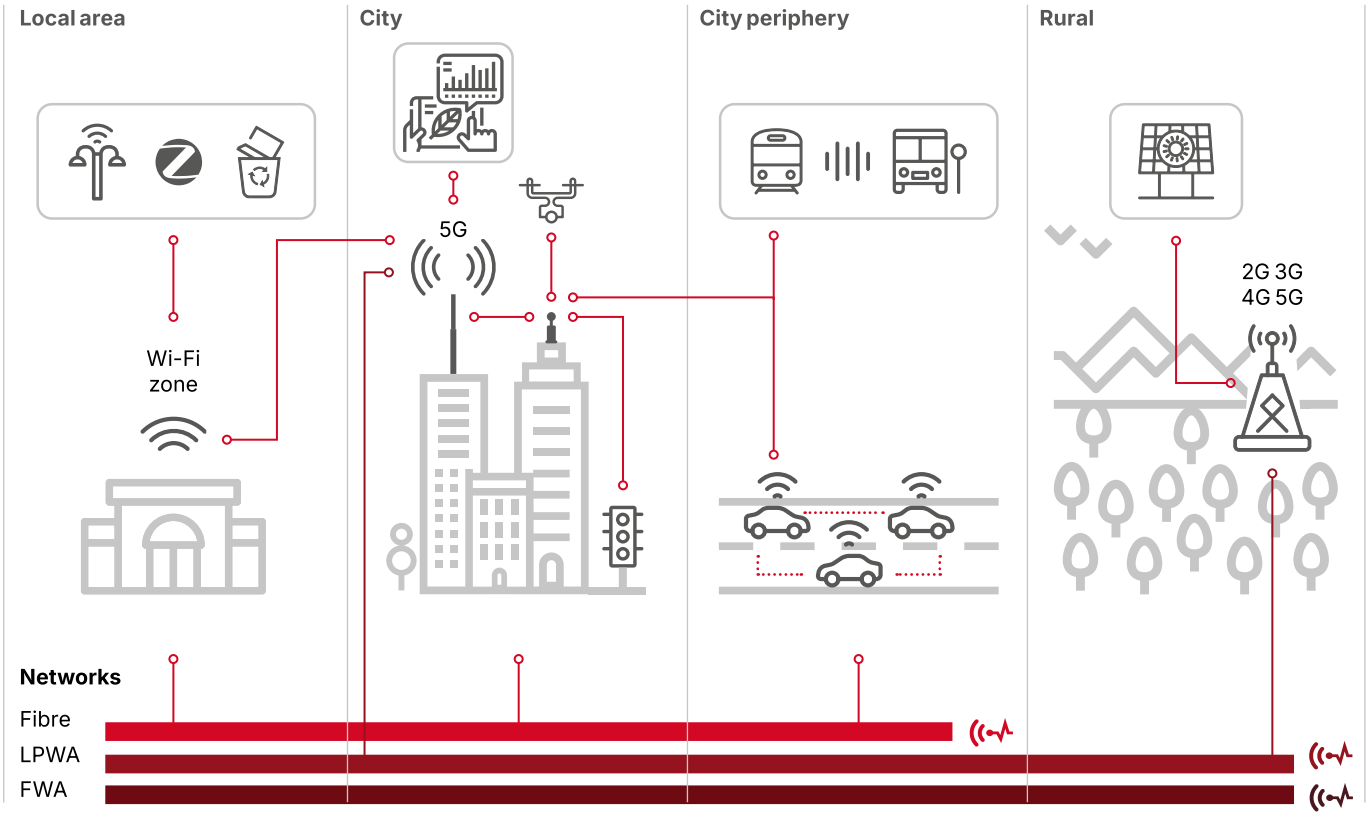
Short-range technologies, such as Bluetooth, near field communication (NFC), Zigbee and infrared, operate over just a few metres and are typically embedded in personal devices. These technologies are valued for their low cost, low power consumption and device compatibility. For instance, Bluetooth is widely used in health monitoring devices in India's smart clinics, while Zigbee supports smart lighting systems in parts of South Africa. NFC is widely used in contactless ticketing, including in Indonesia's urban transit systems and in Malaysia's mobile payment government service apps.

Local connectivity expands the range to neighbourhoods, buildings or campuses through technologies like ethernet, powerline communication and Wi-Fi. One of the most significant enablers in this category is public Wi-Fi, which serves as a gateway for digital inclusion and local service delivery and is a major focus in cities in middle-income countries. Examples include Wi-Fi in public markets and youth centres in Mombasa and Nairobi, public hotspots in parks and transport hubs in Lagos, 1,300 free hotspots in Cape Town via the SmartCape initiative, Wi-Fi in high-traffic zones to support CCTV and public access in Punjab and India's ambitious PM-WANI scheme is rapidly expanding public Wi-Fi in railway stations and urban neighbourhoods.

18. Dialog. (2023). Sri Lanka's Four Mobile Operators Commercially Launch Country-Wide Network APIs. Press release.
19. GSMA. (2025). South African mobile operators announce new services to combat fraud, as part of GSMA Open Gateway initiative. Press release.
20. GSMA. (2024). GSMA and Automotive Edge Computing Consortium Work Together. Press release.

Figure 2

Network technologies and use cases



Source: GSMA

Wide-area connectivity encompasses cellular networks (2G to 5G), LPWA and satellite systems, each suited for citywide and nationwide coverage. In recent years, many countries have been decommissioning legacy 2G and 3G networks to reallocate valuable spectrum for more advanced technologies. This shift enables 4G and 5G to deliver significantly higher data rates, lower latency and support more simultaneous connections. With 5G deployments still in their early stages, 4G LTE has become the foundation for services such as real-time traffic monitoring, mobile health delivery, digital identity systems and remote learning platforms. Europe and Asia Pacific have established themselves as regional leaders, with Europe leading in 3G sunset and Asia Pacific in 2G sunsets. Network shutdowns are less common in Sub-Saharan Africa, where less than 10% and 5% of countries are decommissioning their 2G and 3G networks, respectively. South Africa is currently the only Sub-Saharan African country with a formal plan to retire both 2G and 3G networks by 2027.[21]

The three connectivity groups (short-range, local and wide-area networks) form a dynamic and complementary ecosystem supported by fibre optic networks and fixed wireless access (FWA). Fibre networks are the backbone of smart city deployments, linking mobile base stations, Wi-Fi hotspots and municipal data centres through ultra-fast, low-latency connections. The mix of connectivity options available in a market are a key determinant of the range and cost of the use cases that can be deployed. Section 2.2 discusses the evolving connectivity options and mobile operator roles, and the GSMA report, *IoT for Development*, provides more detail on identifying use case-network fit, and provides connectivity data for the focus regions in this report.[22]

21. GSMAi. (2025). Network Sunsets, Q4 2024. Report.
22. GSMA. (2023). IoT for Development: Use cases delivering impact. Report.

AI: a generation-defining technology

Recent advances in AI, particularly large language models, have created new capabilities and use cases. Machine learning (ML) and other predictive AI technologies have long been central to smart grids and other solutions as they predict demand and enable smoother integration of renewables. Recent advancements in generative AI enhance this capacity, primarily by allowing new data sets to be generated and a much wider range of data to be processed.[23] Some of the clearest use cases are transport (traffic flow optimisation and projection, or multimodal transport applications), energy (smart grids and load forecasting, digital twins for scenario planning), citizen engagement (AI chatbots and citizen feedback analysis) and climate assessments (air quality monitoring, urban heat island monitoring).

AI also amplifies the opportunities and risks of existing solutions. This primarily relates to the governance and regulation of the use of AI, which is still evolving in most countries. Such regulations will be particularly relevant to the use cases with the greatest ethical concerns, such as facial recognition and surveillance. The explosion of AI has brought into sharp focus the energy and water requirements of data centres, which combined with data sovereignty and localisation, highlight the need for many nations to rapidly develop data infrastructure, putting pressure on energy, water and financial resources.[24] This is not, however, a zero-sum game. In the context of insufficient or intermittent grid infrastructure, the need for more and stable power can be a catalyst for broader investment in energy systems and provide utilities with a reliable off-taker for power purchase agreements (PPAs).[25] This logic is similar to investing in mini-grids to power remote tower sites in mobile networks while also serving surrounding communities.[26]

1.3 Key actors and solutions

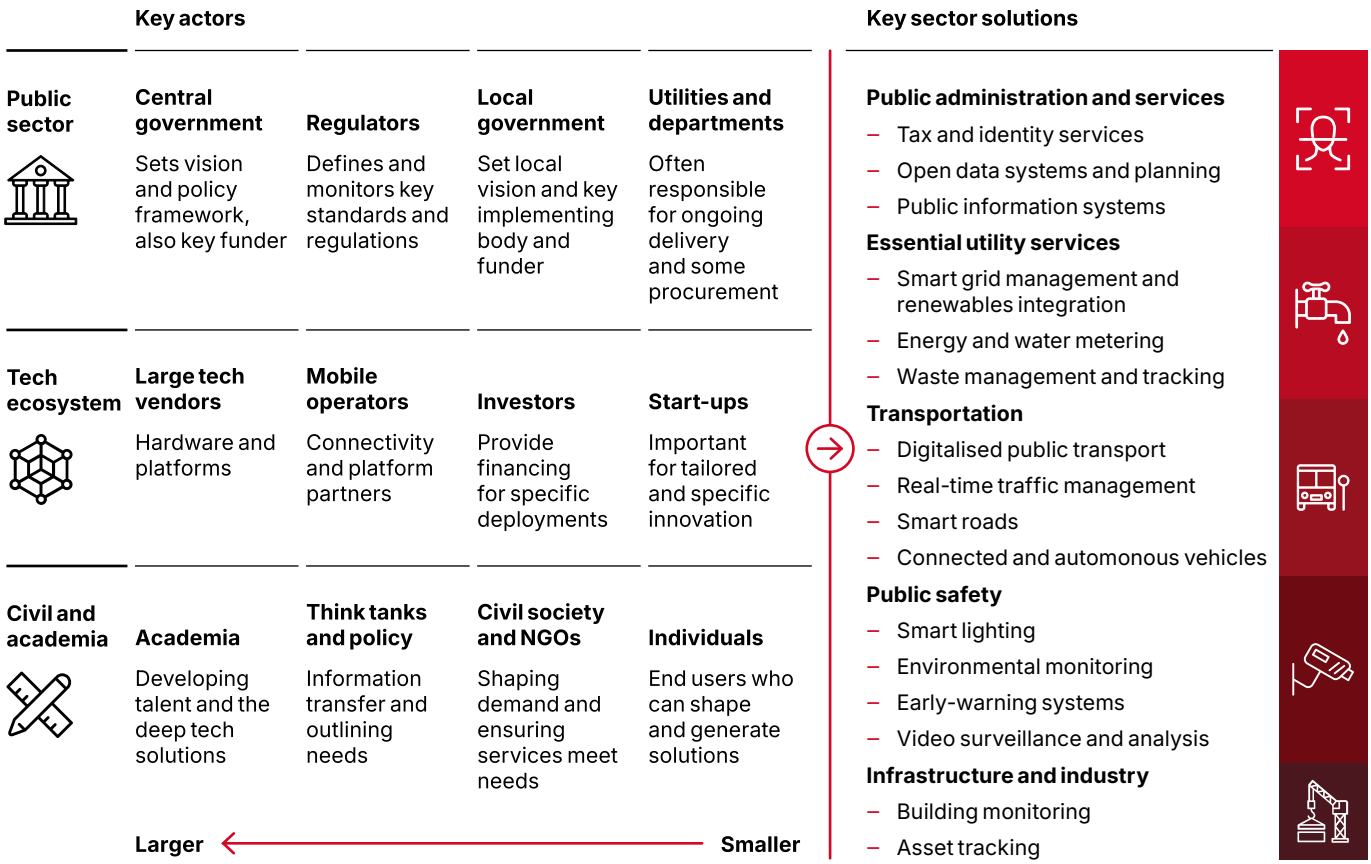
Smart city deployments are, by necessity, multi-stakeholder endeavours, with the complexity of implementation reflecting the complexity of city systems. Coordinated policy between different tiers of government and regulators provide the basis for delivery and need to cover a wide range of issues, from data sovereignty and privacy considerations to the nuts and bolts of public procurement and technical standards. An added complexity is that, in many cases, urban service providers – utilities, transport or waste management authorities – may be either publicly run, operated privately or a mix of the two through state-owned enterprises or systems that blend responsibilities. This complexity requires both city-level coordination and considerations of how smart city technologies are incorporated in concession or service-level agreements. Similarly, delivering across the technology value chain – devices, connectivity and applications – often requires engaging a range of actors, with start-ups a key source of innovation for certain sectors or services. Finally, ensuring services are inclusive and responding to needs requires strong civic engagement and feedback mechanisms between those commissioning and delivering the solutions and those they are intended to benefit.

Smart city and city competitiveness indices are often designed to reflect the supply and demand side of service delivery. Connectivity services, an adequate policy framework, access to capital and technology and the digital skills to implement them, are all essential to providing solutions. Equally important is the demand-side: what makes it necessary. In many contexts, the combination of rapid urbanisation and service gaps have created clear areas where digital technology can enable new service models. The infrastructure deficit in sectors such as waste, energy and transport create opportunities to pursue digital-first approaches to developing new services, for example, smarter grids that integrate renewables or electric and multi-modal transport systems. Smart city interventions can also carry risk, particularly in terms of privacy and security. This is most notable in cases where smart city infrastructure can be used to repress protest, or the use of facial recognition.[27]

23. GSMA. (2024). AI for Africa: Use cases delivering impact. Report.
24. African Union. (2024). Continental Artificial Intelligence Strategy. Policy Document.
25. Mutiso, R. (2024). "AI in Africa: Basics Over Buzz". Science
26. GSMA. (2024). Why and how mobile operators are looking to renewables to power networks across Africa. Blog.
27. Privacy International. (2021). Mapping Huawei's Smart Cities creep. Blog.

Figure 3

Key smart actors and use cases



Source: Authors, adapted from Arup and ThinkCity. (2021). Smart City Handbook: Malaysia.

1.4 National strategies

Dedicated national smart city strategies are a relatively recent development and are not yet widespread. Instead, smart city objectives are more often embedded across national urbanisation plans, digital transformation agendas and/or long-term national visions. Six of the eight focus countries in this study – India, Indonesia, Egypt, Malaysia, Nigeria and South Africa – have adopted stand-alone smart city policies, while Kenya's and Pakistan's smart city policy frameworks are embedded in existing sectoral strategies. For example, Egypt's approach to smart cities is anchored in its National Urban Policy and Vision 2030, and Kenya's priorities are situated within the Vision 2030 framework and the National Digital Master Plan.[28,29]

While most smart city strategies have been driven by national agendas, some local governments have acted independently, often ahead of national frameworks. In Indonesia, for example, cities like Bandung and Jakarta launched their own smart city programmes in 2013 and 2014, respectively, well before the national 100 Smart Cities Movement was launched in 2017.[30,31] A similar trajectory occurred in South Africa, where the City of Johannesburg began shaping a smart city vision shortly after the 2010 FIFA World Cup. The city established a Smart City Office, incorporated smart city planning in its Integrated Development Plan in 2013, and formally launched a Smart City Strategy in 2020, preceding the

28. UN-Habitat. (n.d.). Urban Policy Platform: Egypt County Profile. Webpage.
29. See: Konza Technopolis
30. Sholeh, C. et al. (2019). Formulation of Innovation Policy: Case of Bandung Smart City, JSP
31. Wulandari, W. and Munawaroh, S. (2020). "The Implementation of Smart City in Creating Innovations of Public Services". Jurnal Caraka Prabu

national Smart Cities Framework introduced by the Department of Cooperative Governance in 2021.[32]

Smart city initiatives are managed primarily by municipal governments, although with variation in the degree to which specialised units are established. In Cape Town, Lagos and Islamabad, smart city initiatives are pursued through existing municipal departments or sector-specific agencies. Other countries have adopted a hybrid model with decentralised and formalised. In Malaysia, PLANMalaysia, a department under the Ministry of Housing and Local Government, provides strategic guidance while actively encouraging subnational governments to develop their own local smart city strategies. India's Smart Cities Mission (SCM) was deployed with a very specific delivery structure: the Ministry of Housing and Urban Affairs provided funding and oversight, while cities were required to establish Special Purpose Vehicles (SPVs) to manage implementation. These SPVs serve as dedicated, multi-level institutions with representation from national, state and local governments.[33]

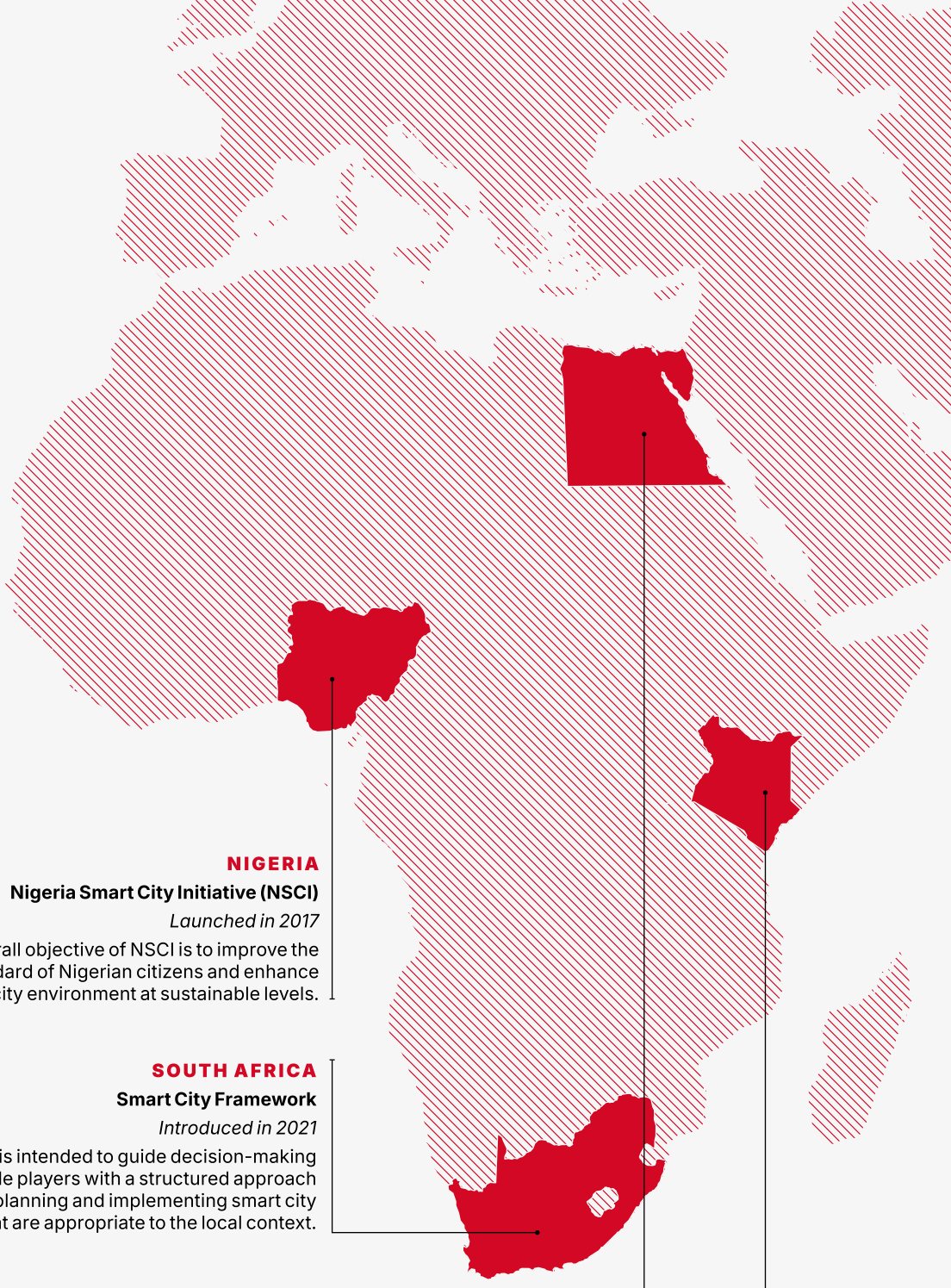
A common thread across the eight countries is an emphasis on climate- and people-centred development in smart city policies. While earlier strategies focused largely on infrastructure and emerging technologies, newer frameworks are increasingly linking technology to sustainable development, urban resilience, inclusive service delivery and citizen engagement. This shift reflects the recognition that technological advancement must align with social inclusion, respond to the needs of residents and help build trust in public services. It also reflects a growing recognition that cities are at the forefront of climate action.

In the context of climate change, cities must adopt innovative and integrated urban planning strategies that simultaneously address climate adaptation, mitigation, as well as broader urban planning and development challenges. Coastal flooding and landslides are particular risks because urban development is often informal, creating sprawling, unplanned urban areas with little adaptive capacity. Increasingly, UN agencies and climate investment funds are explicitly supporting cities through "climate-smart city" challenges to accelerate innovative responses to climate mitigation, adaptation and resilience priorities. The focus on climate resilience and disaster preparedness is reflected in the policy frameworks of some of the focus countries. In Indonesia, for example, the National Medium-Term Development Plan 2020–2024 calls for the development of green, disaster-resilient cities, promoting alignment between urban growth, disaster risk management and nature-based solutions.[34] This focus is echoed in Indonesia's National Urban Development Policy, which defines resilience as a core pillar of sustainable urban development. At the city-level, Jakarta's Mid-Term Development Plan and Resilience Strategy emphasises the integration of digital solutions to tackle urban challenges such as flood management and waste reduction.

The digital pillars of smart city strategies

Connectivity and broadband infrastructure are key to the implementation of national strategies. This is often expressed through commitments to expand broadband access through fibre, public Wi-Fi, mobile networks (3G/4G/5G) and fixed wireless access. In Kenya, the Digital Master Plan 2022–2032 identifies broadband development as central to national digital transformation, setting targets such as the deployment of 100,000 kilometres of fibre-optic cable. These efforts are linked to broader goals such as automating public services, institutionalising data-driven governance and creating an enabling environment to attract private-sector innovation.[35] Malaysia's Smart City Framework embeds connectivity as one of its seven core components, recognising it as a prerequisite for smart mobility, e-governance and sustainable urban services.[36] In Indonesia, the 100 Smart Cities Movement, RPJMN (2020–2024) and the Digital Roadmap policies position broadband connectivity as the foundation for Indonesia's digital transformation.[37,38] This emphasis on digital infrastructure is also evident at the subnational level, where cities such as Kuala Lumpur, Nairobi and Jakarta have placed broadband at the core of their smart city ambitions.

32. UN-Habitat. (n.d.). Urban Policy Platform: Egypt County Profile. Webpage.
33. See: Smart Cities Mission India
34. World Bank. (2019). Strengthening the Disaster Resilience of Indonesian Cities. Report.
35. Government of Kenya. (2022). Kenya Digital Masterplan 2022–2032. Policy Document.
36. Government of Malysia. (2018). Malaysia Smart City Framework. Policy Document.
37. GSMA. (2023). Forging a resilient digital nation: proposals for Indonesia's future. Report.
38. IBM. (2023). Realizing Indonesia's Digital Transformation Ambition: From AI to IoT. Blog.



NIGERIA

Nigeria Smart City Initiative (NSCI)

Launched in 2017

The overall objective of NSCI is to improve the living standard of Nigerian citizens and enhance the city environment at sustainable levels.

SOUTH AFRICA

Smart City Framework

Introduced in 2021

The framework is intended to guide decision-making and provide all role players with a structured approach for identifying, planning and implementing smart city initiatives that are appropriate to the local context.

EGYPT

National Smart Cities Strategy

Introduced in 2024

The overall objective of the strategy is to provide a comprehensive framework to guide the country's urban development towards a more sustainable, equitable, and technologically advanced future.

KENYA

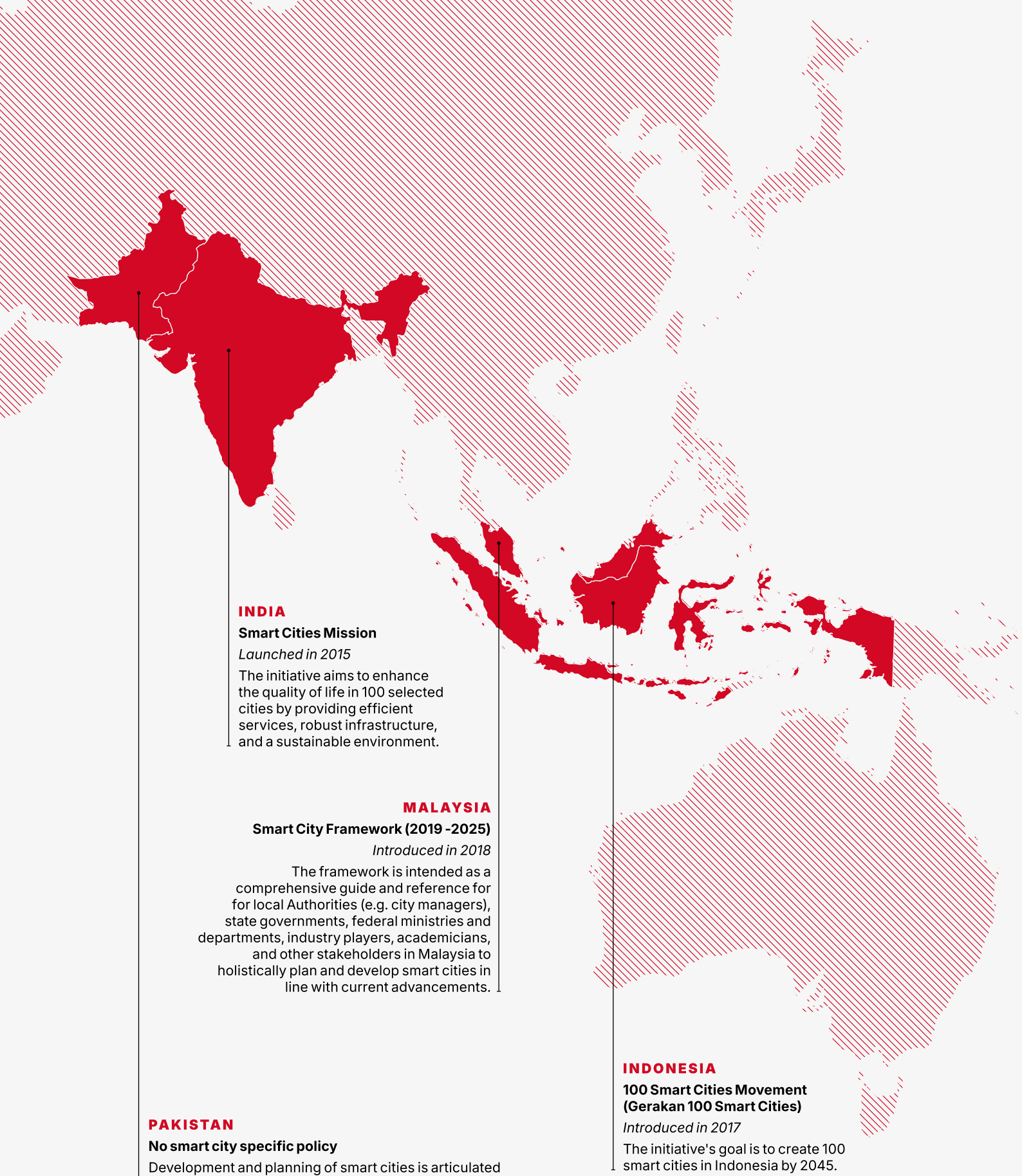
No smart city specific policy

Smart city initiatives are guided by Kenya's Vision 2030, launched in 2008.

In the vision, smart cities principles are embedded within key flagship projects and strategic objectives

Figure 4

Map of national strategies



INDIA

Smart Cities Mission

Launched in 2015

The initiative aims to enhance the quality of life in 100 selected cities by providing efficient services, robust infrastructure, and a sustainable environment.

MALAYSIA

Smart City Framework (2019 -2025)

Introduced in 2018

The framework is intended as a comprehensive guide and reference for for local Authorities (e.g. city managers), state governments, federal ministries and departments, industry players, academicians, and other stakeholders in Malaysia to holistically plan and develop smart cities in line with current advancements.

INDONESIA

100 Smart Cities Movement (Gerakan 100 Smart Cities)

Introduced in 2017

The initiative's goal is to create 100 smart cities in Indonesia by 2045.

PAKISTAN

No smart city specific policy

Development and planning of smart cities is articulated in the Pakistan Vision 2025, launched in 2014.

Pillar 2 of the vision aims to achieve sustained, indigenous, and inclusive growth. A key step towards this is to reform urban areas, serving as the foundational stage for developing smart cities.

For a list of other key policies supporting smart city development in these countries, please see the annex

Emerging technologies – IoT, AI, GIS, cloud computing and open data platforms – are framed as critical building blocks for smart city development and digital governance. For example, Egypt and Pakistan have both taken early steps to formalise the role of IoT through national regulatory frameworks. Both frameworks (2022) seek to guide service deployment, attract investment and overcome adoption barriers.[39] India, Pakistan and Indonesia have also adopted national AI strategies, and Malaysia recently approved the establishment of a national AI office to support the adoption and regulation of AI. AI is a priority for governments in South and Southeast Asia because it offers scalable, cost-effective solutions to pressing challenges such as rapid urbanisation, resource management, public health, education and disaster preparedness. These national priorities are also reflected at the city level, where institutions like Punjab's Urban Unit have digitalised urban planning processes by converting traditional master plans into GIS-based platforms. This has enabled the creation of high-resolution geospatial datasets on roads, utilities, land parcels and public infrastructure in cities like Lahore.[40] The Ahmedabad Municipal Corporation has launched an AI-powered dashcam system to enhance civic monitoring. Mounted on municipal vehicles, these smart cameras detect issues like potholes, broken streetlights, garbage accumulation and traffic violations. The system captures and geotags short video clips or images of incidents, transmitting them in real time to a central control room for analysis.

Data governance: spotlight on South Africa and India

India and South Africa have some of the more advanced data governance models among the countries reviewed. In India, Integrated Command and Control Centres (ICCCs) were mandated under the Smart Cities Mission, and by 2023 all 100 cities in the programme had operational centres.[41] These centres consolidate data from multiple municipal services, such as solid waste management, water supply, street lighting, public transport and emergency response, into a single digital dashboard. This real-time integration allows city administrators to monitor service performance, detect faults or delays and deploy resources more efficiently. The model has since expanded to cities like Mumbai, which were not part of the SCM. The centres consolidate data across departments, reducing the need for multiple systems, and act as a hub for deploying AI-enabled tools across departments.[42] To support systematic data use, the government also introduced the DataSmart Cities Strategy, aimed at helping cities generate, share and use data more effectively. The strategy led to the creation of several national urban data platforms, including the India Urban Data Exchange (IUDX), the Smart Cities Open Data Platform (SCODP), the India Urban Observatory (IUO) and the Smart Code Platform.

Such platforms integrate with city command centres and enable data exchange and storage among city governments, civil society, academia, industry, businesses and citizens.[43] In many cases, a key function of these platforms is integrating the use of privately held data in public planning and service delivery. Integrating third-party and innovative data sources is particularly important for public sector institutions operating in a data-scarce environment.[44] For example, the IUO aggregates and analyses data from diverse sources, including sensor networks, social media and third-party providers, to support planning and performance tracking. The SCODP, meanwhile, serves as a single point of access for publicly available datasets. The platform currently hosts more than 3,300 datasets on various sectors from the 100 smart cities, with each city initially expected to publish at least 50 datasets. Complementing this is the National Urban Learning Platform (NULP), a digital capacity-building initiative that equips municipal officials, administrators and citizens with the skills to manage and adapt these tools effectively. NULP also functions as a knowledge-sharing platform, helping cities replicate successful service delivery innovations. India has also launched initiatives to expand access to digital services, such as PM-WANI, a nationwide programme aimed at providing public Wi-Fi through a decentralised network of community providers.

39. Pakistan Telecommunication Authority. (16 February 2022). "PTA Issues Regulatory Framework for SRD and IoT Services". Press release.
40. Ahmed, N. (2022). The Challenges of Using Data in Urban Planning in Pakistan, International Journal of Urban and Regional Planning
41. Press Information Bureau. (15 March 2023). Integrated Command and Control Centers operationalized in all 100 smart cities. Press release.
42. Ministry of Housing and Urban Affairs, Government of India. (n.d.) DataSmart Cities: Empowering Cities through Data
43. World Economic Forum. (2020). Technology and Data Governance In Cities. Report.
44. GSMA. (2021). Innovative Data for Urban Planning: The Opportunities and Challenges of Public-Private Data Partnerships. Report.

Figure 5

Key outcomes under India's Smart Cities Mission

7,846 PROJECTS

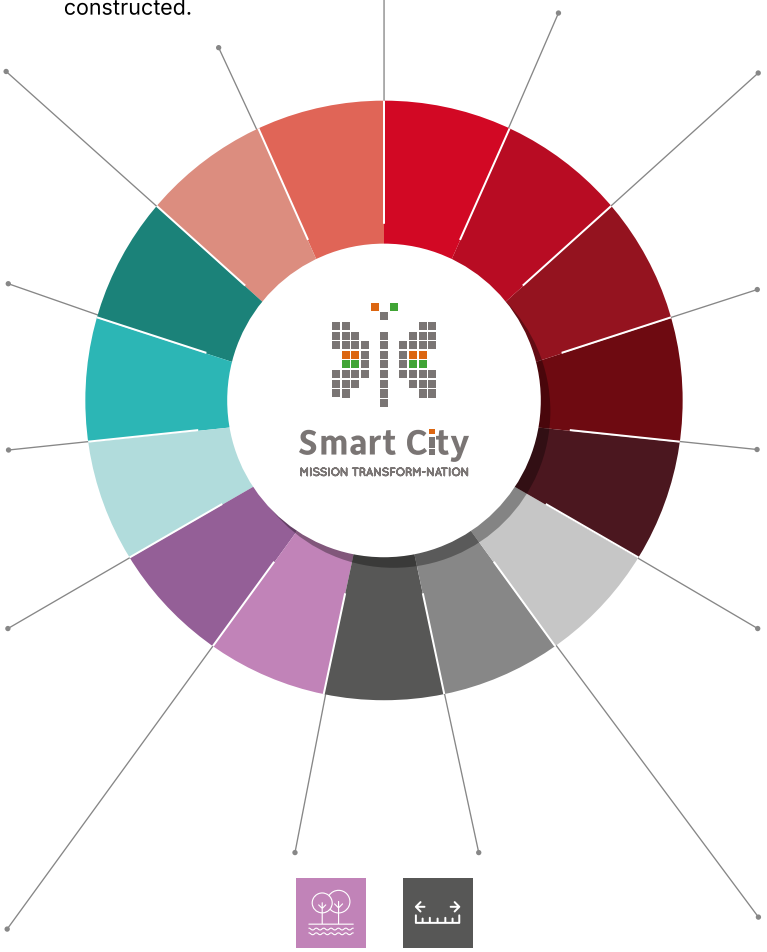
$22 BILLION

Public Safety and Security:
Over 76,000 video surveillance cameras, 1,844 emergency call boxes, 3,000 public addressal systems, RLVD, ANPR installed across 100 Smart Cities.

Improved Solid Waste Management (SWM):
Increased use of technology for improved SWM across 50 Smart Cities. Over 4,800 solid waste collection vehicles RFID enabled for Automatic Vehicle Location (AVL).

Mobility:
Over 7500 public transportation buses deployed, including over 2000 e-buses; over 5,000 bus stops developed; over 2,500 km of smart roads constructed.

National Challenges:
Local action for sustainable transformations through "Challenges". Examples: Cycles4Change, Streets4People, Placemaking Marathons, Nurturing Neighbourhoods, Transport4All, EatSmart Cities.



Economic Hubs:
38 incubation centres/ skill development centres developed.

Integrated Command and Control Centres (ICCC):
ICCCs in 100 Smart for evidence-based policy and decisions.

Health:
308 e-health centres and clinics, 255 health ATMs developed.

Improved Water Supply:
Over 6,800 km of water supply systems monitored through SCADA, leading to reduced non-revenue water and leakages.

Education:
6,855 smart classrooms, 40 digital libraries, 1600 Anganwadis developed

Streetlights and Electrification:
More than 50 Lakhs Solar/ LED streetlights installed; 89,000 kms of underground electricity cabling.

PPP:
210 projects worth USD 1.83 billion under PPP across 50 cities.

Climate Resilience:
Environmental sensors installed; 5,300 personnel and volunteers trained for disaster response.

Vibrant Public Spaces:
Over 1300 projects to improve public spaces across 100 Smart Cities, 180 waterfront projects across 47 Smart Cities, over 200 markets redeveloped across 68 Smart Cities, 170 projects with focus on cultural heritage.

Assessment Frameworks:
100,000 datapoints across 14 sectors and 250 cities through indices and frameworks. Examples: Ease of Living Index, Municipal Performance Index, Data Maturity Assessment Framework and ClimateSmart Cities Assessment Framework.

Affordable Housing and Shelter:
44,054 dwelling units constructed, 6,312 rooms built in community housing projects like Rain Basera, hostels, night shelters, etc.

Source: UN-Habitat. MoHUA, GoI. (2023). Smart Cities Mission, India: Localizing Sustainable Development Goals.

South Africa stands out for its relatively early and structured approach to urban data governance, with several initiatives dating back to the mid-2010s. One of the earliest examples of this commitment is the South African Cities Open Data Almanac (SCODA), developed in 2015 in collaboration with the South African Cities Network. SCODA was envisioned as a centralised, open-source data platform where municipalities could upload and manage urban data in real time or via scheduled updates. While it fell short of expectations, the initiative was an early step towards using data as a governance tool, and laid the groundwork for municipal data initiatives.[45] A notable outcome of this early work is the City of Cape Town's Open Data Portal. The portal hosts more than 160 datasets across 15 thematic areas, including basic services and infrastructure, economic development and transportation. The portal is updated regularly and managed by the city's Information and Technology Services Department in accordance with its Open Data Policy.[46]

At the national level, South Africa has been strengthening its data governance framework through enabling policies such as the recent South African National Policy on Data and Cloud.[47] The policy sets out a comprehensive framework for cloud-based data storage, cross-border data standards, cybersecurity and consumer protection. Notably, the policy outlines interventions such as the Data for Development Framework, which was developed to ensure timely, secure and equitable access to private-sector data, particularly for MSMEs, startups and individuals. It also affirms the government's goal of 100% broadband coverage by 2030, with plans to consolidate data into unified, cloud-enabled public data centres to promote interoperability and reduce cost inefficiencies.

Cities in South Africa are also increasingly focused on public-private data sharing to inform policymaking and planning. In the digital era, the private sector generates and holds vast amounts of data that could be useful for policymakers, such as mobile operator data, mobility data from ride-sharing companies, transaction data or social media data. The City of Cape Town and the International Growth Centre have been exploring how the city can use such data most effectively, what partnerships and data-sharing frameworks should be put in place and what internal capabilities the city needs to translate data insights into policy outcomes.[48]

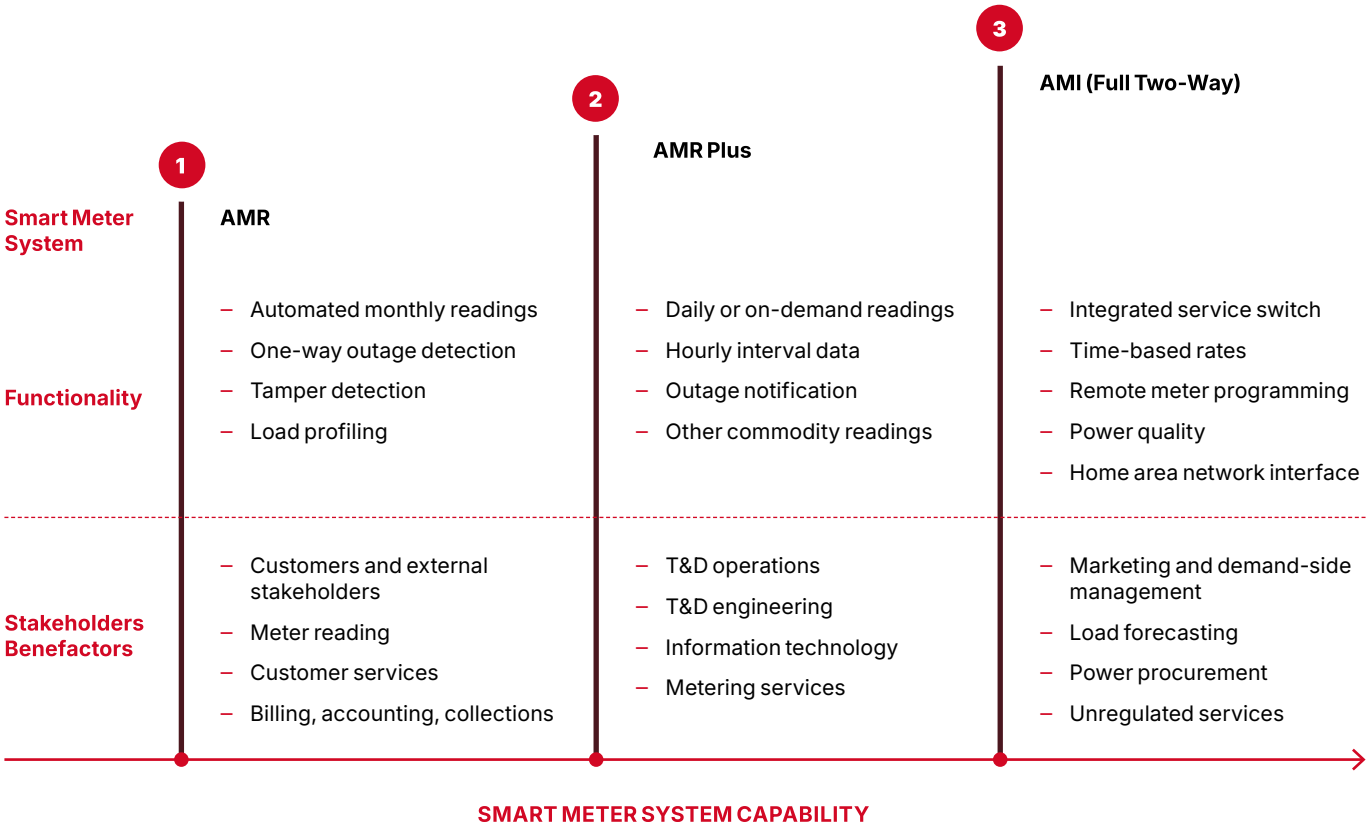
Sectoral approaches to smart cities: smart grids and smart metering in the power sector

Smart meter technology has evolved from basic AMR (Automatic Meter Reading) to advanced AMI (Advanced Metering Infrastructure), increasing functionality such as integrated service switching, time-based rates, remote meter programming and home area network interfaces. This allows for more sophisticated use cases that benefit both utilities and consumers, such as load forecasting, demand-side management, strategic marketing and power procurement. By the end of 2023, utility service providers globally are projected to have installed more than 1.06 billion smart meters for electricity, gas and water. North America leads in smart electricity meter adoption (76% market penetration) followed by Asia Pacific driven by nationwide deployments in China and Japan (49% market penetration), and Europe, where adoption differs greatly by country (47% market penetration). While North America, Europe and East Asia have mature markets for smart meters, South Asia, Latin America and Africa have high-growth potential.

45. OneCity. (2021). Urban Data and Analytics in Johannesburg and South Africa. Blog.
46. City of Cape Town. (2020). Open Data Policy. Policy document.
47. Department of Communications and Digital Technologies. (2024). National Policy on Data and Cloud. Policy document.
48. International Growth Centre. (2023). Data and research as key enablers of city outcomes: A case study of the City of Cape Town. Report

Figure 6

The evolution of smart meters

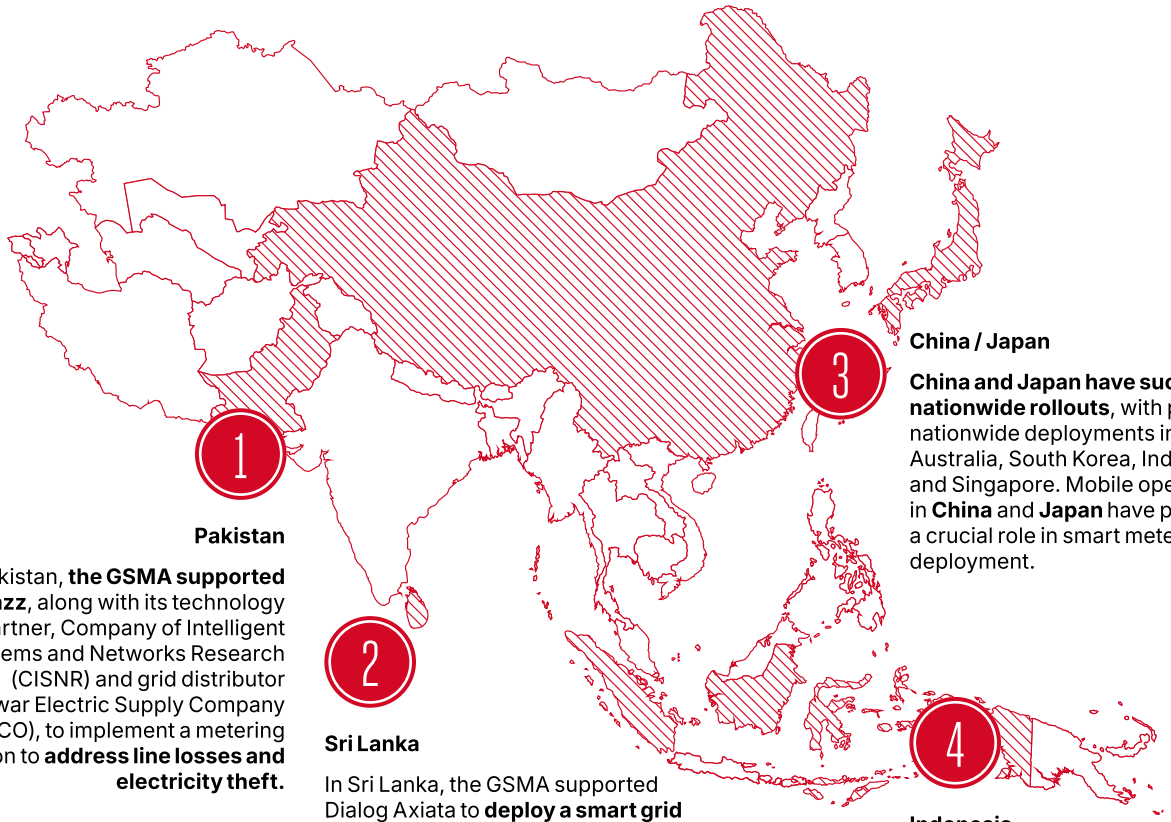


Source: World Bank. (2019). Can Utilities Realise the Benefits of AMI Infrastructure?

Globally, the adoption of smart meters is driven primarily by the need for enhanced revenue collection, reliability improvements, integration of renewable energy, real-time data exchange and opportunities for new products and services. Institutional capacity, effective procurement and technology acquisition, progressive regulation with a focus on interoperability and the standardisation of communication protocols, as well as comprehensive customer engagement, have been key to the long-term success of smart meter deployments worldwide. As highlighted by the GSMA Innovation Fund support for startups in the energy sector, mobile operators have been key partners in the digital transformation of utilities across South and Southeast Asia (see Figure 7).

Figure 7

Operator engagement with smart grid solutions in South and Southeast Asia



Pakistan

In Pakistan, **the GSMA supported Jazz**, along with its technology partner, Company of Intelligent Systems and Networks Research (CISNR) and grid distributor Peshawar Electric Supply Company (PESCO), to implement a metering solution to **address line losses and electricity theft.**

Sri Lanka

In Sri Lanka, the GSMA supported Dialog Axiata to **deploy a smart grid solution** in partnership with Lanka Electricity Company and the Dialog-University of Moratuwa Mobile Communications Research Laboratory.

China / Japan

China and Japan have successful nationwide rollouts, with planned nationwide deployments in Australia, South Korea, Indonesia, and Singapore. Mobile operators in **China** and **Japan** have played a crucial role in smart meter deployment.

Indonesia

In Indonesia, the State Electricity Corporation PNL partnered with Telkomsel to implement **advanced metering infrastructure (AMI) using the operator's NB-IoT network.**

From a national policy perspective, the Revamped Distribution Sector Scheme (RDSS), introduced by the Government of India in 2021, represents one of the world's most ambitious smart meter initiatives, aiming to replace 250 million conventional meters by 2026. For several years, the financial performance of distribution companies (DISCOMs) has been a critical issue for policymakers. High aggregate technical and commercial (AT&C) losses, delayed tariff revisions, increasing debt, long-term PPA lock-ins, theft and grid instability have all resulted in financial losses for energy utilities. In India over the past three years, there have been several partnerships between operators, advanced metering infrastructure service providers and energy utilities in India:

- Airtel partnered with IntelliSmart (20 million smart meters), Secure Meters (1.3 million smart meters in Bihar), Avon Meters, TP Western Odisha Distribution Limited (200,000 smart meters in Odisha) and, more recently, Adani Energy Solutions Limited to deploy 20 million smart meters.
- Jio and Tata Power Delhi Distribution launched a smart metering solution for households using the MNO's NB-IoT network. Jio also partnered with Energy Efficiency Services Limited to deploy 1 million smart meters in Bihar.
- Vodafone-Idea partnered with IoT platform provider Trilliant to deploy more than 1.5 million smart meters for seven utilities in Haryana and Uttar Pradesh.

These partnerships highlight how power sector reforms and government mandates have spurred the digital transformation of utilities across India and created significant market opportunities for MNOs. The energy sector reforms in India have already reduced technical and commercial losses from 22% in 2021 to 16% in 2022. Financial losses of energy utilities have also come down, from Rs. 46,521 crore[49] ($5.6 billion) in 2021 to Rs. 31,026 crore ($3.7 billion) in 2022.[50]

While India has made some progress, several challenges remain. Government data shows that more than 222 million smart meter tenders have been approved, of which 115 million smart meter contracts have been awarded, but only 16 million meters (7%) have been installed. A GSMA forum convening stakeholders in India's smart meter ecosystem, such as utilities, mobile operators, national regulators, local government stakeholders, metering companies and private-sector innovators, highlighted the importance of cross-sector and cross-government coordination to break down silos and rapidly identify and address barriers to implementation. It also highlighted the crucial role that cities, local governments and the Ministry of Urban Affairs must play in smart meter roll-outs, given their potential to drive implementation, enhance citizen engagement and connect smart metering to broader smart city initiatives.[51] The growth of the IoT market in India, combined with ambitious initiatives like the RDSS, underscores the importance of smart metering for energy efficiency and grid stability. However, challenges remain, particularly ensuring consistent connectivity, interoperability, data analytics capabilities and relevant use cases; managing high data volumes; and addressing community concerns. Innovations from startups and collaborations between telecom operators, utilities and regulators can unlock new opportunities through advanced analytics and AI-driven solutions.

1.5 Development paradigms

When it comes to smart city projects, policymakers, developers and technology providers can choose from a range of approaches. A key consideration for policymakers is where urban growth will occur, how concentrated it will be and whether this projected growth can be channelled and harnessed to promote national development objectives. While rapid urbanisation underlines the need for countries to implement smart city solutions to improve service delivery and the efficiency of public resources, it also poses interesting questions for policymakers and donors aiming to promote sustainable urban development.

Smart city projects can be broadly categorised as "brownfield" or "greenfield" (see Figure 8). The key differences are the starting conditions and the approach to development, governance and financing. Brownfield projects integrate smart city approaches in existing urban infrastructure and service delivery, with all the accompanying imperfections and complexities, while greenfield projects begin with a clean slate (built from scratch or on underdeveloped land) to circumvent some of the challenges arising from legacy systems and interest groups associated with the status quo.

Brownfield smart city projects focus on upgrading existing urban infrastructure with digital technologies to improve efficiency, sustainability and quality of life. Unlike greenfield developments, brownfield projects must navigate legacy systems, informal settlements and interest groups. However, they offer opportunities to leverage existing urban density and community networks. By integrating smart mobility, energy and public services in existing cityscapes, these projects can address urban challenges like congestion, pollution and inequality, while fostering more resilient and adaptive urban environments tailored to local needs and capacities. In many LMICs, brownfield projects tend to be in capital cities (e.g. Nairobi and Delhi) or major economic hubs (e.g. Lagos and Karachi) given their comparatively stronger tax base, higher digital capacity, greater political importance and the fact that these cities tend to be a country's first entry point for international technology solution providers.

49. Crore = 10 million
50. GSMA. (2024). The Role of Mobile Operators in Smart Meter Adoption in India. Blog
51. GSMA. (2024). IoT Solutions for Smart Cities: Highlights from the Digital Urban Utility Forum on smart metering in Delhi. Blog

Figure 8

Key features of greenfield and brownfield developments

Brownfield smart city

Built on existing urban areas, retrofitting older infrastructure with smart technologies. Most established cities fall under this category.

Greenfield smart city

Built from the ground up, often on undeveloped land, and designed with smart technology and sustainability from the outset.

Key features	Details
Retrofitting legacy systems	Existing buildings, roads and utilities are upgraded using technologies such as IoT sensors, smart grids or digital platforms.
Legacy constraints	Development must consider current layouts and outdated infrastructure, which may limit flexibility.
Incremental change	Progress is implemented in phases, incorporating smart solutions gradually due to resource constraints and risks of disruption.
Diverse stakeholders	Requires collaboration among governments, businesses and established communities with diverse interests.
Data-rich environment	Extensive historical data, such as traffic patterns and utility usage, which can be used to inform smart upgrades.

Key features	Details
Purpose-built design	From the outset, all infrastructure, including roads, buildings and utilities, is integrated with advanced systems such as IoT networks and renewable energy grids.
Flexibility and innovation	Without legacy constraints, planners can create innovative designs like car-free zones and underground utilities.
Holistic integration	Cities can be designed with coordinated energy, water and transport networks from the beginning.
Top-down approach	Usually directed by governments or corporations, allowing for fast implementation but with limited or no community input.
Sustainability focus	Ecofriendly designs, including solar infrastructure, are often integrated from the beginning.

Models for "new city" greenfield developments

Greenfield projects have seen increased interest from LMICs and have been the subject of intense debate among urbanists, policymakers, donors and academics. Between 2000 and 2020, 159 new city projects were launched worldwide, surpassing the 126 initiated between 1945 and 1999. Of these recent developments, only six are located in the Global North, while the vast majority are concentrated in regions like East Asia and Pacific (50 projects), the Middle East and North Africa (49) and Sub-Saharan Africa (43).[52] In Africa alone, many new cities are under construction, including 10 in Rwanda, nine in Egypt, seven in Nigeria and four each in South Africa, Morocco and Algeria.

Many of these new cities are being developed on greenfield sites adjacent to existing economic or administrative centres, with the goal of circumventing the structural challenges faced by older urban areas. By focusing investment on digital-first infrastructure and services, they aim to deliver a higher quality of life. However, these developments often remain inaccessible to much of the population, raising questions about their inclusiveness, scalability and long-term viability as a response to urbanisation pressures in Africa. Recent efforts have aimed to pair new city construction with special jurisdictional status, also known as "charter cities". Charter cities have emerged as a novel approach to urban development, particularly in regions grappling with rapid urbanisation and weak governance. Popularised by economist Paul Romer in the late 2000s, the concept involves creating new cities governed by independent legal or regulatory frameworks – often through partnerships with external governments or institutions – to attract investment and ensure better governance.[53] Charter city projects take inspiration from China's development trajectory, where special economic zones, Shenzhen in particular, were a catalyst for structural transformation, foreign investment, technological innovation and export-oriented manufacturing. Its success provided a blueprint for similar market-oriented reforms in areas across the country.

A key focus for charter cities, beyond traditional special economic zone projects, is the power to experiment with governance and political institutions to support foreign direct investment (FDI), globally competitive industries and technological innovations. Notable examples include Prospera in Honduras, Nkwashi in Zambia and Itana (formerly Talent City) in Nigeria.[54] Egypt has also championed new city development in its national urban development strategy. Located 45 kilometres east of the capital Cairo, the New Administrative Capital sits at the heart of Egypt's smart cities programme. Nine other smart cities are being built across Egypt, from New Alamein and New Mansoura on the Mediterranean coast to New Luxor in the south. New Alamein is one of the most ambitious of Egypt's smart cities, covering 50,000 acres and a proposed population of 3 million.[55] Across Africa, new city builders include real estate developers and planners such as Surbana Jurong, Rendeavour and Thebe Investment Management, as well as Future Africa, a private investment fund.

The Charter Cities Institute (CCI), a key proponent of charter cities in LMICs, is an association and advocacy platform for developers, and supports them to lobby for rule changes and approvals for a range of new city projects. CCI's Next 50 African Cities Coalition, a network of African charter city advocates, argues that new cities are critical to "create jobs, foster investment, cluster innovation, and promote human flourishing.[56] CCI's recently published governance handbook outlines 16 areas that charter city developers and policymakers must consider when governing and regulating new cities, including land use, tax policy and labour rights.[57]

New city projects aim to deliver modern infrastructure, efficient services and transparent regulations, offering an alternative to the challenges of legacy cities. While advocates see charter cities as catalysts for economic growth and reform, critics warn of risks related to sovereignty, exclusion and the potential for elite enclaves. As the model gains traction in Africa and beyond, questions remain about its scalability and alignment with inclusive urban development goals. Some of

52. El Hanafy, H. (2024). Greenfield Visions – Charter Cities and New Cities for Urban Prosperity in Africa. Blog
53. Romer, P. (2010). Technologies, Rules, and Progress: The Case for Charter Cities. Article.
54. Muwowu, C. (2022). Charter cities offer alternative to ailing African SEZs. Blog.
55. Bloomberg. (2024). Egypt's New Cities: A Blueprint for Sustainability in the Middle East. Media.
56. Charter Cities Institute. (n.d.). Africa's NXT50 Cities Coalition. Webpage.
57. Charter Cities Institute. (2024). Governance Handbook. Report.

the key reasons why policymakers in LMICs are drawn to greenfield approaches are the challenge of urban primacy (see the next section) and excessive costs associated with retrofitting.

Urban primacy, intermediary cities and key trade-offs facing policymakers

Research has shown that urban primacy – demographic and economic concentration in one or two cities within a country – can be detrimental to economic growth. Urbanisation in Africa is dominated by high levels of urban primacy. In 41 of 51 countries, more than 15% of the urban population live in the largest city, while in 27 countries, more than 30% live in a metropolitan region. In Ghana, close to 30% of the urban population lives in Accra and Kumasi metropolitan regions. Urban primacy is at the expense of secondary cities, especially in Egypt, Nigeria, Kenya, Uganda and Angola. Unless policymakers can foster a more balanced urbanisation trajectory, this trend will lead to inequitable spatial distribution of wealth, with political power, skills and resources concentrated in a few cities.[58]

Retrofitting infrastructure and service provision in existing cities can be up to three times more expensive than planning for infrastructure in advance of settlement.[59] As policymakers struggle to contain urban sprawl in large existing cities, new city development appears an increasingly attractive solution to increase returns on public spending on municipal infrastructure and services. With an estimated $100 billion being invested in new city projects across Africa and the fiscal space for most governments shrinking, it is important to test the assumption that these investments will pay off.[60] Many new city projects have failed to live up to their initial aims and become associated with ghost towns detached from local priorities.

Intermediary cities could offer an interesting strategic opportunity to reap some of the advantages associated with greenfield projects while safeguarding against brownfield risks. Intermediary cities, usually with populations ranging from 100,000 to 1 million, are often overlooked in national urban strategies.[61] Intermediary cities have an important role as production, transportation and processing hubs, linking regional and national urban systems. For greenfield smart city projects, they offer several advantages over greenfield projects not located near any major existing settlements:

- **Scale for implementation:** Intermediary cities offer a more practical and manageable scale for introducing smart city technologies and infrastructure. Their size allows for more agile governance, efficient service delivery and lower implementation costs compared to megacities, where complexity and congestion can hinder innovation.

- **Urban growth anticipation:** Many intermediary cities are in the process of rapid expansion and account for a significant proportion of urban growth in LMICs. Investing in greenfield smart city projects in or near these cities provides the opportunity to plan and build infrastructure before unplanned expansion and informal settlements take hold. This approach reduces the long-term costs and social challenges associated with retrofitting infrastructure.

- **Spatial equality:** Focusing on intermediary cities can help address geographic disparities by decentralising economic opportunities and public investment. Strengthening these cities reduces migration pressures on capital cities and helps build more balanced national urban systems. It can also help coordinate with existing place-based economic policies, such as the promotion of industrial or service clusters, or the promotion of rural-urban linkages through agro-processing.

- **Inclusive economic growth:** Well-planned smart intermediary cities can become engines of local and regional development. By integrating digital infrastructure, sustainable mobility and efficient public services, they can enhance productivity, support SMEs and create jobs in emerging sectors.

58. African Development Bank. (2022). The dynamics of secondary cities in Africa: Urbanisation, migration and development. Report.
59. International Growth Centre. (2019). Policy options for informal settlements. Blog.
60. Haas, A.R.N. (2019). Building new cities to meet Africa's rapid urbanisation is a risky bet. Media.
61. GSMA. (2024). Co-Designing Urban Futures: Innovation and partnerships for improved service delivery in intermediary cities. Report.

- **Environmental sustainability:** Starting from scratch allows for the integration of climate-smart infrastructure, renewable energy systems and green public spaces. These elements are essential for ensuring environmental sustainability and resilience in the face of climate change – a growing concern for many LMICs.

Only a few African countries, such as Morocco, Ghana, Rwanda, Senegal and Uganda, have designed national urban policies that specifically address the development of secondary cities. Rwanda and Senegal both have a high degree of urban primacy (demographic concentration in one or two cities) and stand out for their policies that prioritise the development of selected secondary cities. Rwanda developed a National Roadmap for Green Secondary City Development, which envisions six priority secondary cities developing niche economic activities that are expected to benefit the surrounding areas.[62]

While intermediary cities offer an interesting pathway for more sustainable greenfield projects, there are many important risks for both greenfield and brownfield smart city projects to consider. Many policymakers have prioritised shiny new developments to attract international capital over more substantive investments in long-term urban development outcomes. Such "world-class city" vanity projects are often supported by foreign planning, architecture and design firms without a rigorous assessment of whether such visions align with national development objectives. Some projects prioritise signalling to foreign investors that they are open to business over making cities more liveable for residents. Other projects are too top-down in their approach and consider local community engagement a barrier to rapid technological disruption.

Such a view is very limiting and disregards the long-term political economy of change. Community buy-in has transformative potential, as civil society organisations, local leaders and interest groups can be part of the political settlement driving the successful adoption and implementation of smart city strategies. Given that one of the most common criticisms associated with smart city projects is weak implementation, it is critical to interrogate how strategies can adapt and harness local support to build capacity and support more rapid implementation. For smart city projects to be successful, they must have a clear purpose, be grounded in the local context, share the risk between the public and private sectors and align with broader national development objectives. Smart city interventions do not become "smarter" because they focus on the most high-end, cutting-edge or capital-intensive technological solutions, but because they address real problems that are a priority in the context in which they are implemented.

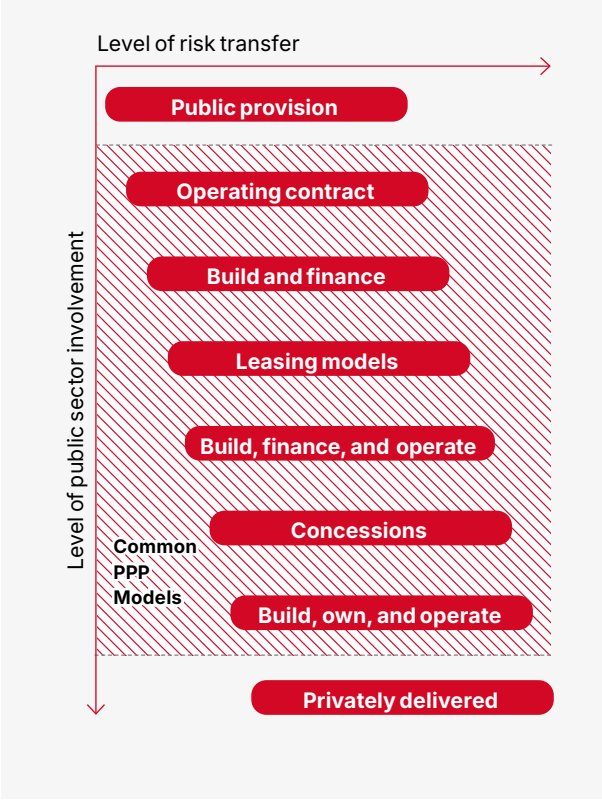
1.6 Financing smart cities

Delivering smart city solutions often involves substantial capital investment, often beyond the reach of municipal budgets and the complex partnerships needed for delivery. This raises the question of financing. It is important to distinguish between the sources of funding and financing and the modes of delivery. While there are some examples of purely public and private smart city solutions, public-private collaboration is more common. Importantly, the sources of the funds do not necessarily correspond to how they are spent. Municipalities may raise funds in capital markets through municipal or green bonds and then spend this capital entirely on public services. Similarly, a national grant to a municipality may be channelled into a concession contract for operating waste management services. Since many smart city solutions are tied to revenue-generating services (e.g. transport, water, energy), they are well suited to leasing models, concessions, revenue sharing or repayable financing. This section examines some of the main financing models used to fund smart city deployments in the eight focus countries.

62. Gutheil, L. and Schlimmer, S. (2024). Growth Beyond the Capital: Understanding Africa's Secondary Cities. Blog.

Figure 9

Key funding sources and delivery models

	Prominent funding sources		Common implementation models
Public sources	National budgets	– National programmes/ missions – Transfers to local government	
	Municipal budgets	– Budget allocations to departments – Payments to service providers	
	Multilateral funding	– Lending to national or local bodies – Risk guarantees for private investment – Equity stakes in SPVs	
Private sources	Municipal bonds	– Repayable finance for municipalities or specific initiatives	
	Equity investments	– Investments in startups and private companies – Investments in financing vehicles	
	Vendor financing	– Pre-financing of infrastructure – Revenue-share models	
	Private investment/FDI	– Investments in privately owned infrastructure	

Public funding through national programmes and municipal budgets is a key source of funding for smart city projects. A global survey of municipalities found that, in most cases, national or locally raised revenues were the predominant source of funds for their projects.[63] Public funding for smart city adoption is generally higher in South and Southeast Asian countries, with India's Smart City Mission and Indonesia's 100 Smart Cities Movement prominent examples. As of 2024, the Government of India reported that projects totalling $17 billion (₹1,442 billion) had been completed, with another $2.4 billion (₹465 billion) in projects at advanced stage of completion. Of this funding, approximately a quarter was national government budget allocations, with the remainder coming from municipal budgets and private sources.[64] Such a large and explicit budget allocation is unusual in the focus countries and regions, but highlights that even with a large central allocation, municipal and private sources are still significant in driving adoption. That municipalities occupy such a central role in funding underscores the value they place on digitalising public administration and revenue collection.

Over the past few years, there has been a growing number of municipal and green bonds supporting smart city initiatives. Sovereign green and municipal bonds are becoming a key source of raising funds in capital markets. For example, in April 2025, China listed their first green bond on the London Stock Exchange, raising about $830 million,

63. UN-Habitat. (2024). World Smart Cities Outlook 2024. Report.
64. Government of India. (2024). Smart Cities Mission extended till March 2025. Press release.

with demand significantly exceeding supply.[65] In an earlier milestone, Egypt issued the first green bond in Middle East and North Africa (MENA) in 2020, and in 2022 issued $500 billion in yen-denominated bonds and another $478 in yuan-denominated bonds in 2023.[66,67] Municipal bonds are growing in popularity in India, with the World Economic Forum reporting that, as of 2023, 12 cities had issued more than $413 million (₹35 billion) in bonds.[68] The surge in India is due, in part, to an enabling policy framework from the national government, which includes guidance for municipalities and a strong emphasis in the Smart City Mission on mobilising private capital.[69] Countries like India, South Africa and Colombia have had very successful municipal bond programmes, supported by regulatory reforms, credit enhancements and improved financial management at the city level.

Despite progress, broader adoption remains constrained by governance challenges, limited investor confidence and underdeveloped domestic capital markets. While strong demand for bonds opens an important new avenue for financing, there are reasons for caution in taking on debt. The large foreign-denominated bond issuances in Egypt were followed by a major financial crisis and devaluation of the Egyptian pound, and there are cases in India where funds that are raised by bonds and not used reportedly earned less in interest than was paid in investor yields, effectively a cost for taxpayers. These cases highlight that while bonds are a promising source of financing and in demand, they must be used judiciously and put to good use.

Across LMICs, multilateral and development finance institutions (M/DFIs) play a central role in infrastructure development and many smart city initiatives. This capital supports these initiatives in a variety of ways. While much is channelled directly through government ministries, municipalities and utility providers, it also plays a crucial role in supporting public-private partnerships (PPPs). Common roles include providing political and currency risk protection, providing first-loss guarantees, or supporting the development of SPVs commonly used in infrastructure PPPs.[70] SPVs can perform many functions, most commonly enabling off-balance sheet financing, ring-fencing revenues and protecting government balance sheets from losses. They can also act to pool funds and management across a city (as was required under the Smart Cities Mission), pool investments and implementation across many cities or operate and manage a particular project.[71] Bilateral DFIs, such as the U.S. International Development Finance Corporation (DFC) and British International Investment, are often more explicit in their support for smart city initiatives and have more flexibility to deploy comparatively smaller (<$100 million) and more targeted investments.[72,73]

Public procurement leasing and vendor financing models provide a more flexible option for municipalities, with lower upfront costs. Digitally enabled assets that can be tracked and have payments integrated are particularly well suited to this model, as those providing the asset can maintain oversight as it is used. An early example of this is Kenyan startup BasiGo's model for scaling electric public transport. BasiGo raised the capital needed to fund the infrastructure outlay for its buses and charging stations. For a small upfront fee, private providers or municipalities can then lease the buses, which BasiGo maintain, and pay per kilometre driven. This model is an example of digitally enabled assets opening the door to new services. In a clear case of smart city vendor financing, South Africa's fourth largest municipality, Ekurhuleni, established a fibre-optic network, cloud data centres and digital governance with Huawei, allowing immediate access to infrastructure and the municipality to pay for it over time.[74]

Venture financing is a relatively small, but nonetheless significant part of the mix. It has been a tough few years for tech ventures seeking funding. The challenging global macroeconomic

65. London Stock Exchange. (2025). People's Republic of China launches inaugural Sovereign Green Bonds Issuance. Press release.
66. Government of Egypt. (2022). Sovereign Sustainable Financing Framework. Policy document.
67. AfDB. (2023) Egypt issues Africa's first Sustainable Panda Bond. Blog
68. Guha, A. and Biswas, D. (2023). Sustainable financing of cities: 4 success factors from India's Smart City Mission experience. Blog.
69. Government of India. (2017). Guidance on use of Municipal Bond Financing for Infrastructure projects. Policy document.
70. ADB, OECD, UNECA, World Bank *et al.* (2017). Public-Private Partnerships Reference Guide: Version 3. Report
71. World Bank and UNCDF. (2024). Local Governments Climate Finance Instruments: Global Experiences and Prospects. Report
72. BII. (2025). The Urban Resilience Fund B – International Municipal Investment Fund SCSp. Webpage.
73. DFC. (2021). DFC Announces $267 Million Guaranty for Smart Rio. Press release.
74. Huawei (n.d.) Huawei Helps the City of Ekurhuleni Grow into a South African Smart City Pioneer. Blog

context and inflationary shock following the COVID-19 pandemic and the war in Ukraine saw global deal numbers drop to a five-year low in 2023, with value falling by a third year-on-year to $340 billion. This trend was relatively consistent across regions and sectors, although venture capital (VC) funding volumes in South and Southeast Asia are considerably higher than in Sub-Saharan Africa.[75] Venture funding is significant because it is channelled into some of the most innovative early-stage solutions and companies, which are often seeking to address specific market or segment challenges. VC funding plays a significant role in South and Southeast Asian markets compared to African markets, with $65.8 billion and $2.6 billion invested in 2024, respectively, and these disparities reflected in an addressable market analysis.[76]

To attract more VC funding to innovative smart city use cases, countries and cities need to create an enabling environment for startups and encourage the formation of innovation hubs. National and local governments can do this by streamlining business registration, offering tax incentives, improving access to finance, ensuring reliable internet connectivity, protecting intellectual property rights and supporting education and skills development in technology and entrepreneurship. Many LMICs have recently passed startup acts – national legal and policy frameworks designed to support the growth of startups and innovation ecosystems – to signal to investors and entrepreneurs their commitment to an enabling environment. Governments can also leverage their market-shaping capacity by earmarking public procurement for startups or providing seed funding to startups and ecosystem enablers. A prominent example of a state-owned fund investing in startups in India is the Funds for Startups, launched by the Government of India in 2016. Managed by the Small Industries Development Bank of India, the fund has a corpus of ₹10,000 crore and operates by investing in registered Alternative Investment Funds, which in turn invest in startups. In Nigeria, the Nigeria Sovereign Investment Authority has teamed up with Sustainable Energy for All (SEforALL), the International Solar Alliance and Africa50, to create a $500 million fund dedicated to the development and financing of distributed renewable energy projects in Nigeria.

Foreign direct investment (FDI) from private and government-to-government (G2G) investments through state-owned banks and sovereign funds are also a significant source of funding, particularly for larger greenfield projects. This funding is particularly relevant in the development of new cities and export and trade-focused infrastructure. A prominent recent G2G greenfield investment is the United Arab Emirates' sovereign fund ADQ's $35 billion co-investment with the Egyptian government in the new city project of Ras El-Hekma. Another example is the Export Import Bank of China's funding under the Digital Skills Road component of the Belt and Road Initiative.[77] Other examples of new cities include Konza Technopolis in Kenya, GIFT city (Gujarat International Finance Tec-City) in India and Eko Atlantic in Nigeria. Konza is a flagship project of the Government of Kenya and is managed by a development authority set up to accommodate G2G and private investment. In 2024, The Republic of Korea signed a $284 million deal to invest in Konza, financed through the Korea Exim bank.[78] India's GIFT city, while state owned, is designated as a special economic zone (SEZ) targeting financial services with provisions for zero capital gains tax and currency restrictions lifted in some sectors, attracting significant investment. Eko Atlantic in Nigeria is an example of a new city model entirely privately funded. Built on reclaimed land off the coast of Lagos, it aims to attract direct investment and become a major financial hub.

Identifying the right financing mechanisms and financing sources is critical for smart city projects. Smart city advocates argue that technology adoption and innovation can help crowd-in private sector funding and close the persistent investment gap for urban services and infrastructure provision in LMICs. However, many blended finance

75. GSMA. (2024). Fundraising milestones under the GSMA Innovation Fund for Digital Urban Services. Blog.
76. AVCA. (2025). Venture Capital in Africa Report. Report.
77. Merics. (2019). Networking the "Belt and Road" - The future is digital. Blog.
78. Government of Kenya. (2024). Kenya signs a Financing Agreement with Republic of Korea. Press release.

approaches, and attempts for public sector funding or frameworks to de-risk private sector investment, have fallen short of their stated outcomes. For example, a common challenge under the SCM was that the sectors with major urban service gaps in India – water, waste and sanitation – are least attractive to the private sector.[79] Policymakers should think about what reforms could make these priority sectors more appealing to the private sector, while also being clear about which policy priorities cannot be solved with private sector funding.

In this context, strengthening PPP frameworks could help provide clarity for potential private sector partners and encourage the adoption of innovative approaches and new technologies.[80] Recent GSMA research has shown that growing adoption of technologies like digital payments, digital platforms, AI, blockchain and IoT across LMICs has not only transformed how governments and businesses operate, but also enabled new data-driven financing mechanisms, such as receivables financing, revenue-share models and carbon credits, and made more established financing mechanisms, such as subsidies, more efficient and scalable.[81] Government subsidies to water and sanitation total $320 billion annually, equivalent to 0.5% of global GDP. For LMICs, this figure rises to 1.5%–2%, and pre-tax energy subsidies are estimated at approximately $300 billion. Digital payments and digital identity (some of the core pillars of DPI), and the use of innovative data sources such as geospatial data or alternative credit scoring mechanisms, offer exciting opportunities for governments to target and delivery subsidies more effectively and ensure they reach low-income populations in need.[82]

79. World Economic Forum. (2016), Smart Cities: Promoting Urban Governance in India. Report.
80. GSMA. (2022). Partnering With the Public Sector: A toolkit for start-ups in the utilities sectors. Report.
81. GSMA. (2023). Digitalising Innovative Finance: Emerging instruments for early-stage innovators in low- and middle-income countries. Report.
82. GSMA. (2021). Smarter subsidies and digital innovation: Implications for utility services. Blog.

2
Operator roles in smart city deployments

2.1 Addressable market to 2030

This section presents forecasts for the total addressable market (TAM) for select IoT-based smart city use cases. The data covers energy, water and gas smart metering solutions. and IoT-based solutions related to public transport, waste management, street lighting and smart parking. The figures are based on total device numbers for all forms of connectivity multiplied by the average revenue per user/device. The average revenue per user (ARPU) figures were calculated for all types of IoT connectivity including licensed and unlicensed cellular networks (2G, 3G, 4G LTE, 5G, LoRaWAN, SigFox, Wi-fi, Bluetooth).

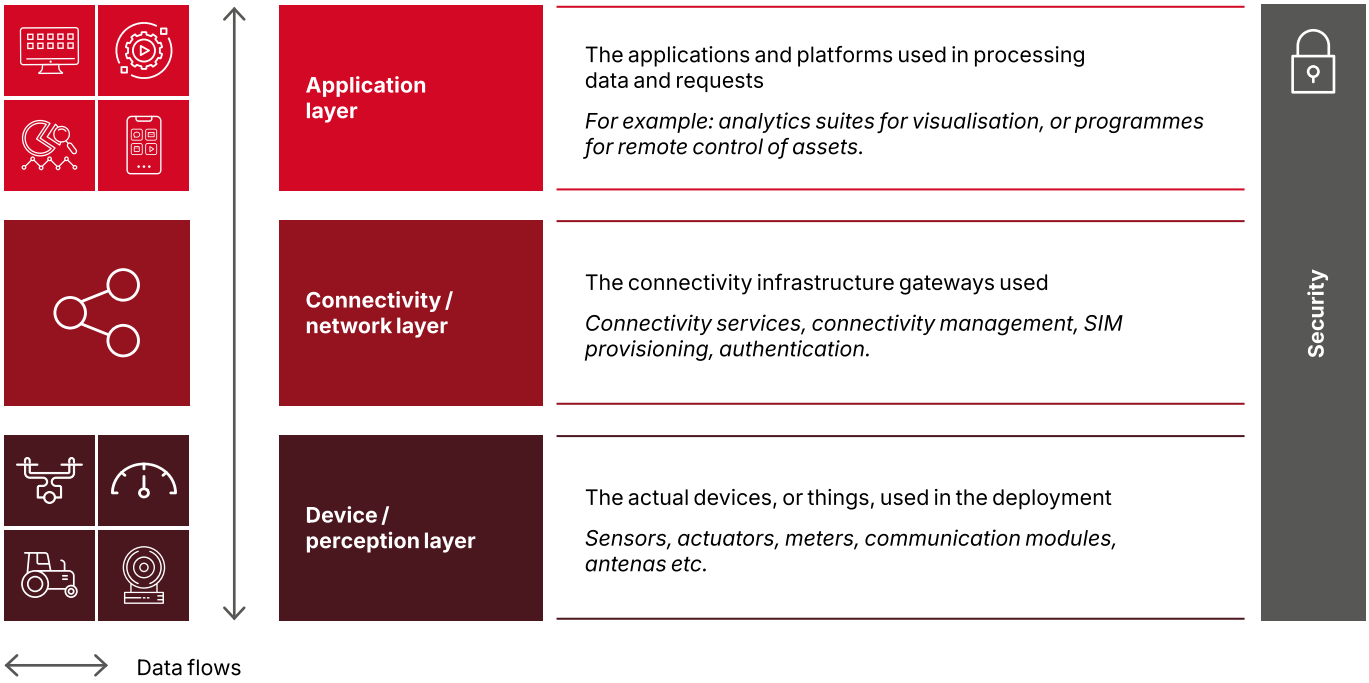
The data covers the device, connectivity and platform/service layers of the solutions (see Figure 10). The focus on IoT-enabled solutions reflects where there are suitable data for modelling, and as such the smart city opportunity more broadly will be larger. The analysis presents the total revenue opportunity across the three main layers of the IoT reference architecture: devices, connectivity, and platform/services. The methodology for estimating the revenue-based TAM for IoT smart city solutions considers the timeframe from 2024 to 2030. The analysis focuses on four regions – South Asia, Southeast Asia, Sub-Saharan Africa and MENA – and eight markets: India, Indonesia, Malaysia, Pakistan, Egypt, Kenya, Nigeria and South Africa.

Between 2020 and 2024, smart city IoT connections increased from 173 million to 271 million, and will increase another 222 million to 593 million by 2030. This equates to a cumulative revenue opportunity of $38.3 billion and a compound annual growth rate (CAGR) of 25%. South Asia will account for just over a third of this opportunity, driven largely by growth in the Indian market, reflecting the market size and increasing activities of MNOs within the smart city sector, particularly in the device and platform layers of the technology value chain. Although starting from a low base, the market in Sub-Saharan Africa nonetheless shows strong growth over the period with a CAGR of 21%. Other non-GSMA estimates[83] put the global revenue opportunity for all smart city technologies at $300 billion by 2030, with a CAGR 10.7%. This comparison highlights that the IoT-enabled segment in the focus regions will grow much more quickly than the wider market.

83. Cities Today. (2023). Smart city market to reach $300 billion by 2032. Media.

Figure 10

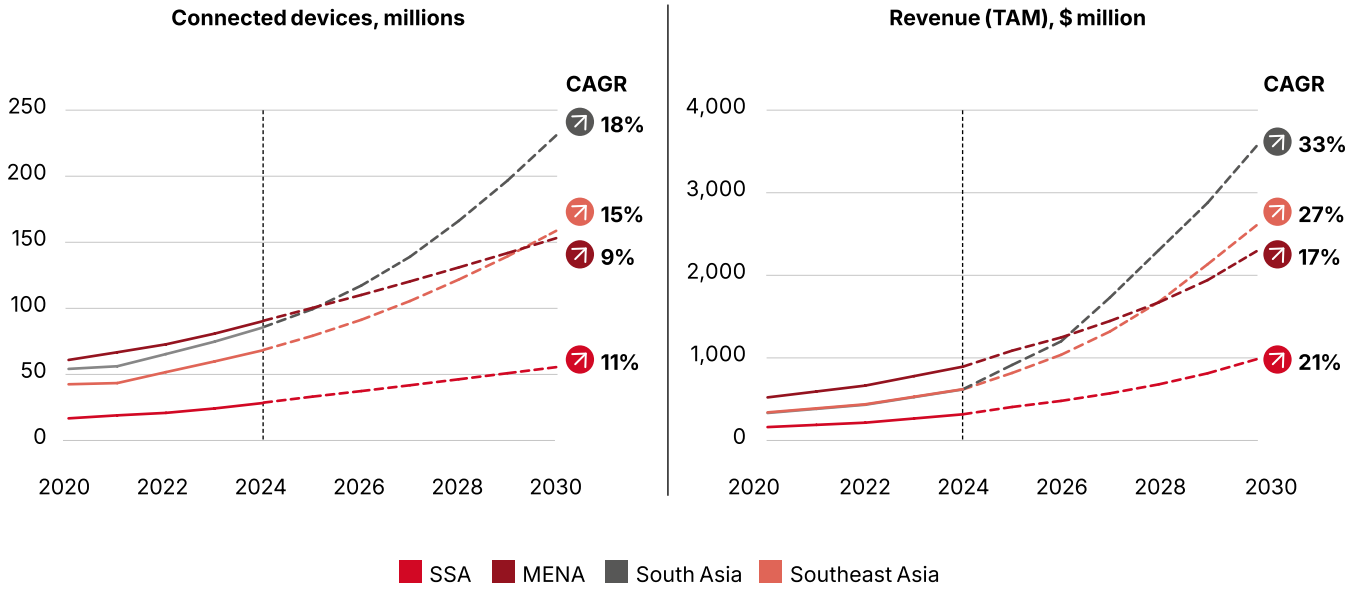
Simplified IoT reference architecture



Note: This depiction of the IoT reference architecture is an adaptation of the original IoT reference architecture as published by the ITU and represents a simplified view of an IoT solution. In reality, IoT solutions are comprised of many devices, sensors, actuators and other connectivity-enabled 'things' that may receive one or more types of communication service.

Figure 11

IoT devices and revenues from smart city solutions, by region



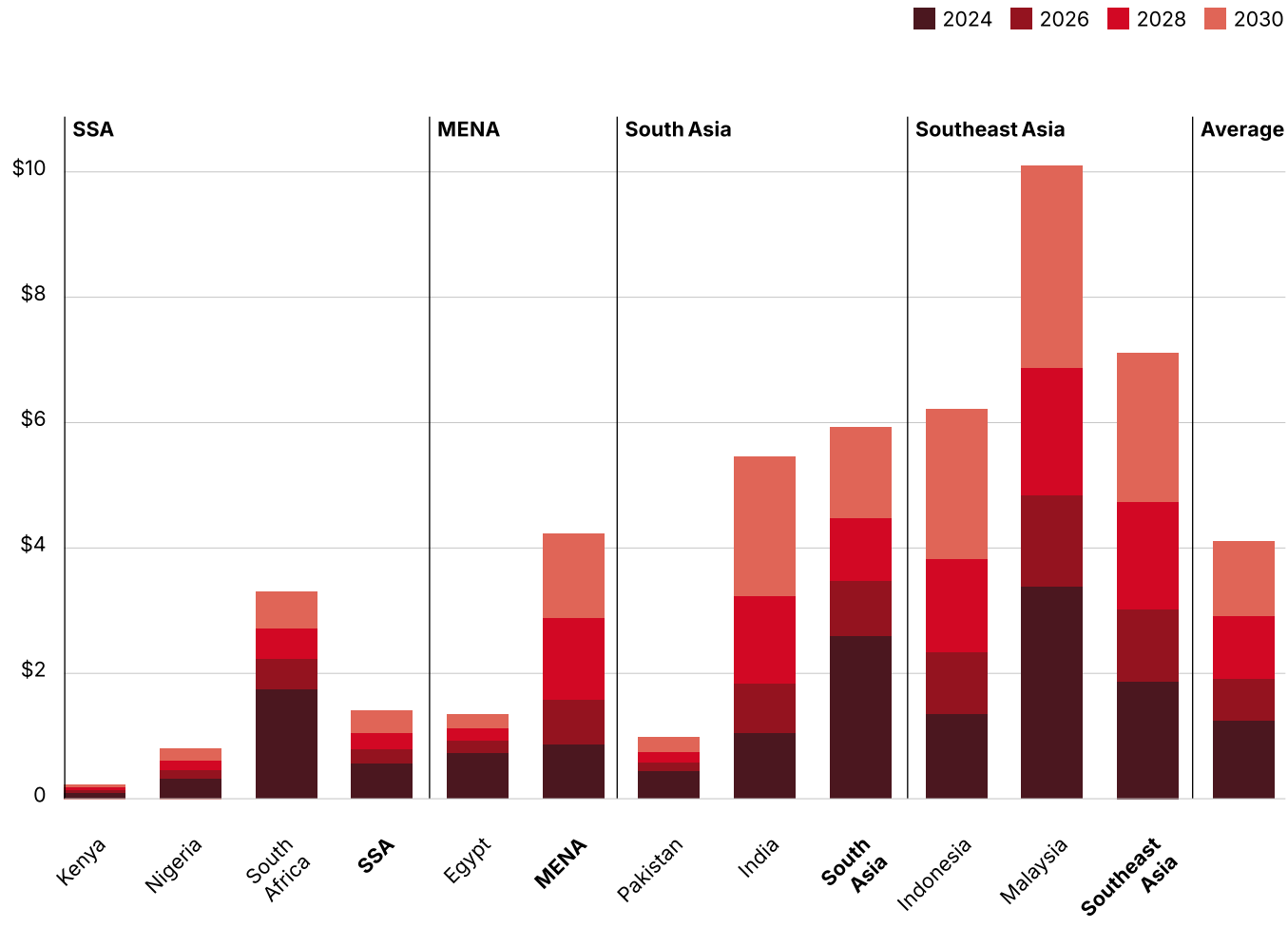
Source: GSMA forecasts

Connections and addressable market to 2030

Dividing TAM by the forecasted urban population in 2030 provides a different view of the market opportunity, as it measures the size of the opportunity between and within regions. This analysis highlights that, in the relatively short time frame to 2030, the opportunity will be very different across markets. This measure is different from ARPU as it accounts for the size of the opportunity relative to the total urban population. MNOs in more established and growth markets are likely to benefit from diversifying their offering and expanding into new verticals and service layers. In more nascent markets, meanwhile, MNOs may need to focus on fewer key verticals while the ecosystem is developing. In the medium term, and beyond 2030, these foundations are likely to serve as the basis for the continued growth in the ecosystem. For example, in terms of market intensity, Nigeria will be in a similar position in 2030 to where India is at present, indicating that the market may be poised for more exponential growth once it has reached a tipping point, reflected by similar enabling conditions in India today.

Figure 12

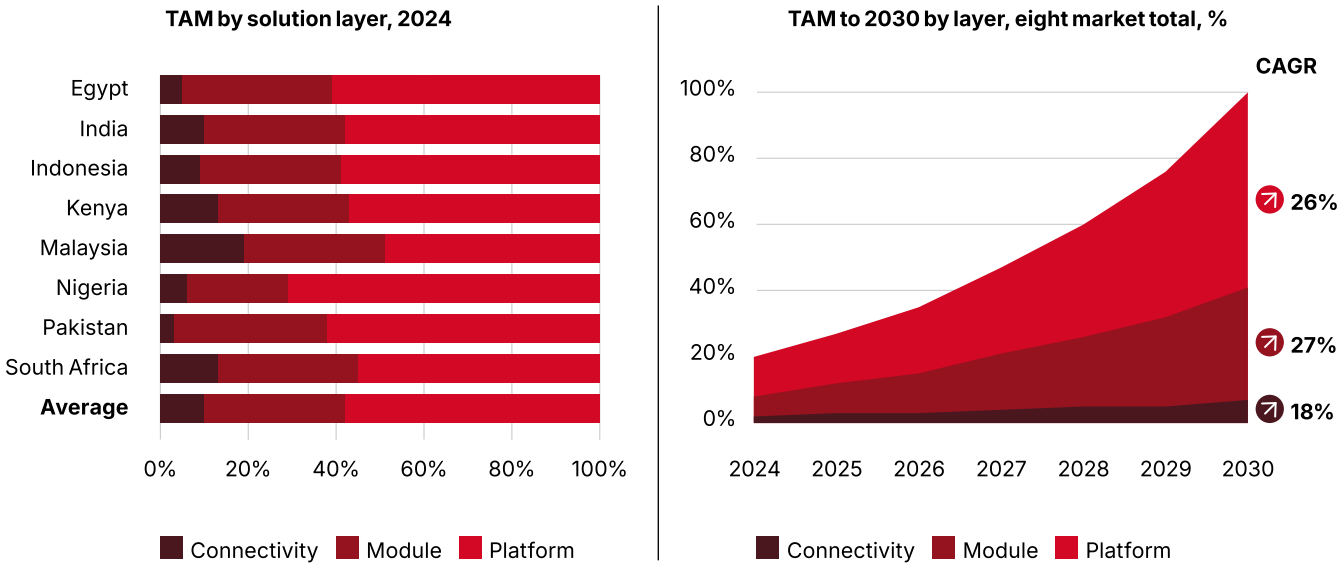
Total addressable market by urban population



Sources: GSMA (TAM forecasts), World Bank (urban population projections)

Figure 13

Total addressable market by solution layer

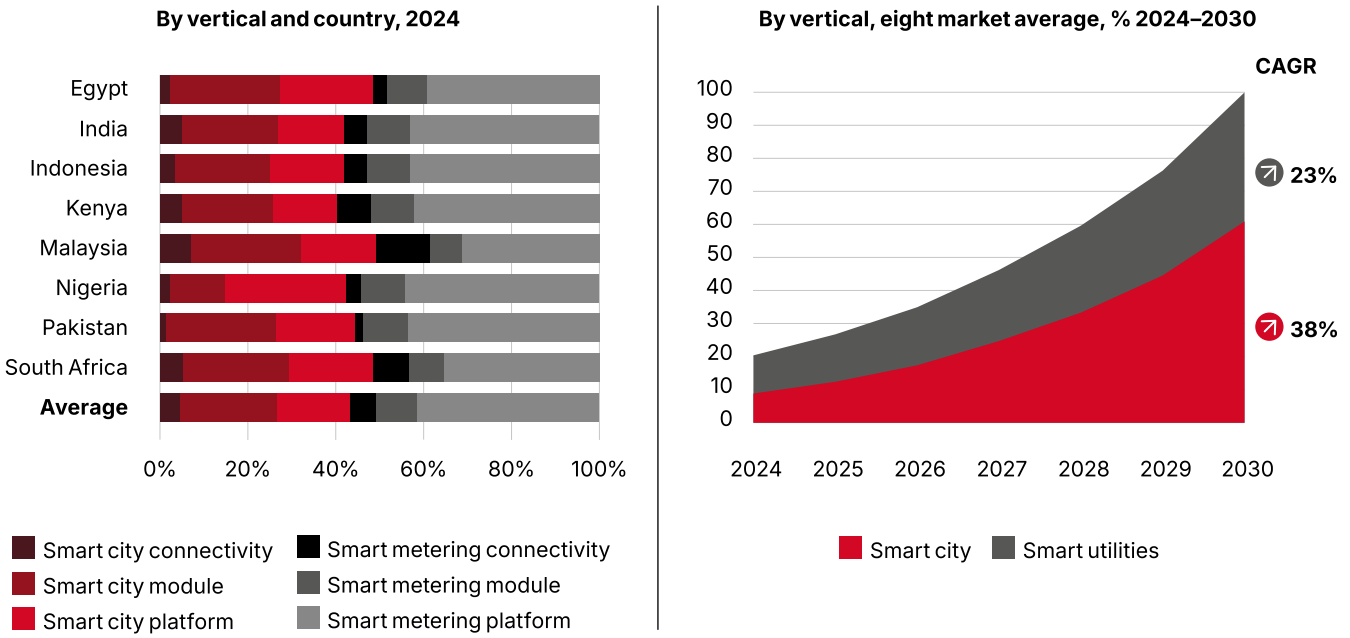


Sources: GSMA
Note: The average (LHS) and total figures (RHS) are for the eight focus markets only

Of the three main layers – connectivity, module and platform/service – platform/services account for 58% of TAM revenues, on average, across the eight focus markets surveyed. Connectivity accounts for 10% of TAM on average (range: 2%–15%) and modules 32% (range: 23%–35%). Revenues from the module and platform layers are also anticipated to grow more quickly as compared to those from connectivity. This highlights that positioning across service layers is more important for mobile operators than scale within connectivity. The analysis also estimated the proportion of the opportunity associated with smart metering compared to other IoT-enabled smart metering solutions. Across the eight markets, as of 2024, the metering component averages 57% of TAM revenues, making it a key vertical. However, across the eight markets to 2030, the IoT smart city solutions included in the review – public transport, waste management, street lighting and smart parking – are set to grow more quickly. By 2030, across the eight markets, the broader smart city solutions are set to account for 61% of TAM revenues, growing at a CAGR of 38%, compared to 22% for metering revenues. Although there is some variation in the proportion and growth rates, the broad trend holds for each of the eight markets.

Figure 14

Total addressable market revenues by vertical



Sources: GSMA
Note: the average is for the eight focus markets only. Metering includes energy, wate, and gas.
Smart city includes public transport, waste management, street lighting and smart parking.

2.2 The evolving role of mobile operators

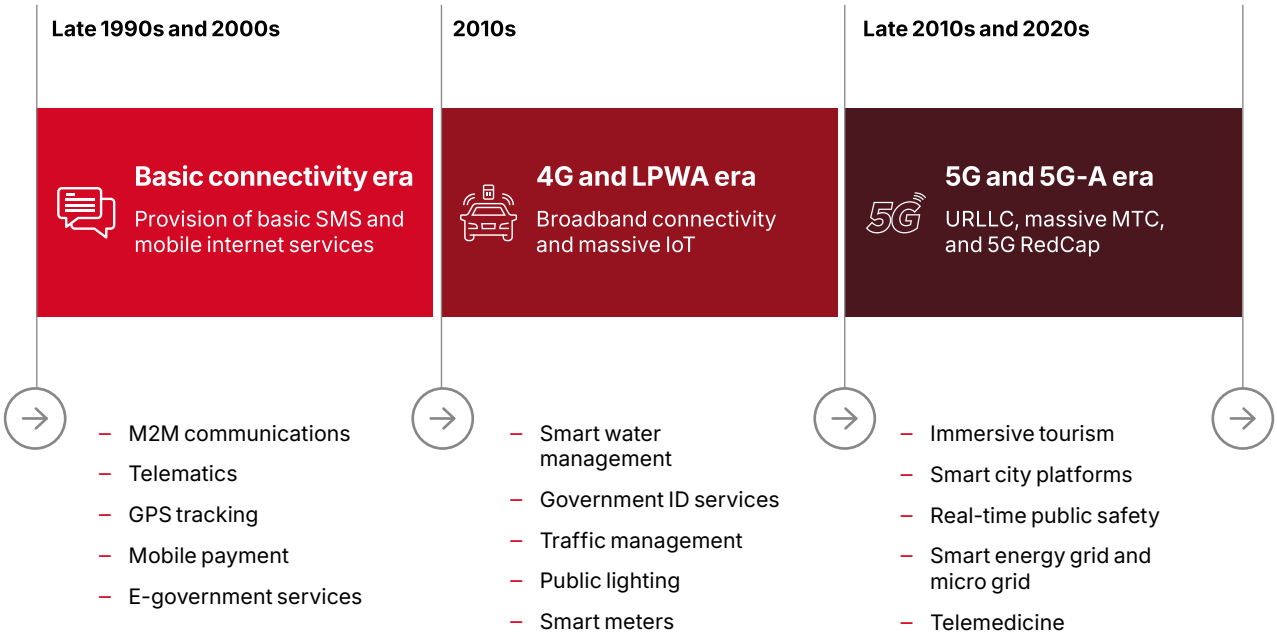
The enhanced connectivity offer

Mobile operators are central to smart cities, providing the digital infrastructure that connects devices, sensors and users, and enabling seamless data exchange across urban systems. Through their ownership of networks, spectrum, core networks backhaul and digital payment infrastructure, they establish the telecommunications backbone on which smart city applications depend – from real-time mobility and energy management to public safety and environmental monitoring. Since the early 2000s, their role has steadily evolved – not only keeping pace with mobile technology but also expanding beyond basic connectivity to support broader layers of the digital ecosystem.

The first major turning point in the connectivity offers for smart cities came with 4G and LPWA technologies. Legacy networks like 2G and 3G were crucial in the early development of smart solutions, supporting basic machine-to-machine (M2M) communications and providing mobile internet for simple GPS tracking. 4G marked a turning point for the bandwidth, speed and reliability required to support large-scale, data-intensive applications beyond voice and basic mobile internet. This made it possible for operators to support real-time video, cloud-based services and a new generation of IoT use cases with greater consistency. LPWA technologies – NB-IoT and LTE-M – were then able to serve LPWA connectivity needs while significantly lowering battery requirements. These advancements enabled citywide deployments of connected infrastructure, such as smart meters, environmental sensors and intelligent transport systems, and introduced new monetisation pathways.

Figure 15

Evolution of mobile-enabled connectivity

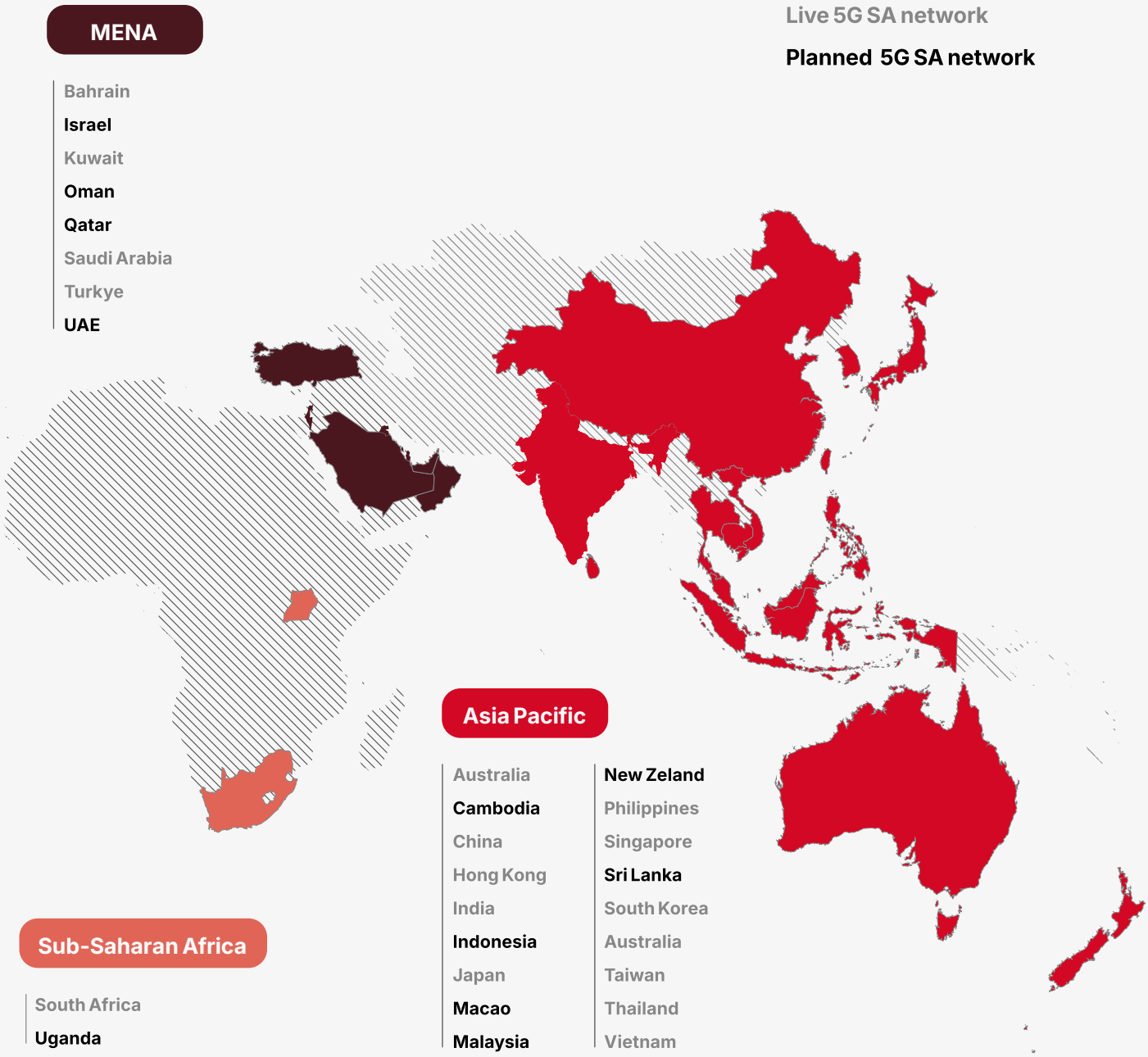


5G introduced capabilities such as ultra-low latency, network slicing and edge computing, which not only improve network performance but also unlock new categories of use cases. From a smart cities perspective, these features are critical for enabling applications that rely on real-time responsiveness, such as autonomous traffic systems, real-time surveillance, connected emergency services and responsive energy grid management. Initially deployed in a non-standalone (NSA) configuration, which overlays 5G radio access on existing 4G cores, 5G has already improved capacity and speed for mobile broadband services, delivering enhanced bandwidth and lower latency.

Operators are now transitioning to standalone (SA) 5G, which is 5G built on a dedicated core. This transition is set to unlock the full breadth of 5G's capabilities. This includes ultra-reliable low-latency communication (URLLC), massive machine-type communications (mMTC), edge computing and network slicing. In the context of smart cities, 5G SA represents a major leap forward, enabling the seamless management of dense networks of connected devices such as traffic cameras. Its dedicated architecture supports edge computing, which shifts data processing closer to where it is generated, reducing latency and easing pressure on centralised cloud infrastructure. This localised processing improves responsiveness and supports real-time applications. Crucially, 5G SA architecture also enables network slicing, which allows multiple virtual networks to coexist on the same physical infrastructure, each tailored to specific service requirements. For example, a city can allocate a high-priority slice for emergency response while maintaining separate, optimised slices for utilities or traffic management.

Figure 16

5G Standalone network launches in focus regions



Data correct to 31 December 2024
For updates, see gsmaintelligence.com

Source: GSMAi (2025) 5G in context: Q4 2024

At the end of 2024, operators in 64 markets had either launched or announced plans to deploy 5G SA. Among the eight countries studied, India, Indonesia, Malaysia and South Africa have deployed 5G SA. Egypt, Kenya and Nigeria continue to operate on 5G NSA, and Pakistan is expected to assign 5G spectrum and commence its first commercial deployment in 2025. As 5G SA networks scale, there is growing interest in extending the benefits of 5G beyond high-performance applications to mid-tier use cases that prioritise reliability, efficiency and affordability. 5G RedCap (Reduced Capability) addresses this need by offering a simplified version of 5G that reduces power consumption and hardware complexity, while retaining essential features such as low latency and strong network reliability. While RedCap is still in the early commercial phase, deployment is gaining pace globally. As of November 2024, four countries had confirmed commercial launches of RedCap services, with trials underway in more than 20 other markets.[84]

Crucially, smart cities depend on hybrid network architectures that seamlessly integrate multiple technologies to meet diverse connectivity needs. For example, 5G and Wi-Fi coexist as complementary layers, with 5G providing the backbone for high-performance, mobility-intensive and latency-sensitive digital services, while Wi-Fi – particularly in the form of public access networks – extends affordable, high-capacity access within public spaces, buildings and community hubs. In countries like Egypt, India and Malaysia, national fibre roll-out programmes have underpinned the development of smart districts, cloud-connected public services and integrated surveillance systems. In areas where fibre deployment remains limited or cost-prohibitive, FWA is increasingly used as a flexible alternative for last-mile access, offering faster deployment and lower infrastructure costs compared to traditional fixed-line solutions. Similarly, rather than replacing NB-IoT or LTE-M, these technologies will continue to support ultra-LPWA applications, such as environmental monitoring and utility metering, while 5G RedCap complements them by targeting applications that need more bandwidth and responsiveness than LPWA can offer, but without the full complexity of enhanced 5G.

Operator engagement beyond connectivity

Across markets operators are transforming from connectivity providers to end-to-end technology partners. Changes in the telecoms landscape, including stagnating data revenues, evolving enterprise needs, the accelerating digitalisation of public services and rapid technological advancements, have led operators to transition from providing connectivity as a product to using it as the foundational layer for a broader suite of digital services and applications. This aligns with the findings of a 2023 GSMA Intelligence survey of 100 operators, which revealed that enhanced connectivity is not the end goal but a way to deliver value beyond traditional telecoms offerings.[85] This strategic shift from providing core infrastructure to delivering end-to-end digital solutions is evident as operators leverage their network assets, ecosystem partnerships and technical capabilities to play a more active role in value creation across both consumer and enterprise segments.

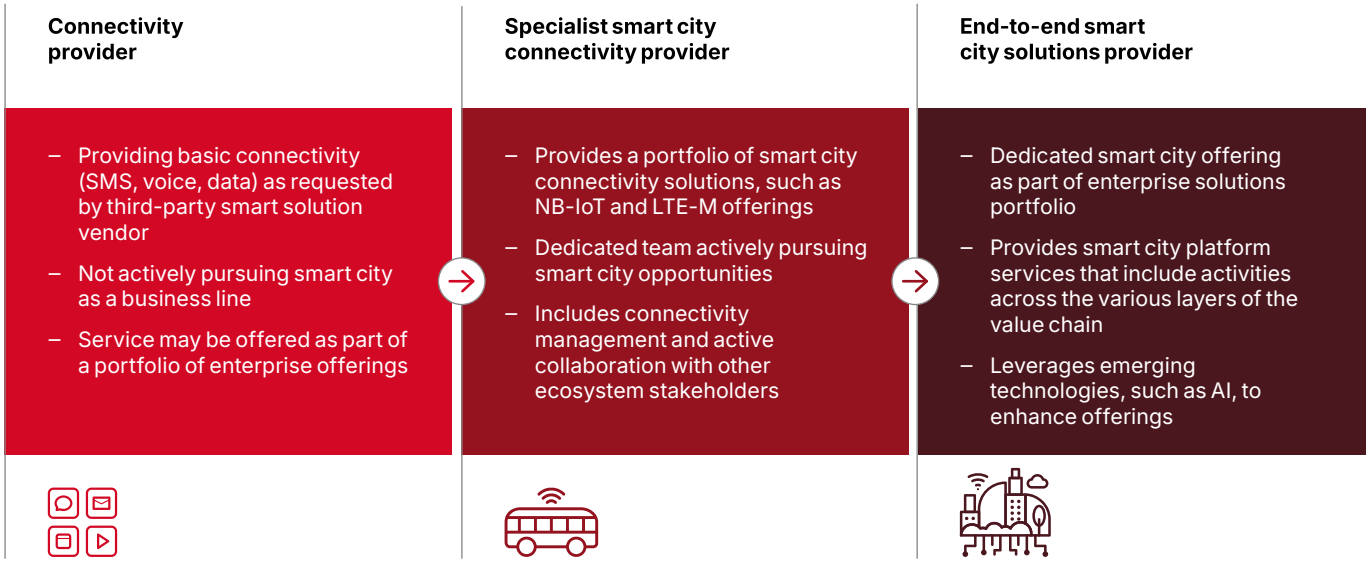
This transition is already evident in the services offered to non-enterprise users. In markets where access to traditional banking remains limited, MNOs have launched mobile money platforms that are now the backbone of digital financial ecosystems. These platforms benefit from operators' widespread distribution networks, extensive subscriber bases and high levels of user trust. Safaricom's M-PESA in Kenya remains the most prominent example, evolving from a simple money transfer tool to a comprehensive financial service offering savings, credit, insurance and international remittances. Other examples include Telenor Pakistan's Easypaisa, Vodafone Egypt's Vodafone Cash and MTN's MoMo in Nigeria and South Africa. Collectively, these services have enabled millions to access formal financial services, deepened digital engagement and facilitated significant new revenue streams for operators.

84. GSMA. (2025). RedCap/eRedCap for IOT. Report.

85. GSMA Intelligence. (2023). Operator revenue growth and innovation strategies: together with connectivity and beyond connectivity. Report.

Figure 17

Smart city market profiles of MNOs



Source: GSMA Intelligence

Importantly, mobile financial services have provided a gateway to other digital offerings, such as e-commerce and, increasingly, e-government services. In countries like Kenya, platforms such as eCitizen allow citizens to pay for public services like licence renewals directly through mobile money platforms like M-PESA. This integration has significantly expanded the utility of mobile money, embedding it in public service delivery and creating new and recurring transaction volumes that drive mobile money usage and generate revenue through processing fees.

Operators are also leveraging their mobile money platforms to offer tailored solutions for businesses, particularly MSMEs and service providers. These solutions help them manage operations, digitalise transactions, improve cash flow and provide access to essential financial tools such as credit. In Kenya, Pakistan, South Africa, Nigeria and Egypt, operators such as Safaricom (M-PESA for Business), Telkomsel (LinkAja), Telenor Pakistan (Easypaisa), MTN (MoMo Business) and Vodafone Egypt (Cash for Business), offer digital payment acceptance, bulk disbursement tools, merchant QR codes and business wallets to support MSMEs and informal businesses.

These platforms are multifunctional ecosystems that enable merchants to receive payments securely, track transactions in real time, manage invoices, process bulk disbursement and access options for business loans and microcredit, using transaction histories to access creditworthiness. These offerings vary by market, for example, MTN Nigeria has partnered with fintechs to provide microcredit to small traders and shop owners, with loans disbursed and repaid directly through MoMo wallets. Mobile financial services also enable pay-as-you-go (PAYG) utilities, particularly in sectors such as energy, water and sanitation. By partnering with service providers, MNOs support usage-based billing and micropayment systems, allowing essential services to reach low-income and underserved communities.

Recent GSMA research on the value of PAYG for mobile operators, demonstrates that PAYG increases the use of mobile money, as well as other mobile services such as voice/SMS and data, while also building digital literacy and driving demand for digital services and other PAYG assets.[86] Core utility services build consumer trust in mobile money as these services are essential to daily life and require regular payments. Results of the 2020

86. GSMA. (n.d.). What is the value of pay-as-you-go for mobile operators?. Webpage.

GSMA Global Adoption Survey show that utility bill payments, such as for energy and water, account for 50% of providers' mobile money bill payments, on average.[87]

Revenue collection through mobile money also offers substantial benefits to utilities and service providers while also making it more convenient for customers to pay. According to a 2019 GSMA-CGAP study, digital payments reduced revenue collection costs by 57% to 95% for water and sanitation service providers.[88] In Dhaka, Bangladesh, the digital payments were introduced for a water ATM operating in collaboration with the city's utility to serve informal settlements. This reduced the amount of time low-income households spent on water collection and provided price transparency where previously unregulated private water tankers would charge high, fluctuating rates.[89]

More widespread adoption of mobile utility bill payments could also play an important role in achieving the mobile money industry's stated aim of transitioning to a platform-based business model.[90] WeChat's successful app-within-app platform business model, which allows third parties to embed their content or their own functionalities on a mobile money platform, shows where the future of the platform payment industry could be headed.

AI and big data solutions are also becoming a major focus for mobile operator seeking to diversify revenue. Mobile operators in LMICs hold vast quantities of passively generated data, such as:

- **Event data:** Logs recorded when users connect to their network for calls, SMS, mobile internet, USSD, mobile money transactions or other type of event data recorded by the MNO's system.
- **Network data:** Includes data on the telecoms network itself, including the location of cells, antennas and underground networks, infrastructure status and other logs of activities taking place on the network.
- **Customer data:** This is usually collected during the registration process and includes socio-economic and demographic information, as well as information related to customer sign-up, status and activity.

The COVID-19 pandemic fuelled the use of big data to monitor and predict the spread of the pandemic and evaluate the effectiveness of different mitigation measures.[91] However, it has also highlighted the potential value of mobile big data for urban planning, such as mapping traffic flow patterns, planning EV charging infrastructure, delineating metropolitan boundaries and predicting energy demand.[92] Many MNOs have prioritised their internal mobile big data and AI capabilities through dedicated business divisions such as Orange Flux Vision or Vodafone's big data and AI team. Orange Flux Vision has identified the transportation sector as one of its key focus areas and has partnered with private companies and governments to leverage insights from AI and mobile big data to map and predict traffic flow patterns.

In Indonesia, the Bureau of Statistics used Telkomsel Indonesia data to understand commuting patterns within Metropolitan Bandung and nationally throughout Indonesia, creating opportunities to make planning decisions. As a result of this initial engagement, Telkomsel Indonesia expanded its AI and big data capabilities. Given that large data sets are a key requirement for many AI solutions, and that mobile operators have a strong track record of upholding data principles such as anonymisation and aggregation, they are uniquely placed to leverage their data to offer unique data products and services, while also ensuring the responsible use of AI. With AI becoming a priority for policymakers across LMICs, mobile operators are well positioned to build their capabilities in this area.

87. GSMA. (2021). State of the Industry Report on Mobile Money 2021. Report.
88. CGAP, GSMA. (2019), Testing the Waters: Digital Payments for Water and Sanitation. Report.
89. GSMA. (2020). Digital Solutions for the Urban Poor. Report.
90. GSMA. (2019). Mobile money transaction fees and utility bill payments in emerging markets. Blog.
91. GSMA. (2021). Utilising mobile big data and AI to benefit society. Report.
92. GSMA. (2021). Innovative Data for Urban Planning: The Opportunities and Challenges of Public-Private Data Partnerships. Report.

This growing focus on advanced enterprise services has also shaped how operators approach smart city opportunities. For operators in most countries, IoT has long driven service innovation and revenue diversification, enabling practical applications such as smart utility management. Operators in India, Indonesia, Nigeria and South Africa have either deployed or piloted NB-IoT and LTE-M technologies to support applications such as smart metering, logistics and other urban services. In countries where 5G capabilities are maturing through 5G SA, smart cities are emerging as a strategic vertical for operators. According to the GSMA Intelligence Network Transformation Survey, operators are increasingly recognising the unique demands of this segment, which is distinguished by complex stakeholders, the need for interoperable digital ecosystems and greater regulatory engagement than other sectors like manufacturing or logistics. Figure 18highlights additional enterprise-facing services offered by operators. These services underpin the digital infrastructure that modern economies rely on, enabling smarter industry operations, supporting sector-specific innovation and improving the agility and resilience of public and private systems alike.

Given the growing strategic importance of smart cities, operators are taking two main approaches to delivering urban digital solutions: developing them in-house or co-creating them through partnerships. The strategy they choose typically depends on their size, technical capacity and the maturity of the local market. Tier 1 MNOs, which have more resources and technical capacity, often pursue in-house development, building proprietary IoT platforms, middleware and analytics tools. This strategy offers greater control over feature customisation, cost structures and long-term value capture. However, it also demands significant organisational capacity, including specialised talent, sustained R&D investment and longer time-to-market. To mitigate these challenges, some operators have pursued acquisitions to accelerate capability building and reduce reliance on third-party vendors. For example, Reliance Jio in India developed proprietary IoT sensors and gateways under its Jio Platforms division. These include environmental sensors (e.g. for air quality monitoring) deployed under its smart city applications division.

For many other operators, the preferred approach is partnership-led co-creation. This involves working with a diverse ecosystem of cloud providers, analytics firms, device manufacturers and vertical solution developers to rapidly build and scale tailored smart city offerings. These partnerships offer flexibility, faster time-to-market and access to best-in-class technologies across the value chain. This trend is evident across the eight focus countries, where operators are actively forming strategic alliances to accelerate innovation. For example, in 2025, Malaysian operator CelcomDigi has signed multiple MoUs with partners including Huawei, ZTE, Ericsson, Aduna Global and EDOTCO Group, reflecting a broader shift towards collaborative approaches with sector-specific experts. This aligns with the 2024 GSMA Intelligence Operator Enterprise Survey, which found that partnerships with other technology companies are the top method used in advancing enterprise strategies.[93] This signals growing industry recognition that co-creation and interoperability are critical to delivering complex, cross-sector solutions like smart cities.

93. GSMA Intelligence. (2025). Operators' enterprise strategies and plans: survey insights reveal shifting trends in 2025 and beyond. Report.

Figure 18

MNO enterprise offerings

Service	Definition	Example
Private networks	A 5G private network makes exclusive use of available capacity. There is no contention from other network users as on a public network.	MTN South Africa technology ecosystem enabled by 5G private networks, forming a network of partners and service providers to create solutions for smart cities.
IoT and eSIM	Solutions to help enterprises connect, manage and scale their IoT deployments, using both traditional SIMs and eSIM technology.	MTN's partnership to deploy Cisco Jasper's Control Center, enabling their business customers to launch, manage and monetise IoT services worldwide.
Cloud and edge computing	Cloud computing provides vast storage capacities and powerful computational resources, and edge brings data processing closer to the source of data.	MTN South Africa and Nigeria leveraging Microsoft Azure's and Ericsson's cloud-native 5G core to deliver cloud-based services to governments and enterprises. Vodafone Egypt cloud and hosting solutions, including both public and private cloud services, backed by secure, locally hosted infrastructure.
Network APIs	Enabling businesses to directly access and control network features like quality of service, location or security through simple interfaces.	CelcomDigi Malaysia's Open Gateway platform, which provides enterprises with standardised APIs. It is already in use by PayNet to provide secure real-time financial transactions.
Professional services	These services (including consulting, system integration and technical support) help enterprises build and manage digital solutions.	Safaricom's business unit provides a suite of digital business services comprising of cloud computing, cybersecurity and IoT solutions, all supported by IT consulting.
Cybersecurity solutions	These include services such as threat detection, secure access and protection for cloud-based operations.	Safaricom Kenya, in partnership with Cloudflare, a global web infrastructure and cybersecurity provider, and CopyCat, a systems integrator, is delivering cybersecurity solutions tailored for MSMEs to lower the cost of access to digital protection.
Big data and analytics	MNOs helping organisations turn large volumes of data into insights for planning, efficiency and decision-making.	Telkomsel offers big data solutions such as MSIGHT, which provides insights into customer behaviour, digital activity and mobility patterns. It also collaborates with Huawei Cloud on a Fix-Mobile Convergence Big Data Platform for integrated data analysis and offers a customer engagement platform.
AI services	Enabling smarter automation, real-time responses and predictive maintenance.	Reliance Jio's Jio Brain, a Machine Learning as a Service (MLaaS) platform, offering AI-powered tools like fraud detection and translation to enhance enterprise decision-making and operational efficiency.
Network slicing services	MNOs creating customised network experiences for different needs like massive connectivity for utilities.	Reliance Jio's 5G Network Slicing and Discovery platform allows enterprises and private parties to customise and prioritise 5G bandwidth based on requirements.
Sustainability services	Solutions such as energy tracking to help businesses meet environmental goals.	Telkomsel's IoT Envion, an AI-powered energy management solution designed to provide real-time visibility into energy usage, helping enterprises monitor, optimise and reduce energy consumption.
Sector-specific platforms	Operators developing and tailoring platforms for industries such as transport, utilities and public safety.	Telkomsel's MarineMobile initiative, developed in partnership with ZTE, to deliver long-range 5G connectivity and tailored digital services to Indonesia's fishing communities.


OK

3
Market case studies

3.1 South and Southeast Asian market case studies

India

India has, by far, the largest addressable market of the eight countries reviewed, and accounts for 94% of the forecasted addressable market in South Asia by 2030. By 2030 it is expected that the addressable market per year in India will be $3.3 billion, representing a cumulative $11.5 billion opportunity from 2024 to 2030. Market growth in India is also higher than any other country or region at 34.8% CAGR. This is due, in large part, to India's large population, high rate of growth and rapidly expanding cities. Using the per urban resident metric (see Section 2) the market in India is less concentrated than the focus countries in Southeast Asia, but still about average for the four regions reviewed.

Beyond underlying macroeconomic forces, government policy has been a major driver in the sector. In 2015, the Government of India launched the Smart Cities Mission (SCM), an ambitious initiative designed to develop 100 smart cities, supported by a substantial national budget allocation and clear implementation guidance on technology, governance and the creation of municipal SPVs for delivery.[94] Total funding to the SCM was reportedly around $20 billion, a quarter of which came from the federal government.[95] Additionally, in 2021 the National Urban Digital Mission was created as a framework for digital governance, and includes standardising data-sharing protocols and regulations for smart infrastructure.[96]

94. MoHUA. (2025). Empowerment of urban staff for better city planning and management. Press release.
95. Government of India. (2024). Smart Cities Mission extended till March 2025. Press release.
96. MoHUA. (n.d.). National Urban Digital Mission. Webpage.

Under the SCM, the initiatives predominantly involve brownfield projects, along with some greenfield activities. Some notable greenfield developments include GIFT City (see Section 0) and Amaravati, the new capital of Andrah Pradesh currently under construction. India's approach is characterised by strong government-led coordination and funding. For instance, the SCM ICCCs were established to enable data sharing across departments (see Section 1.4), and the SPV structures that were mandated to be created serve as both a channel for private capital to co-fund initiatives and as centres for digital expertise. However, their future is in doubt as the mission comes to an end. Beyond the SCM, the Government of India has eased the rules and regulations for FDI, which is expected to play a pivotal role in smart city projects. Additionally, the government has allocated $83 million for the Digital India programme and intends to use PPP models to improve infrastructure in approximately 500 urban locations across the country.

Smart grid and energy-efficiency solutions have become important commercial opportunities for operators including Airtel, Jio and Vodafone. India is currently implementing one of the world's most ambitious smart metering programmes, aiming to replace 250 million conventional meters by 2026 (see Section 1.3). Vodafone, Jio and Airtel have already engaged in substantial smart metering programmes in partnership with utilities and metering companies. In a recent white paper, Airtel India positions itself as a key partner for businesses aiming to reduce their energy costs and carbon emissions. Its data-driven energy management solutions, leveraging IoT, AI and cloud analytics, can provide business with real-time monitoring, predictive analytics and seamless infrastructure integration.[97]

Looking forward, our research indicates a need for smart solutions in mid-tier cities. Additionally, while some cities have effectively implemented monitoring platforms, they are not always able to fully utilise the data obtained. Beyond the SCM cities, skills gaps in local bodies mean solution providers and operators can play a consultancy role recommending connectivity technologies and developing customised solutions based on local needs. However, interviews for this research highlighted that among smart city vendors, the operator offerings are perceived as uncompetitive due to high fees.

97. Airtel. (2025). Efficient, Effective, and Sustainable: The Impact of Smart Energy Management for Organisations. Report.

Spotlight 2

Reliance Jio in India

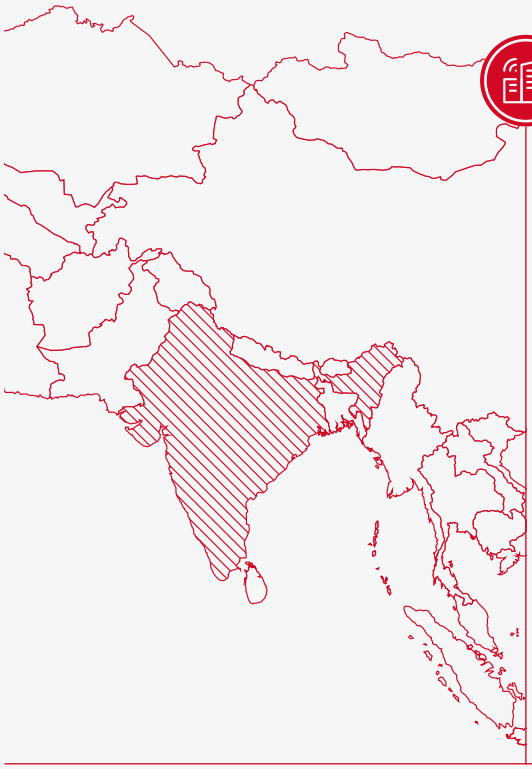
Reliance Jio offers comprehensive smart city solutions spanning devices, connectivity and platform layers of the technology value chain. Jio has established one of the largest 5G SA networks globally in India, with more than 170 million users in nearly 8,000 towns and cities. Its 5G and 4G networks serve as the digital foundation for an ambitious smart city portfolio that includes everything from connected utilities and mobility to public safety. Jio has also invested in NB-IoT infrastructure with the goal of connecting to 1 billion IoT devices through its JioThings platform. Jio has also developed platforms such as Jio Brain that enable faster decision-making, improved predictive capabilities, fraud detection and personalised customer experiences. It also powers a suite of domain-specific AI applications, including JioVault for secure data management, JioTranslate for multilingual communication and PeopleGPT for human resource management.

On the device layer, Reliance Jio is actively manufacturing and integrating IoT- and AI-enabled devices for smart city applications. These include smart sensors for parking guidance systems and automated garbage collection, as well as advanced metering infrastructure (AMI) and automatic meter reading (AMR) solutions. For example:

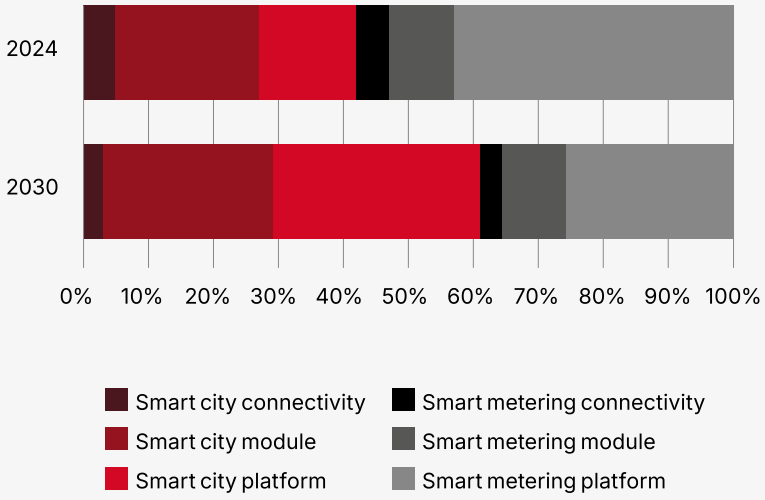
- Jio launched its first commercial NB-IoT service for Tata Power Delhi Distribution smart meters in 2021, in collaboration with meter manufacturers, enabling remote meter readings.
- Reliance Jio, through its Jio-bp joint venture, collaborates with Zingbus to establish an electric mobility charging network for intercity and intracity bus operators, to support the shift to electric bus fleets.
- JioThings, a subsidiary of Jio Platforms, partners with electric bike manufacturer PURE EV to integrate smart digital clusters and telematics in its EVs. PURE EV explores JioThings' smart digital clusters, which incorporate end-to-end IoT solutions in its electric two-wheelers to enhance functionality and interactivity.

Figure 19

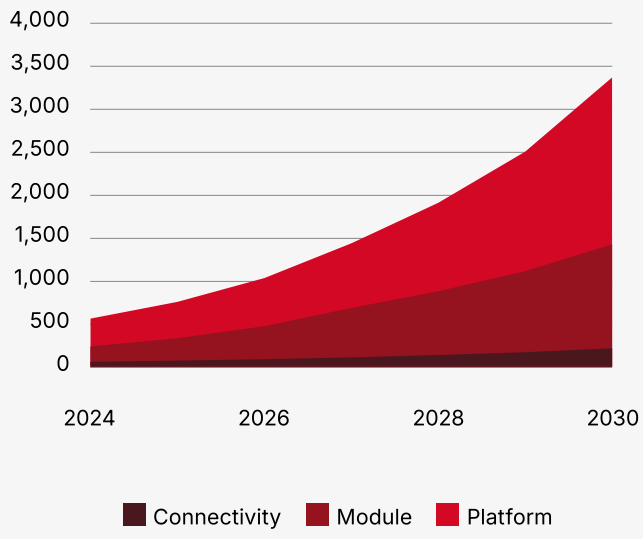
India TAM profile



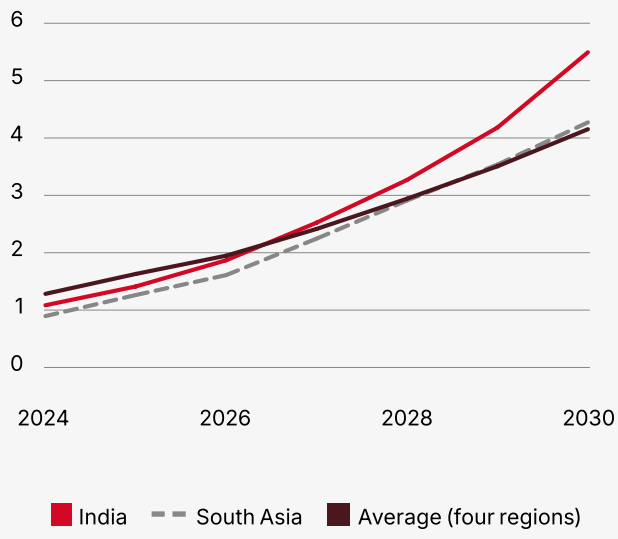
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Indonesia

Indonesia aims to achieve a carbon-neutral target by 2060 as part of its urban transformation vision. The National Long-Term Development Plan for 2025–2045 highlights the importance of strengthening the economy and improving quality of life through digital infrastructure and innovative public services.[98] Indonesia has established 25 smart cities and plans to create 100 smart cities to support this policy with green technology and sustainable infrastructure.[99] In line with this, the Ministry of Communication and Information (Kemenkominfo) launched the Indonesia Digital Vision 2045 to support the Indonesia Emas 2045 vision.[100] Vision 2045 promotes smart city development through six key pillars: governance, people, infrastructure and mobility, economy, living and environment. Recently, the Minister of Communication and Digital Affairs signed an agreement with China to enhance cooperation in AI and smart city development.[101]

Indonesia accounts for 45% of the TAM opportunity in Southeast Asia. By 2030 this market will top $1.1 billion per year, representing a cumulative revenue opportunity of $4.2 billion between 2024 and 2030. In terms of the size of the opportunity, Indonesia tracks regional trends, which are significantly above the average of the four regions reviewed, signalling relatively high adoption across cities and sectors. As with other countries, the opportunity is currently in metering solutions (58%), but most of the growth is likely to be in other verticals until 2030.

Indonesia takes both a greenfield and brownfield approach, notably with Nusantara, the country's new capital city currently under construction. The development of Nusantara is in response to extreme environmental pressures on Jakarta, chief among that the city is rapidly sinking due to groundwater extraction.[102,103] In 2024, a budget of about $2.7 billion (Rp 43.4 trillion) was approved by the national government for the 2025–2029 development phase, which followed an approximate $4.5 billion budget for 2022–2024. The Nusantara Authority is overseeing a $3.8 billion PPP facility for the city. In 2012, the country began the National Green City Pilot Project, selecting 10 cities for pilot smart city projects.[104] In 2023, a nationwide strategy was adopted following the successful pilot programmes. These solutions are being applied particularly in the transport sector and for energy-saving initiatives in the utility sectors, with platforms aiding in monitoring and tracking in cities such as Jakarta, Bandung and Malang.

Decision-making is decentralised, with national policy developed by a national entity guiding project implementation and maintenance. The National Smart City Council coordinates smart city initiatives across the country to ensure alignment with national goals. In Makassar City, for example, the Rindu Capil policy involved cooperation between the government, PT Telkom Indonesia and the private sector, represented by Lintasarta, which helped improve the efficiency of public services.[105] While there are ambitious strategic efforts, MNO interviews noted gaps in implementing the national strategy at the local level, and that while a decentralised approach promotes diversity and local relevance, it presents challenges for scalability and cohesion.

98. Republic of Indonesia. (2024). Government to Accelerate Inclusive Sustainable Economic Growth for 2025 Work Plan. Press Release.
99. Ardy Syah et al. (2024). Smart City Implementation in Indonesian Regions: Juridical and Empirical Review. Report.
100. See: Visi Indonesia Digital 2045. Webpage.
101. ANTARA. (2025). Indonesia, China to strengthen AI, smart city cooperation. Media.
102. NASA Earth Observatory. (2024). Nusantara: A New Capital City in the Forest. Blog.
103. Aljazeera. (2022). Why Indonesia is abandoning its capital city to save it. Media.
104. Luc Citrinot. (2012). Ten Indonesian cities designated as national green city in a pilot project. Media.
105. Sri Wahyuni *et al.* (2022) Implementation Strategy Smart Governance in Makassar City Article.

Spotlight 3

Telkomsel in Indonesia

Telkomsel's contributions to smart cities focus on its network infrastructure. Its 4G network covers all urban areas, while its 5G network – launched in 2021 – is available in major cities. In addition, Telkomsel offers NB-IoT connectivity for smart city applications, following initial trials in 2016, and is increasingly integrating AI in its software-based service delivery platforms. On platforms, Telkomsel's Digihub platform provides developers and enterprises with secure, streamlined access to its network APIs. By exposing key network functions via APIs, Digihub lowers the barrier for innovation and helps businesses integrate. In collaboration with Indosat Ooredoo Hutchison, XL Axiata and Smartfren, Telkomsel has also launched three interoperable API services: Number Verify, SIM Swap and Device Location. These APIs enhance digital identity verification, fraud detection and user security.[106] Telkomsel has partnered with Tencent Cloud to develop AI and cloud-based solutions, and with Singtel to launch Indonesia's first 5G and edge cloud orchestration platform, enabling low-latency enterprise solutions across industries.

Telkomsel's IoT devices and sensors monitor air quality and provide continuous data on pollution levels to facilitate informed decision-making. These solutions support real-time data collection and analysis, optimising city operations and enhancing public safety in various smart city projects, including Nusantara. Examples of other smart deployments include partnering with Bandung City to deploy IoT-based traffic monitoring solutions. IoT solutions have also been used to monitor environmental conditions as part of a smart city programme in Surabaya.

- Telkomsel has partnered with NEC Indonesia to develop smart solutions for the new capital city of Ibu Kota Nusantara (IKN) and other smart cities, with plans to formulate a strategy, roadmap, design, architecture and implementation plan for smart city projects. Telkom has a similar agreement with South Korean telco KT Corp to collaborate on ICT, including quantum cryptography, cybersecurity and smart city solutions.

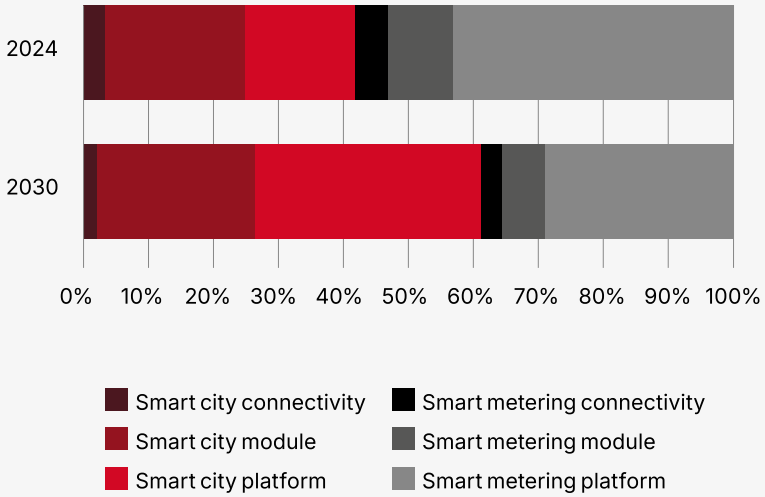
- Telkomsel, through its IoT business unit, collaborated with PT Barindo Anggun Industri to implement a solution using the MNO's NB-IoT service to connect water usage measurement devices. The solution aims to improve the efficiency and service of the Regional Drinking Water Company to customers by reading water usage data in real time, reducing the potential for error in the water meter and integrating with a prepaid system.

106. Telecom Review. (2024). Telkomsel partners with Vonage to revolutionize network capabilities. Media.

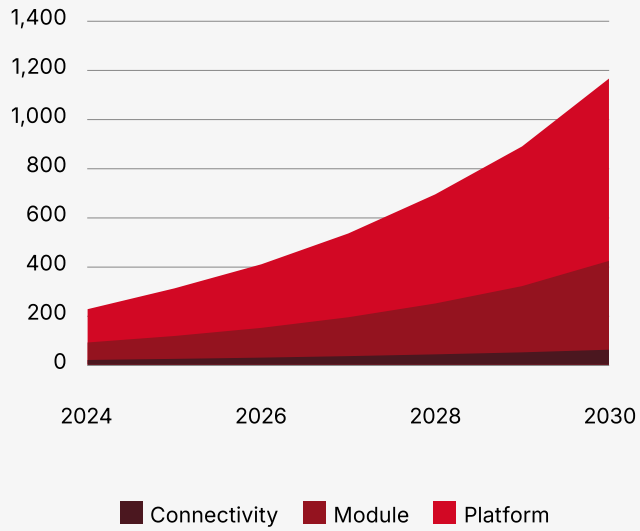
Figure 20

Indonesia TAM profile

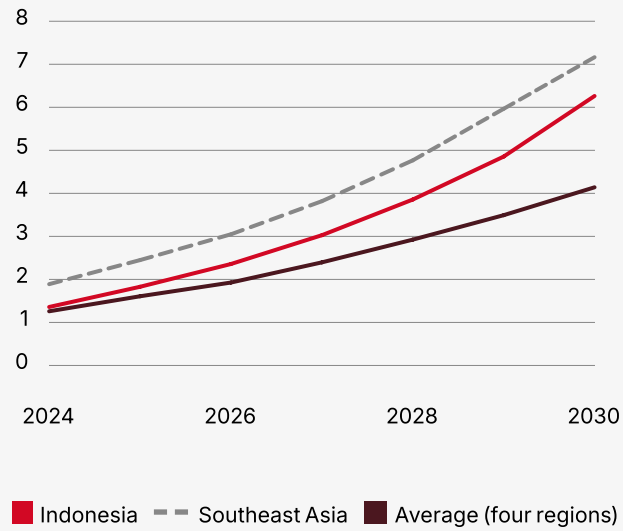
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Malaysia

Malaysia's smart city ecosystem is supported by a clear policy framework, national budget allocations and a strong tech ecosystem. The Malaysia Smart City Framework, developed in 2019 by the Ministry of Housing and Local Government (KPKT), provides guidelines for local authorities using 85 maturity indicators.[107] Smart city initiatives benefit from sizeable budget allocations.[108] Of all the countries reviewed for this study, Malaysia has the highest TAM figure per urban resident. This is due to the fact that 75% of Malaysia's population resides in urban areas, and this is projected to reach 87% by 2050.[109] While the per capita figures are high, the total addressable market (TAM) by 2030 will be smaller than other countries in the region at around 300 billion, reflecting the country's comparatively small population. Growing at 22% CAGR, the market will expand slightly slower than the regional average of 27%, but the trend of expanded smart city solutions is evident in Malaysia.

Development trends in Malaysia differ slightly from other markets, with greenfield developments in smaller cities and brownfield initiatives in larger cities. Examples of new greenfield projects include Cyberjaya, Putrajaya, Gamuda Cove, Forest City, Johor and parts of Iskandar Malaysia, which were built from scratch integrating smart tech (e.g. 5G, IoT) in master plans. However, some, like Forest City, are struggling to attract residents. As of 2024, only 15% of the project was built, with just over 1% occupied.[110] Conversely, Kuala Lumpur, Kuching, Selangor and intermediate cities such as Kulim and Kota Kinabalu, are among the brownfield smart cities retrofitting existing infrastructure with advanced technologies, such as NB-IoT meters and 5G upgrades. Additionally, MySmart Wilayah 2030 ("My Smart Region") aims to transform federal territories into smart cities using a brownfield approach.

Governance is decentralised, with responsibilities assigned to various government bodies at the local level. The Federal Town and Country Planning Department (PLANMalaysia) plays a central role in coordinating and planning projects that are aligned with national policies, while state governments, through designated committees, are responsible for project implementation. Local authorities are involved in the management and execution of specific tasks, such as traffic management and waste management. PPPs are used for implementation, for example, Alibaba's City Brain, TNB's smart meters with GSPARX and PLANMalaysia's collaboration with 25 local councils as Smart City Early Adopters. Further, initiatives like MyDigital Blueprint and special economic zones support various smart city projects, focusing on areas such as smart lighting and mobility.

Key challenges to scaling in Malaysia include the high initial investment costs of some smart city projects that deter participation, and the need for increased funding support for solution providers and startups. In many cases, the platform offer is developed but hardware financing is not integrated in business models. Additionally, operational challenges such as uncertainty with return on investment (ROI), vendor lock-in, after-sales support and fragmented ecosystems, are also common. Selecting vendors that offer long-term support, standardising communication between devices and platforms and clarifying roles and responsibilities can help address these issues.

107. Ministry of Housing and Local Government. (2018). Malaysia Smart City Framework. Report.
108. Bernama. (2024). Budget 2025: RM15.1 mil to bolster smart city development. Media.
109. Khazanah Research Institute. (2024). Urban mobility challenges in Malaysian Cities Report.
110. BBC. (2023). Forest City: Inside Malaysia's Chinese-built 'ghost city'. Media.

Spotlight 4

CelcomDigi in Malaysia

CelcomDigi operates the widest 4G LTE network in Malaysia, covering 97% of populated areas nationwide. The MNO is also delivering 5G services through a commercial partnership with Digital Nasional Berhad (DNB), a government-owned special purpose vehicle (SPV) responsible for deploying the national 5G infrastructure. In 2024, DNB launched 5G Advanced technology in collaboration with Ericsson, making it one of the first networks globally to adopt this next-generation capability. 5G Advanced uses AI to optimise performance, delivering ultra-low latency and high-speed services for enterprise and smart city applications.

CelcomDigi's enterprise portfolio spans IoT platforms and network APIs to data analytics and AI enablement. To support enterprise and municipal IoT use cases, CelcomDigi has established a dedicated business division that oversees its smart city initiatives, providing solutions including fleet tracking and surveillance. To enable more scalable and secure services, CelcomDigi joined the Aduna network API initiative, a global operator collaboration supported by Ericsson. Through this, the company offers standardised APIs to developers and enterprises, enabling services such as number verification and SIM swap protection, crucial for security, fintech and digital onboarding applications. These APIs are already being implemented by Payments Network Malaysia (PayNet), operator of DuitNow and Malaysia's real-time retail payments system, to strengthen authentication and fraud prevention in financial transactions.

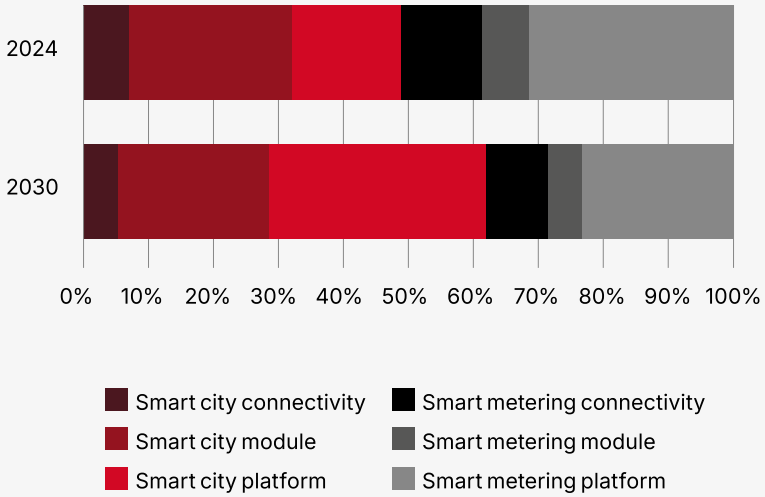
CelecomDigi does not manufacture devices directly but has integrated a variety of connected devices through its NB-IoT and LTE-M networks to enable smart city use cases. In 2024, CelcomDigi entered into a 10-year agreement with the Ampang Jaya Municipal Council to jointly develop Hulu Kelang into a smart city. This partnership involves the deployment of CelcomDigi's fibre infrastructure and 5G connectivity to create a modern and sustainable urban environment.

CelcomDigi's smart city projects primarily focus on brownfield developments, improving existing urban areas such as Hulu Kelang and Shah Alam. However, they also supports greenfield projects by providing connectivity solutions. CelcomDigi takes a collaborative approach with municipalities and other local partners, offering services from strategic planning to implementation.

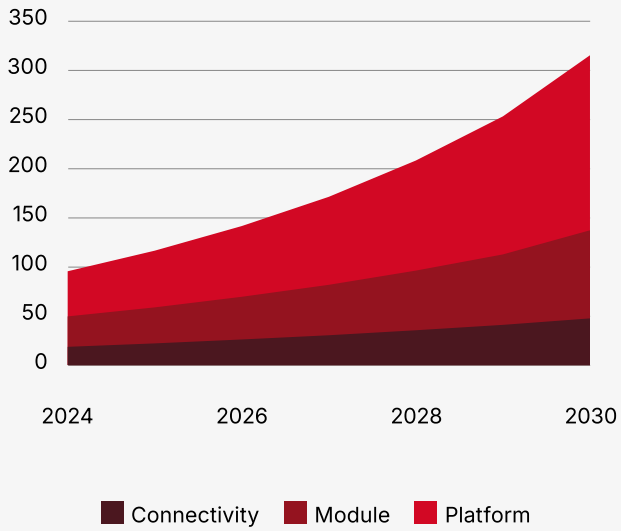
Figure 21

Malaysia TAM profile

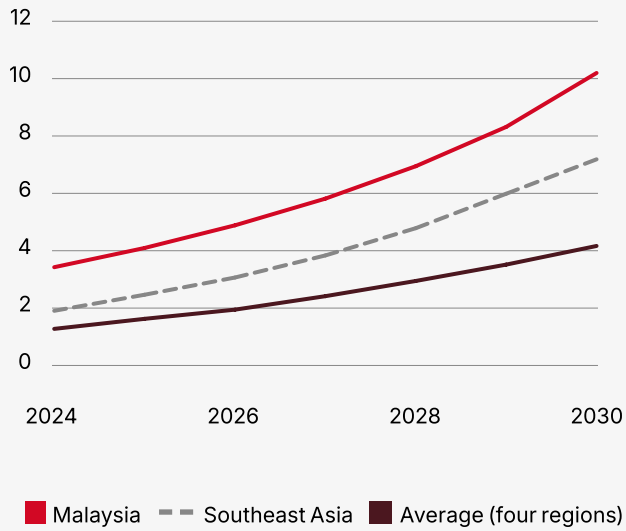
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Pakistan

Under Pakistan Vision 2025, the Government of Pakistan has launched several smart city initiatives, although implementation is not as advanced as markets of comparable size. Projects that have been launched include the Lahore Smart City and the Punjab Intermediate Cities Improvement Investment Programme, which aims to develop a long-term vision for the region and identify a set of bankable projects.[111] This strategy aims to define the overall vision, objectives, governance and institutional framework required for smart city development, with projects across six verticals and short to long-term time frames. With Punjab anchoring the strategy, Lahore is set to become Pakistan's first smart city through a partnership with Huawei, with advanced technologies integrated in city management and services.[112] Elsewhere in the country, initiatives under the Digital Pakistan policy are promoting brownfield projects like New Karachi Town or in large-scale residential areas such as Bahria Town. The government is also introducing e-governance solutions to enhance service delivery, promote transparency and improve efficiency in urban management.

Pakistan's total addressable market is set to reach about $110 million per year by 2030, representing half a billion-dollar revenue opportunity between 2024 and 2030. This is, however, comparatively small given Pakistan's large population, and the TAM per urban resident figure is among the lowest of the countries reviewed. This suggests that beyond the more modest growth of 17% CAGR by 2030, there is considerable room for the market to scale in the medium to long term. Compared with other markets, the connectivity layer share of the TAM is even lower at 2% in 2030, with revenue growth almost exclusively concentrated in the module and platform layers.

Implementation in Pakistan is more bifurcated than in other markets. Greenfield projects are mostly led by the private sector while the public sector focuses on brownfield initiatives. Prominent privately-led greenfield projects include the Capital Smart City and Lahore Smart City projects, a joint venture by Future Developments Holdings and Habib Rafiq Pvt Ltd. The government-led development of Gwadar Smart Port City, part of the China-Pakistan Economic Corridor, is focusing on port infrastructure in its early stages, which includes recommendations to develop the area as a special economic zone.[113] Other notable brownfield projects include the Punjab Safe Cities Authority installation of ICCCs in Lahore focused on CCTV, with plans to expand to Rawalpindi, Faisalabad and Gujranwala; IoT pilots for water supply and sanitation in mid-sized cities like Sialkot and Sahiwal; and Islamabad's Capital Development Authority work on e-governance, transit systems and traffic monitoring pilots. Development funding also plays a significant role in financing smart city projects in Pakistan, with the Asian Development Bank (ADB) one of the key providers of this type of support.

Interviews for this research indicated that the lack of clear policies and regulations for smart cities is likely leading to fragmented implementation across various sectors. Lack of awareness of how to implement smart city projects, and what exactly to implement, is leading to diminished motivation and coordination among ecosystem stakeholders, according to our research. The absence of effective urban policy makes managing rising urbanisation across the country a challenge.[114] A World Bank report on Karachi also identified weak policy frameworks and regulation as key obstacles to commercial, private and institutional investment in the city.[115]

111. BusinessToday. (2023). CelcomDigi, i-City Team Up For Smart City Transformation With 5G, High-Speed Fibre. Media.
112. The News. (2024). Lahore to transform into 'digital city'. Media.
113. Gwadar Development Authority. (n.d.). Master Plan. Webpage.
114. Gondal, M.W. (2021). Exploring the Concept of Smart Cities in Rapidly Urbanizing Pakistan. *Journal of Indian Studies*.
115. World Bank. (2018). Transforming Karachi into a Livable and Competitive Megacity: A City Diagnostic and Transformation Strategy. Report.

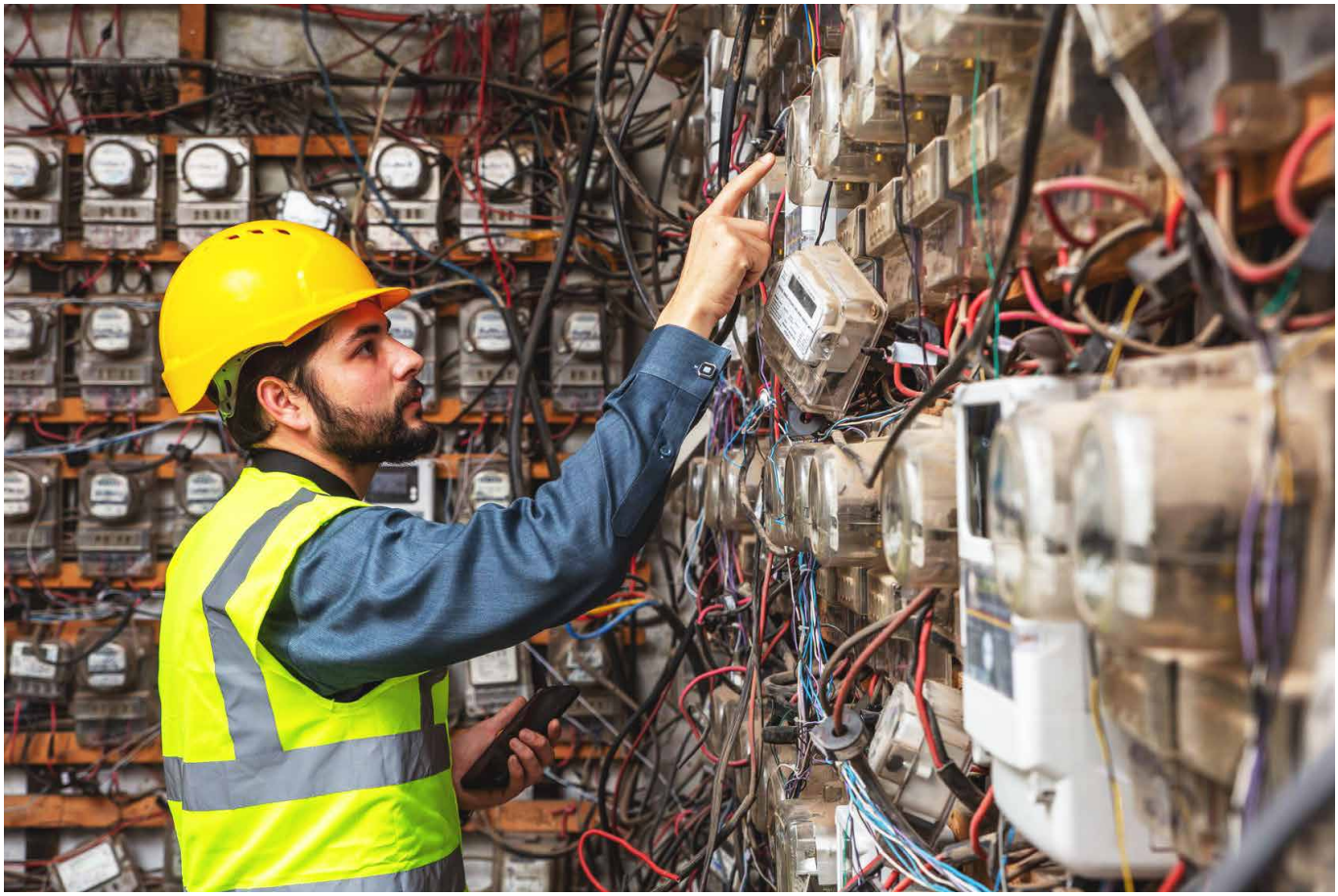
Spotlight 5

Telenor Pakistan

Telenor Pakistan has deployed 4G LTE and the LPWAN technologies LTE-M and NB IoT, and is preparing for future 5G deployment. Telanor has focused on providing IoT connectivity and an IoT analytics platform service. It also offers white-label services, particularly SMS-based communication solutions. The White-Label Platform provides connectivity for various types of SMS communication, allowing users to customise services to their requirements.

Like most operators in this study, Telenor does not manufacture devices directly. Instead, it offers solutions in the transport and energy sectors through partnerships, and its IoT products can help develop smart parking meters and utility sector applications.

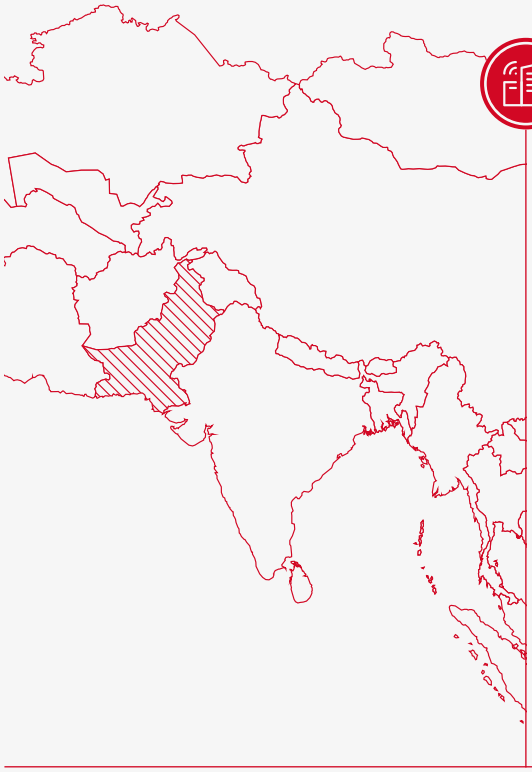
For example, Telenor has partnered with LIFINIT to provide a wide range of smart solutions and services across IoT, AI, cloud, machine-to-machine (M2M) and GSM businesses. Under this arrangement, LIFINIT is responsible for business development and creating new smart products, services and solutions, while Telenor provides the underlying infrastructure and platforms. Telenor Pakistan has independently developed solutions like Auxo Fleet, an end-to-end fleet management platform used by SMEs. One of its customers uses the solution to track ice cream trikes, providing real-time visibility into operations and aiding in the forecasting and planning of its sales cycle. After a pilot involving 700 trikes, the customer plans to use Auxo to track 5,000 vehicles across Pakistan.[116]



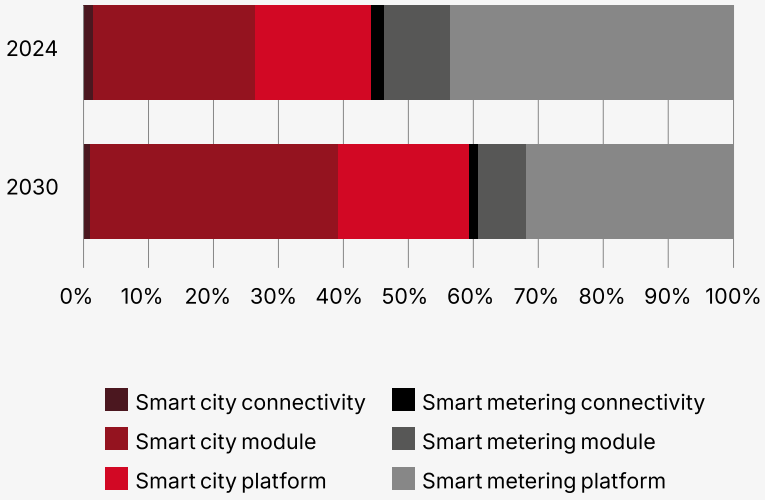
116. GSMA. (2020). Internet of Things Case Studies: Leading the World of Innovation in Asia-Pacific. Report.

Figure 22

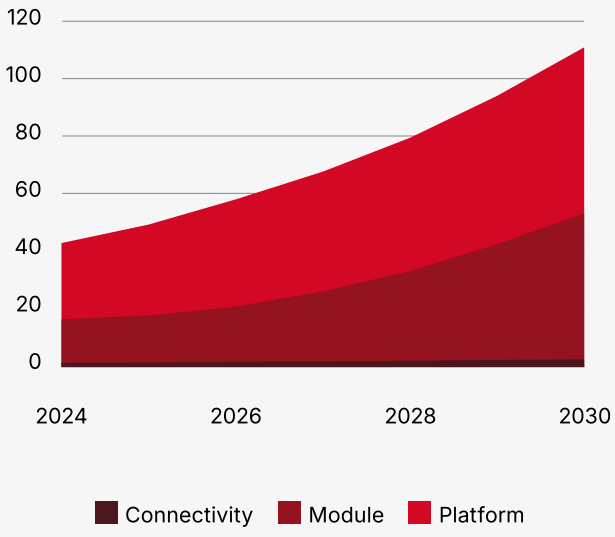
Pakistan TAM profile



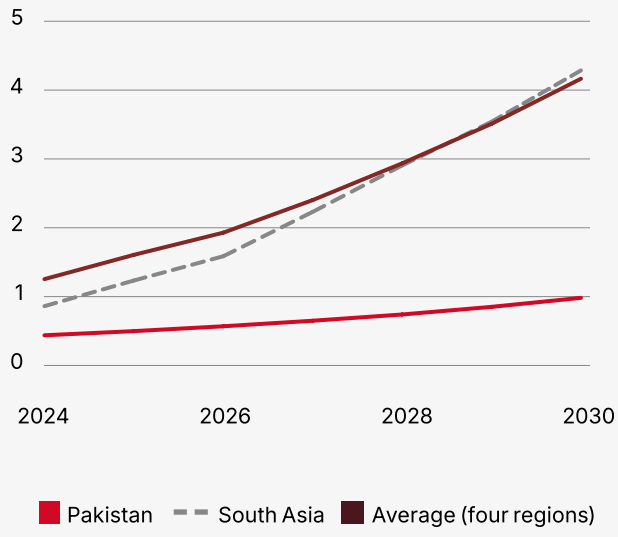
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



3.2 African market case studies

South Africa

South Africa has made substantial progress in urban digitalisation, driven by the National Infrastructure Plan 2050 and projects such as Lanseria Smart Mega City and Durban's efforts to improve smart metering, traffic management and public safety. The South African Smart Cities Framework provides municipalities, national and provincial governments, the private sector, civil society and other stakeholders with structured guidance on identifying, planning and implementing smart city initiatives.[117] The Integrated Urban Development Framework[118] also plays an essential role in aligning smart city projects with the UN Sustainable Development Goals (SDGs). Public funding, PPPs and development financing are the main funding sources for smart city initiatives in South Africa. Complementing this is the Digital Government Policy Framework, launched in 2024, which provides guiding principles for the digital transformation of public services. It seeks to embed digital tools in service delivery and promote citizen-centred governance, further institutionalising the role of digital infrastructure and data-driven systems in South Africa's broader smart city agenda.[119] Unlike many other countries in the region, South Africa has been able to access green bond funding for smart city projects. For example, Johannesburg used green bonds to fund the expansion of the bus rapid system, street lighting and other energy initiatives. Additionally, the new Westtown project, about 20 km from Durban, is expected to attract up to $822 million (ZAR 15 billion) in private sector investment over the next 10 to 15 years.

South Africa accounts for 17% of the TAM opportunity in Sub-Saharan Africa, despite only accounting for about 5% of the region's population. By 2030 it is predicted that the South African market will be worth just over $160 million annually, growing at 13.2% CAGR. South Africa has the highest growth rate of the Sub-Saharan African countries reviewed but is slightly below average in the four focus regions of this study.

To date, the brownfield approach in metropolitan areas has centred largely around enhancing water and energy management, with projects on intelligent traffic management systems, smart utilities and DPI also implemented in Johannesburg and Cape Town. The introduction of prepayments and advanced metering infrastructure, which measures, collects and analyses energy consumption, also enables real-time data collection and efficient utility management.[120] Notable greenfield projects underway in South Africa include Lanseria Smart City and Waterfall City, and a new smart city in Shongweni was also recently announced.[121]

The governance of smart cities in South Africa is decentralised and collaborative, involving multiple stakeholders such as government agencies, private sector partners and international organisations. The governance structure is outlined in the South African Smart Cities Framework, developed by the Department of Cooperative Governance (DCoG) in collaboration with the Council for Scientific and Industrial Research (CSIR). The DCoG provides the guidance and coordination of smart city initiatives and ensures it aligns with national policies. CSIR collaborates with the department to provide expertise and support in planning smart city projects. The national government and relevant departments play central roles in coordinating these efforts, while municipalities are key in planning, implementing and managing smart city initiatives guided by the Smart Cities Framework. Initiatives such as the Capability Maturity Model by the South African Local Government Association help local bodies identify strengths and areas for improvement in governance structures. Municipalities are encouraged to adopt technological innovations and build capacity for effective service delivery.

117. Department of Cooperative Governance. (2021). A South African Smart Cities Framework. Report.
118. Department of Cooperative Governance and Traditional Affairs. (n.d.). Integrated Urban Development Framework. Webpage.
119. DPSA. (2024). Draft Digital Government Policy Framework. Policy.
120. SAP News. (2024). Building South Africa's smart cities. Media.
121. Techpoint Africa. (2025). South Africa bets on futuristic smart city to create 23,000 jobs. Media.

Spotlight 6

MTN South Africa

MTN South Africa is actively contributing to the country's digital transformation and smart city agenda by leveraging its extensive network infrastructure, NB-IoT capabilities and integrated platform services. As of April 2025, MTN's 4G network covers 97% of the South African population, while its 5G network reaches 44%.[122]

The operator has positioned itself as a key enabler of smart infrastructure, focusing on private 5G networks for smart cities,[123] enterprise IoT[124] and sector-specific digital solutions. For example, in collaboration with Huawei, MTN has deployed 5G private networks to more than 14 companies in the mining and port sector. These deployments guarantee the companies high-speed coverage, cloud computing capabilities and improved cybersecurity, and enable advanced use cases such as IoT integration, remote-controlled vehicles and autonomous (driverless) trucks as part of smart mining solutions.

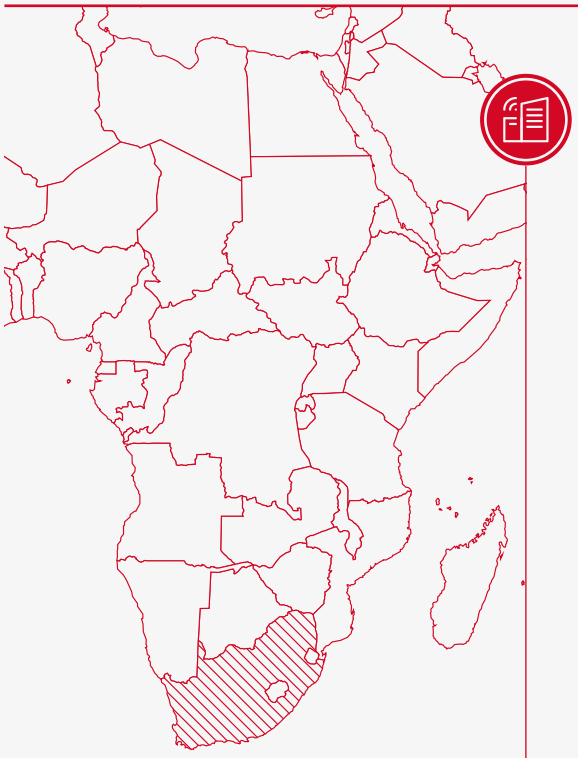
MTN does not manufacture devices directly but instead offers integrated solutions in smart metering, digital platforms and advanced technologies in the waste and energy sectors. Examples of MTN's smart solutions and activities in South Africa include:

- MTN Business aims to digitalise 257 municipalities through smart electricity and water meter technologies with a three-year contract from South Africa's National Treasury, as part of the RT29 Transversal Contract to enhance digitalisation across all 257 municipalities in the country. The project involves supplying, installing, managing and maintaining end-to-end smart metering systems to improve resource efficiency, billing accuracy and municipal financial sustainability.
- In 2024, MTN South Africa collaborated with the South African Local Government Association (SALGA) at the Eastern Cape Provincial Assembly to present smart infrastructure solutions, including smart water and electricity meters, to provincial leaders.

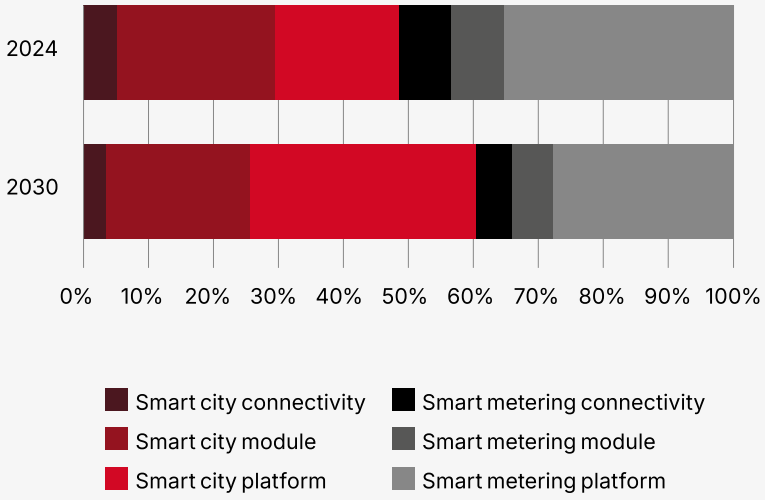
122. MTN. (2025). Enhancing Municipal Digitisation in South Africa. Press release.
123. MTN. (2023). Redefine Smart Cities. Report.
124. Developing Telecoms. (2018). MTN and Cisco Launch IoT Services throughout South Africa. Media.

Figure 23

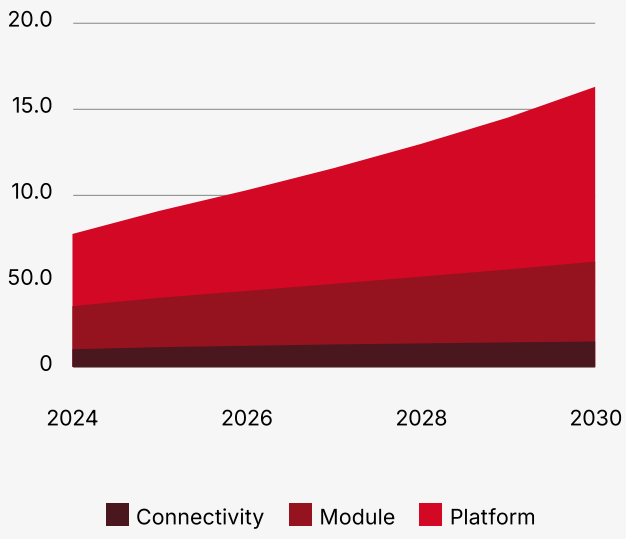
South Africa TAM profile



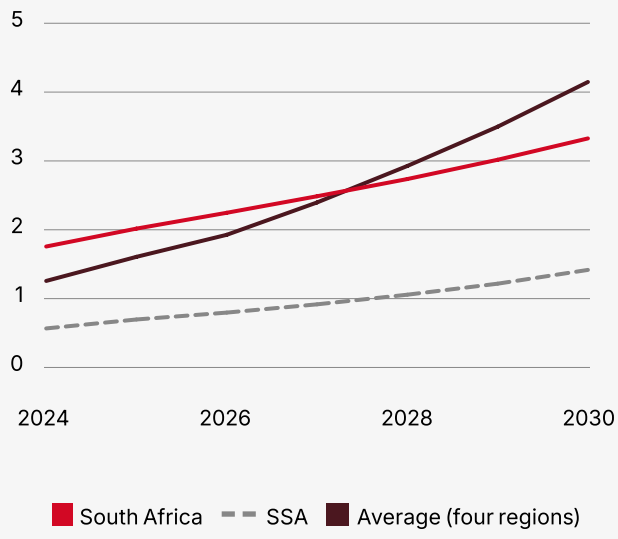
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Egypt

In November 2024, the Egyptian government launched the National Strategy for Smart Cities, which is intended to transform Egypt's urban landscape and promote sustainability, equity and technological advancement.[125] The strategy plans to use digital technologies to improve urban services, quality of life and economic growth, and position Egypt as a significant player in smart city development. Previously, the government announced the Cities of the Future programme, with the goal of establishing 38 new smart cities by 2050 as part of its infrastructure development strategy.[126] These cities, such as New Mansoura City in the Nile Delta region, Al Galala City in northeast Egypt and New Aswan City in southern Egypt, are expected to include smart transportation systems, green energy solutions and AI-driven public services. In 2022, the National Telecom Regulatory Authority issued a framework to serve as a regulatory tool for IoT service operations in Egypt, in line with Egypt Vision 2030, a national strategy for achieving digital transformation in different state sectors and supporting national plans for building smart cities.[127]

Despite the country's size, the addressable market in Egypt remains comparatively small within the region and compared to the average. To some extent, this is due to the economic headwinds in the country in recent years but also reflects a relatively nascent sector. By 2030, the TAM is forecast to reach close to $80 million per year.

In Egypt, major smart city initiatives are primarily greenfield, although there are some brownfield activities. The New Administration Capital (NAC) is a central part of Egypt's smart cities programme. As Greater Cairo has expanded to more than 20 million residents, the NAC, situated 45 km east of Cairo metropolis, addresses Egypt's population growth and aims to create sustainable communities. Other examples of greenfield smart city initiatives include New Alamein, which covers 50,000 acres and is planned for a population of 3 million, and New Mansoura, which is expected to accommodate more than 1 million residents. Brownfield smart city projects receive less attention, but there are notable efforts to incorporate smart solutions in existing cities. Examples include smart energy and water metering in Alexandria, and Cairo is exploring the use of real-time data exchange and IoT sensors to monitor and optimise traffic flow.

The national budget funds significant projects such as the NAC and infrastructure enhancements in cities like Cairo and Alexandria. Companies including Orascom Construction and Hassan Allam Holding have acquired contracts related to smart city initiatives, primarily through PPPs, allowing private firms to work with the government on these initiatives. Egypt also uses loans from bilateral and multilateral financial institutions to finance its urban transformation, accessing funds from organisations like the World Bank and African Development Bank (AfDB) for urban projects. Brownfield projects receive support from the Informal Settlements Development Fund, which aids in integrating smart technologies in existing urban areas.

Despite the promise of the development of new cities, the rate of progress is affecting stakeholders' ability to expand offerings or scale smart city solutions. For example, delays in phase 2 of the NAC have impacted partners invested in the project. Additionally, despite an announced plan to construct "fourth generation" cities in 2018, which involves building new cities on greenfield sites and transforming existing cities with smart technologies, there is still no official guideline defining fourth-generation or smart cities beyond the ambition to leverage technology. This has created uncertainty among stakeholders about its practical implications. This information gap will need to be addressed to realise the full potential of the smart city in Egypt.

125. World Urban Forum. (2024). Launching the National Strategy for Smart Cities. Webpage.
126. Themedialine. (2023). Egyptian Prime Minister Announces Expansion of Smart City Infrastructure to 38 Cities by 2050. Media.
127. NTRA. (2022). Internet of Things (IoT) Framework In the Arab Republic of Egypt. Policy document.

Spotlight 7

Vodafone Egypt

Vodafone Egypt has deployed nationwide 4G services and is actively preparing for the roll out of 5G. In November 2024, Vodafone Egypt and Telecom Egypt signed a $609 million infrastructure agreement to support 5G deployment. As part of this, Vodafone is working with Ericsson to upgrade its network using new equipment that supports multiple technologies in one unit.

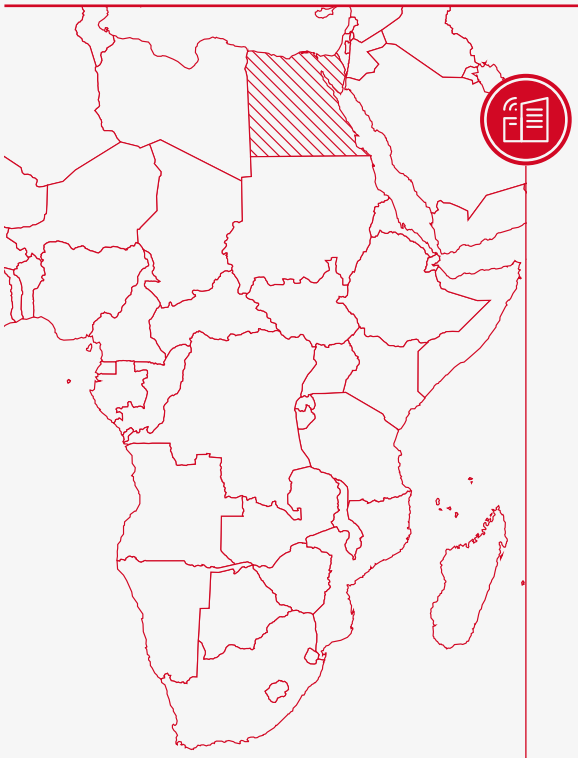
Vodafone Egypt offers a range of digital services to support enterprise innovation. Through its Developer Marketplace, developers can integrate network capabilities, such as messaging and location services, in their applications. The operator also provides an analytics platform that leverages anonymised mobile network data to deliver actionable insights across sectors like retail, tourism and real estate. In addition, Vodafone Egypt offers robust cloud and hosting solutions, including both public and private cloud services, backed by secure, locally hosted infrastructure.

Like many other operators in this study, Vodafone does not manufacture devices directly but has established strategic partnerships to make devices more accessible and support the development of smart solutions. Examples of smart solutions include:

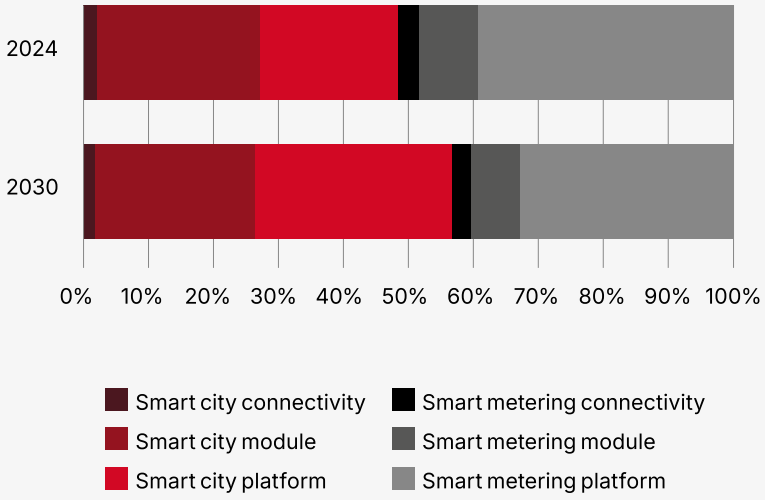
- The Fleet Management System, developed in collaboration with a local tracking and IT services specialist, serves the automotive sector and offers asset visibility and tracking.
- Vodafone provides smart solutions that assist governments and businesses in reducing their water consumption and helps municipalities to monitor and manage water leaks through early detection. One example is a small-scale pilot in Sharm el-Sheikh, in collaboration with UK-based technology provider FIDO, to detect water leakage.

Figure 24

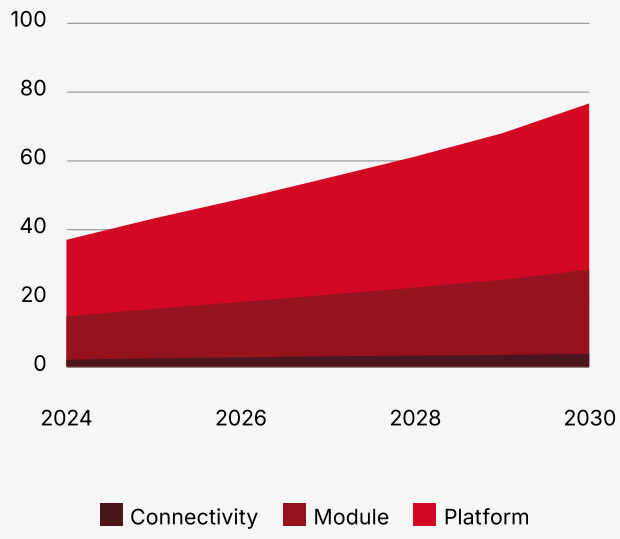
Egypt TAM profile



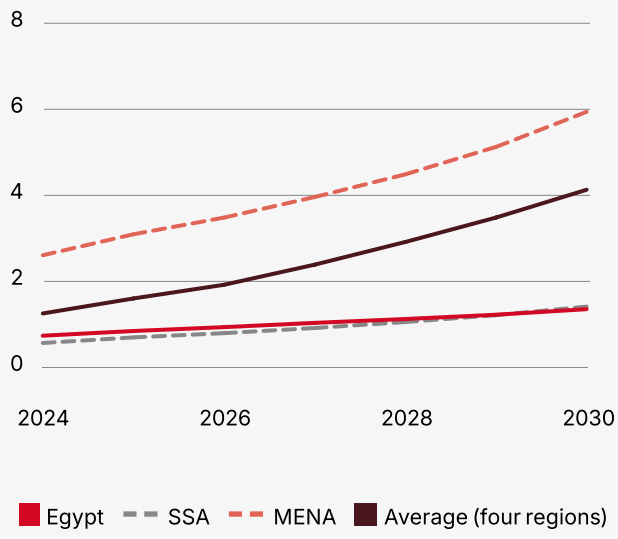
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Nigeria 

In Nigeria, the national government spearheads smart city initiatives while state and local governments implement projects aligned with these objectives. The Federal Ministry of Communications and Digital Economy formulates the national policy and framework, and national and state governments are investing in capacity-building programmes to enhance the skills and knowledge of local government personnel.[128] The Nigeria Smart City Initiative (NSCI) aims to transform major urban centres by employing advanced technologies to enhance service delivery. The primary activities under this initiative include the improvement of public services, effective traffic management, increased citizen safety and the promotion of economic opportunities. Additionally, the Digital Economy Policy and Strategy (2020–2030) focuses on using technology to drive economic growth and social development. The government is also targeting strategic areas such as smart metering to address the 7.1 million smart meter gap. Nigeria's National Broadband Plan (2020–2025) positions broadband as the backbone of innovation across smart city verticals such as transport and security and sets clear targets for minimum broadband speeds and affordability to ensure widespread access.[129]

The total addressable market is set to top $120 million annually by 2030, although compared to the size of the urban population this translates to a relatively low TAM per resident. The revenue potential for operators in smart cities will be driven mainly by platform solutions. However, there is a need to address foundational challenges, particularly inconsistent power supply, limited LPWA network coverage and municipal financing constraints. As with other markets with a low TAM per resident, the medium-term opportunity (beyond 2030) should be sizeable and exceed 20% CAGR from 2024 to 2030.

To date, most smart city projects in Nigeria have been in brownfield contexts, while large greenfield projects have faced delays. Brownfield projects in cities like Abuja and Lagos focus on smart utilities, transport surveillance and traffic monitoring. For example, in Lagos, initiatives have been launched to use data analytics for traffic management; Abuja has adopted smart energy solutions, such as solar-powered street lighting; and Enugu is using smart waste management systems. Funding for smart city projects in Nigeria comes from various sources, including government, PPPs and international donors. The national government largely provides funding and support through budget allocations and international partnerships. The smart metering project, for example, is funded by the Meter Acquisition Fund scheme, supported by the government with $13.7 million approved under the first tranche.[130] The Lagos State government has allocated a budget of NGN 250 million (around $640,000) for research on tech infrastructure.[131] This also includes the installation of 3,000 kilometres of fibre cables to provide high-speed internet access. It is noteworthy that in 2024, Nigerian startups secured more than $400 million in funding,[132] sustaining a steady flow of investments despite global economic uncertainties. This underscores the market's ability to use technology for solutions that address fundamental needs and help advance smart cities.

Insights from this research indicate that the current market dynamics in Nigeria present challenges such as the affordability of smart meters. While mobile operators remain optimistic about the growth of smart cities, there is broad consensus on the need for stronger regulatory support to facilitate innovation across various technologies. There is also an emphasis on the need for capacity building through collaboration with various partners, including subject matter experts on urban development and technical consultants, to develop and implement IoT solutions.

128. NHM. (2024). Development of smart city initiatives in urban areas like Lagos and Abuja. Media.
129. Federal Ministry of Communications and Digital Economy. (2020). Nigerian National Broadband Plan 2020–2025. Policy document.
130. Smart Energy International. (2024). Nigeria's Electricity Reliability Commission issues $13.7m for DISCOM meters. Media.
131. The Borgen Project. (n.d.). The Smart City Project in Lagos, Nigeria. Media.
132. Naira Metrics. (2025). Top 10 Nigerian Startups by funds raised in 2024. Media.

Spotlight 8

MTN Nigeria

MTN Nigeria is exploring smart city opportunities through its enterprise business division, using its 4G and 5G networks and NB-IoT connectivity. In 2023, MTN partnered with Microsoft to migrate its core business and operations systems, along with its big data platform EVA, to Azure. This move is intended to enable MTN to offer its cloud-based services, such as data storage, analytics and AI, to SMEs, businesses and governments, allowing them to access advanced digital tools without investing in costly infrastructure, instead only paying for what they use.[133]

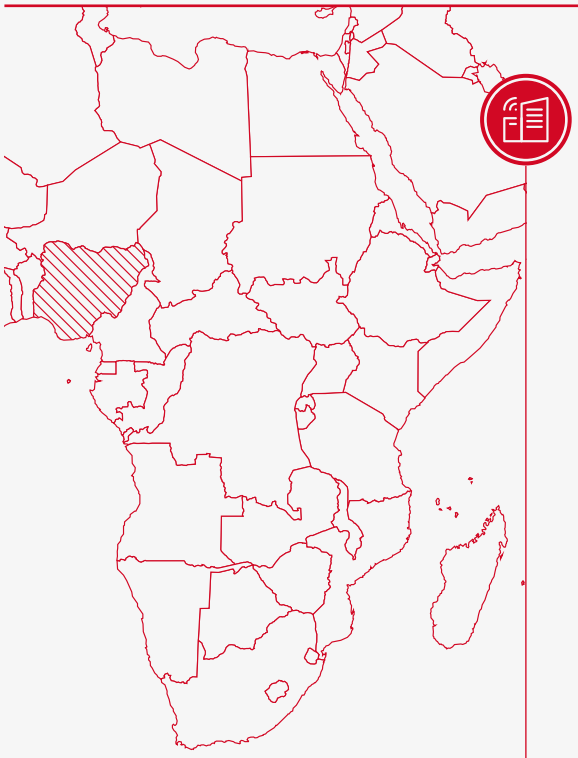
MTN is also building a data centre in Lagos, which could offer cloud computing power and data storage to support its smart city initiatives. In addition to its infrastructure, MTN has developed a digital services portfolio, including digital payments through MTN MoMo and e-learning platforms, which could aid the implementation of smart city solutions. Moreover, the company is partnering with municipalities and innovators to deploy practical applications focused on citizens. For instance, in March 2025, MTN Nigeria partnered with the Lagos State Government to launch the My Lagos App, integrating various services on a single digital platform. This app enables residents to access real-time transportation updates, including bus schedules and traffic conditions, pay utility bills, report emergencies, locate businesses and explore tourism options.[134]

In terms of devices, MTN partners with manufacturers to offer affordable handsets and smartphones and collaborates with third parties in its IoT offerings to provide connected devices. In the smart utilities sector, MTN Nigeria has collaborated with Lumos Global to provide off-grid energy solutions through a PAYG system, allowing users to pay for solar energy equipment in instalments using the operator's mobile payment platform. While off-grid solutions are usually associated with rural areas, 60% of Lumos' customer base live in urban and peri-urban areas. Lumos sees replacing diesel generators, which are common across cities in Nigeria given the chronic unreliability of the grid, as a key commercial opportunity that also helps households and business reduce costs and emissions.[135]

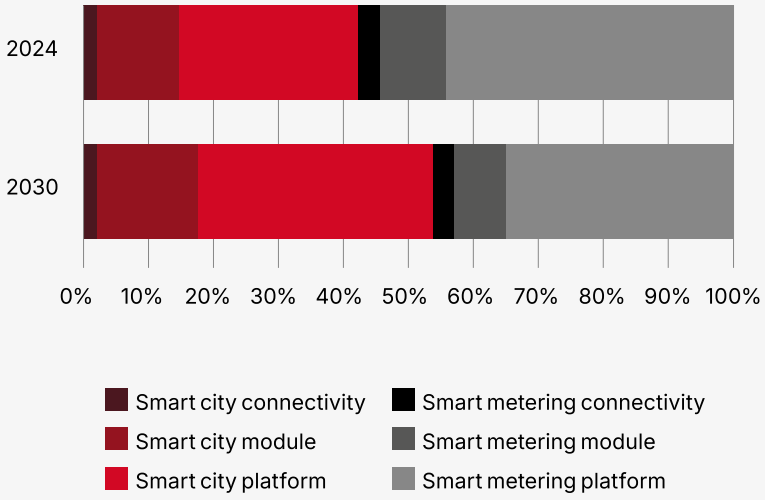
133. MTN. (2023). MTN and Microsoft accelerate Africa's digital transformation in the public cloud. Press release.
134. BusinessDay. (2025). Lagos, MTN's 'My Lagos App' to boost living experience of over 20m Lagosians. Media.
135. GSMA. (2019). Digital Solutions for the Urban Poor. Report.

Figure 25

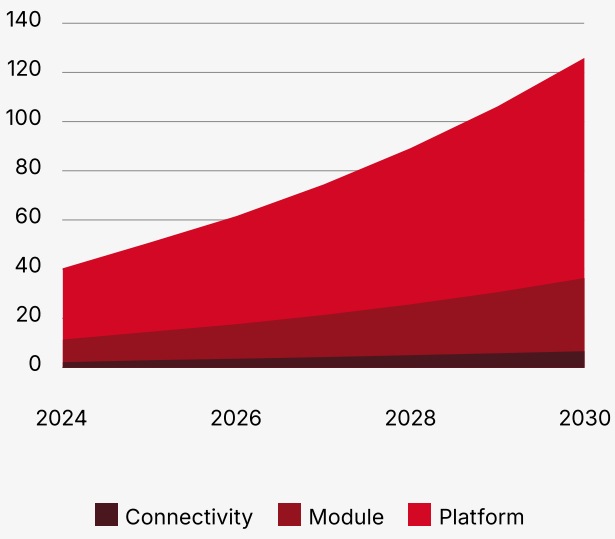
Nigeria TAM profile



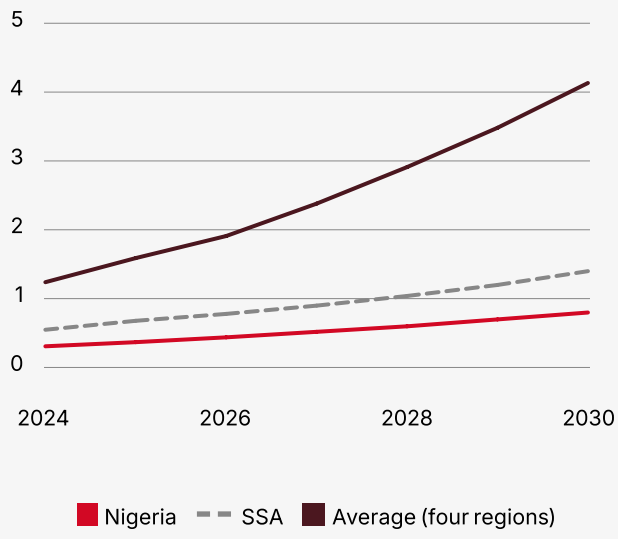
TAM by sector and layer 2024, %



TAM to 2030 by layer, $ millions



TAM per urban resident, $



Kenya 

Kenya's smart city ambition is underpinned by Vision 2030, which aims to transform Kenya into a newly industrialising, middle-income country providing a high quality of life to all its citizens by the end of this decade.[136] In addition, the country has launched various smart city initiatives, notably the Konza Technopolis (a flagship project of Vision 2030), Nairobi's smart transport programmes and the integration of IoT in utilities and public services across the country. The National Broadband policy, launched in 2018, is a foundational policy framework for implementing smart city technologies. The strategy focuses on enhancing connectivity along with digital services and innovation for urban management and citizen engagement.[137] Kenya's large smart city initiatives are financed mainly with public funding and development finance mechanisms. However, private investors, often through tech startups, fund smaller smart solutions for specific sectors, such as transportation and PAYG utilities solutions, and participate in PPP financing structures. The Konza Technopolis project has multiple private-sector partners, such as telecoms equipment vendor Huawei, as well as financing facilities from the Chinese and Italian governments. The Nairobi Intelligent Transport System (ITS) project is funded by the Korea Exim Bank.[138]

While the total addressable market in Kenya is set to reach close to $80 million per year, the growth of the market is slower than in many other countries at just under 20% CAGR. Additionally, the per urban resident figure is the lowest of the eight markets reviewed, a sign that smart city adoption is at a more nascent stage relative to the urban population. In part, this reflects the urban structure of Kenya, Nairobi and Mombasa – the only cities with over a million people and which together account for only about a third of the urban population. The remaining two-thirds are in smaller intermediary cities spread across the country.

Kenya utilises applies both greenfield and brownfield strategies to urban development. The greenfield strategy centres around Konza Technopolis, which plans to include transportation, utilities, public safety and environmental management, along with smart citizen, city and business services. Conversely, the brownfield strategy focuses on improving existing cities, such as Nairobi and Mombasa, through initiatives like the implementation of intelligent traffic management systems, smart utilities and DPI. The water sector has also seen notable digitalisation, but not always with sensing devices or meters.[139]

Smart city governance in Kenya is decentralised, consistent with the country's broader governance structure. The Ministry of ICT and Digital Economy oversees the overall smart city framework and policies. The Konza Technopolis project, for example, is managed by the Konza Technopolis Development Authority under this ministry. Local governments are responsible for service delivery and management, implementing smart services such as e-governance platforms, smart waste management systems and traffic management. They also facilitate citizen participation in decision-making via digital platforms.[140] Challenges to scaling in Kenya include limited municipal implementation capacity regarding decision-making for smaller cities, skill and institutional capabilities and financial capacity. Major greenfield projects have also been slow to take off, for example, the first investment tranche for Konza Technopolois was in 2013, with the first phase now projected to be completed by 2030 and overall completion anticipated by 2050.[141] While the decentralised system facilitates local decision-making, insights from this research highlight the need for effective coordination between national and county governments to ensure consistency and efficiency.

136. See: Vision2030. Webpage.
137. Epic.org. (2022). The Rise of Chinese Surveillance Technology in Africa. Media.
138. DCD. (2019). Huawei to build Konza data center and smart city in Kenya, with Chinese concessional loan. Media.
139. GSMA. (2022). Water Utility Digitalisation in Low- and Middle-Income Countries: Experiences from the Kenyan water sector. Blog.
140. KIPPRA (2024). Smart and sustainable cities in Kenya: A path to progress. Report.
141. Rest of World. (2021). The failed promise of Kenya's smart city. Media.

Spotlight 9

Safaricom in Kenya

Safaricom has been actively involved in advancing smart city solutions through its network infrastructure and digital platforms. Over the years, Safaricom has consistently invested in its network, covering 97% of Kenya's population on 2G to 5G countrywide. According to the operator, its fibre network is also available in more than 560,000 homes and businesses.[142] Safaricom also provides NB-IoT connectivity to support IoT devices for applications like smart meters and enterprise businesses.[143] Through its business unit, Safaricom offers cloud computing, cybersecurity and IoT solutions, alongside IT consulting.[144] Safaricom has partnered with Cloudflare, a global web infrastructure and cybersecurity provider, and Copycat Group, a leading systems integrator in East Africa, to deliver a cybersecurity stack tailored for MSMEs, significantly lowering the cost of access to digital protection.[145]

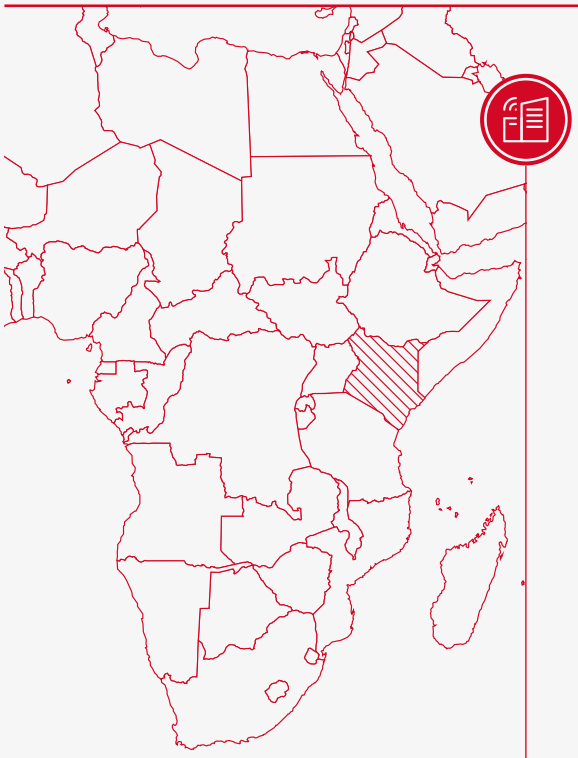
M-PESA, Safaricom's well-known mobile money service, facilitates digital payments across Kenya, supporting many smart solutions. As Safaricom transitions to becoming a technology-led company,[146] it is moving beyond just providing connectivity to delivering analytics and data storage solutions within the smart city space. The following are examples of Safaricom's smart solutions portfolio:

- Safaricom entered a two-year partnership to develop and support the MyNairobi app as part of the MyNairobi hub.[147] This initiative aims to provide digital services and enhance citizen engagement in the city. The solution includes digital communication channels and a payment gateway.
- In 2023, Safaricom partnered with Kitui County to launch the MyCounty App, a scalable platform designed to digitalise county services across Kenya. The app aims to improve access to services and revenue collection, while bridging the engagement gap between citizens and county leadership.
- Safaricom, in collaboration with the Kenya Water Institute, deployed a smart water system at the institute's Nairobi and Kitui campuses. The system uses IoT technology to manage the abstraction, production, distribution and consumption of water. Similarly, in 2021, Safaricom partnered with Cisco on IoT sensors and gateways, including traffic sensors for urban traffic management with real-time data in Nairobi.

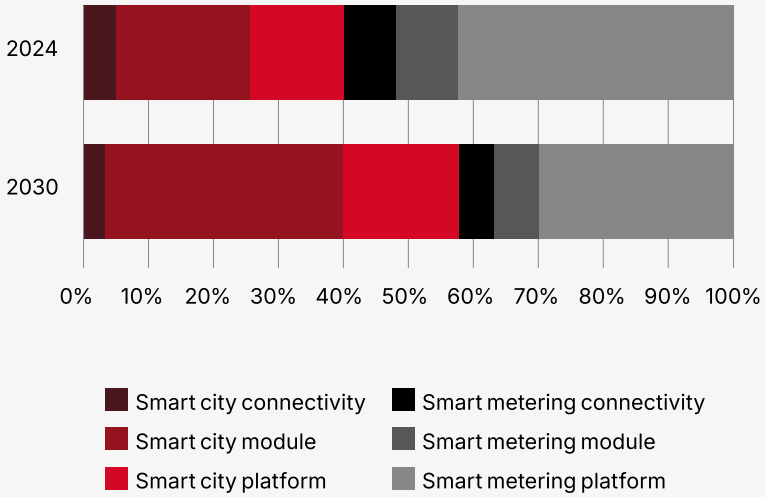
142. Safaricom. (2024). Safaricom Becomes Largest 5G Network In Kenya. Press release.
143. Safaricom (n.d.) Safaricom, M-Gas Extend Brand Partnership With Connectivity Deal. Press release.
144. Safaricom. (2022). Safaricom Introduces Technology Solutions for Enterprises. Press release.
145. Safaricom. (2024). Safaricom Leads the Charge in Cybersecurity for MSMEs with Cloudflare Partnership. Press release.
146. Safaricom. (2023). 2023 Sustainable Business Report: Pathway to a Purpose-led Technology Company. Report.
147. Safaricom. (2023). Safaricom and Nairobi City County Partner to Digitise County Services. Press release.

Figure 26

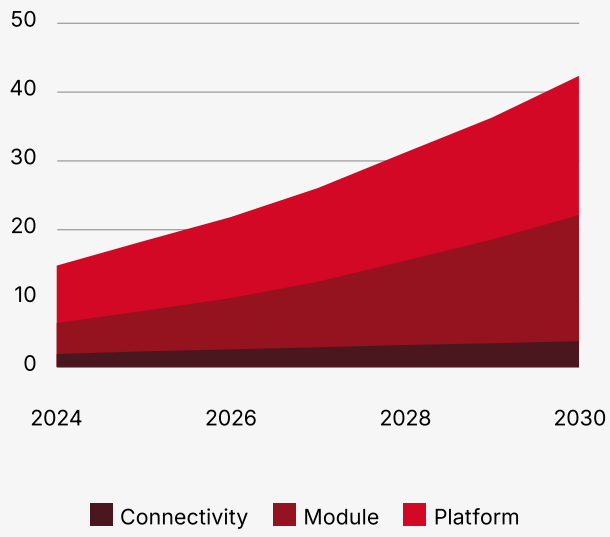
Kenya TAM profile



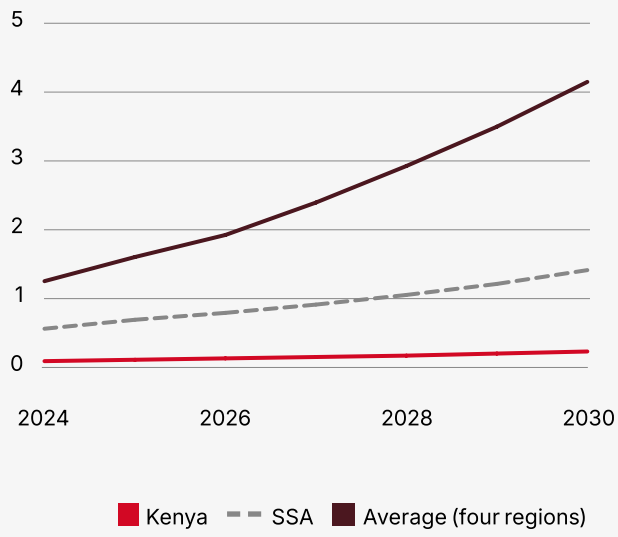
TAM by sector and layer 2024, %

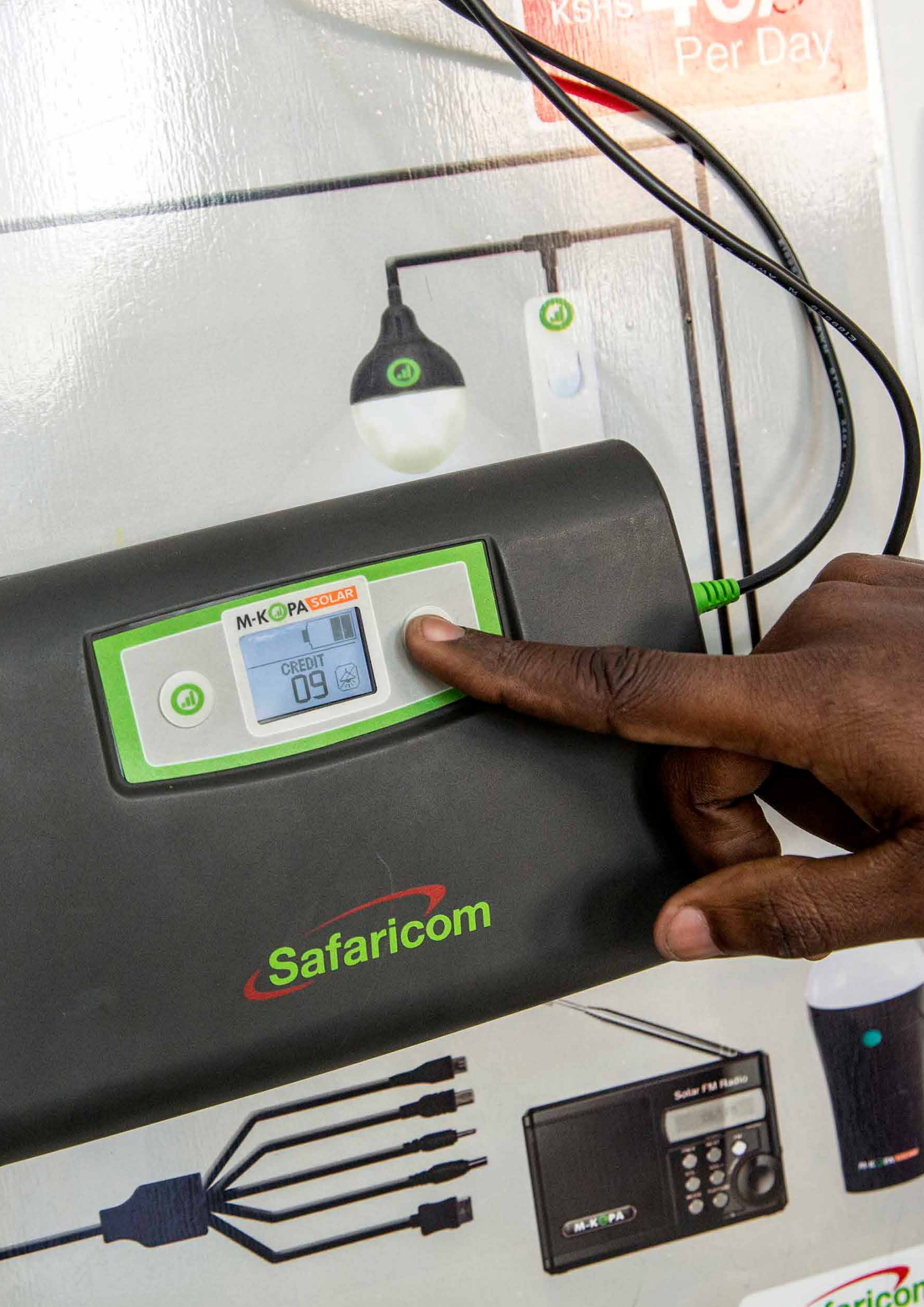


TAM to 2030 by layer, $ millions



TAM per urban resident, $

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4
Outlook and prospects

4.1 The smart city opportunity across markets

This research has highlighted the very different nature of the smart city opportunity in the eight focus markets. These differences are primarily in relation to the total market size and size relative to the urban population, but also in the approaches to smart city development – large-scale greenfield projects versus brownfield initiatives that work with existing infrastructure. These differences in approach have consequences for development outcomes. The new city projects identified in this research have unique characteristics. Government-led projects like Nusantara and Amaravati are multibillion dollar investments in digital-first infrastructure that draw from the tax base and relieve pressure on capitals, but do not directly address the service challenges in existing cities. Similarly, while new cities have a particular economic focus – such as Konza's on tech and GIFT City and Eko Atlantic on financial services – and are likely to stimulate economic development, questions remain about how this will translate into economic outcomes across different income segments.

This research has also highlighted that, beyond major new city developments, many brownfield projects remain concentrated in the largest cities. While this is to be expected due to the size and comparative wealth of these cities, investments in fast-growing intermediary cities present a key opportunity for more balanced urban development. This is particularly true for many African countries, which are set to experience the most rapid growth, and currently have the highest levels of capital city economic primacy.

This push towards more interoperable systems, open networks and DPI is creating a foundation on which to build smart city solutions. Although the core building blocks of interoperability, identity and payments are being developed differently across markets, there is a clear trend in both the public and private sector for these to be built on more open networks. While this focuses attention on ethical and security concerns, it also creates a basis for more targeted individual services and gives individuals more choice in their services. Interoperability and the integration of public and private data is particularly important for smart city deployment in data-scarce environments.

Despite differences in the size of addressable markets, there are commonalities. For example, in all the focus countries, connectivity accounts for the smallest share of the TAM and will grow more slowly than the other layers. The platform layer is set to account for 60% of the market opportunity and represents a clear area for business development. Financing devices is likely to remain one of the key challenges to adoption in all markets. More than the other layers, this often require large upfront expenditures. The vendor financing cases and PPP models highlighted throughout this report offer inspiration for how these financing challenges can be addressed. Finally, the research found that, across all markets, smart metering is currently the largest single use case for IoT solutions but others are set to grow more quickly over the period.

4.2 Drivers in national policy

This research has highlighted the important role that strong national leadership can play in developing the smart city ecosystem. Clear national policies that offer blueprints for implementation – such as in India and Indonesia – have been a catalyst for market development in those countries. While some national governments have outlined their smart city plans and visions, many fall short of providing clear implementation plans and defining stakeholder roles and responsibilities. Hazy guidance, especially at the local level, along with complex regulatory frameworks, can lead to longer bureaucratic processes and unclear implementation for local government and other stakeholders. Particularly important is creating centres of expertise across government.

For countries with a more nascent ecosystem, there is a clear need to strengthen institutional capacity across all levels of government. Smart cities require both technical expertise, such as IoT, AI and 5G-enabled solution implementation, as well as administrative skills, including project coordination, in government and the private sector. Insights from this study show that a lack of capacity and skill gaps, especially among staff at government agencies and municipal authorities, are significant factors in implementation issues or delays in smart city projects. This is particularly relevant to brownfield projects in large urban areas, which often require careful planning and execution to reduce disruptions and integrate solutions with existing infrastructure. Examples of successful models from the case study countries include guidelines for integrating smart technologies focused on cybersecurity and sustainability, such as the South Africa Smart City Framework, and clear guidance on establishing city-level SPVs under the Smart Cities Mission in India.

Even within more decentralised administrative structures, national governments can play an active role in addressing governance issues and fragmentation. In countries such as Indonesia, Malaysia and Nigeria, decentralised political structures often lead to uncoordinated efforts between national and municipal authorities. This results in duplication, policy misalignment and/or implementation gaps. In these contexts, standardising frameworks, launching joint capacity-building programmes or creating multi-city initiatives, are all steps the national government can take to strengthen coherence, increase investor confidence and improve the user experience. Central coordination is also key when projects are funded by multilateral development financing.

4.3 Drivers in city-level policy

Municipalities and local bodies are at the centre of urban development and guide a city's strategic vision. Some cities have used strategic tools such as vision statements or structured plans, but many still operate without formal frameworks, resulting in ambiguity, fragmented efforts and weaker stakeholder alignment. Interviews highlighted such uncertainties in some markets (e.g. Egypt and Indonesia), with respondents not certain whether city-level strategies were even available to clarify what is required. Where there are gaps in the vision, local bodies should seek to develop flexible strategic roadmaps that guide stakeholder engagement and implementation. These should be flexible and dynamic to ensure that actions can be adjusted in response to changing connectivity and technological landscapes.

Local governments, supported by national government, can build internal expertise or collaborate with intergovernmental organisations at different administrative levels to establish common frameworks for regulating the technical, legal and ethical aspects of smart city projects. This could involve setting up a separate entity for smart cities on the implementation side, such as India's SPVs and ICCCs or leveraging support from intergovernmental networks. Training local staff

on digital systems is equally crucial as many local bodies have limited technical capacity. Building local knowledge of technical and management aspects will ensure a broader understanding of the solutions and provide staff with visibility on short-term and long-term needs. Cape Town's Digital City Strategy, for example, includes targeted capacity building by training staff on data analytics and smart grids.

City-level staff are key in ensuring solutions are impactful and deliver services equitably. Smart city solutions fundamentally involve the integration of technologies in traditional city infrastructure, such as transportation, housing and utility facilities. It is common within all these sectors for there to be sharp inequalities in access. Local governments are well placed to monitor and address these gaps and ensure that the digitalisation of services does not contribute to exclusion.

4.4 Ecosystem drivers

Operators have an opportunity to increase their value offering beyond connectivity in smart city initiatives. This could involve investing in technological upgrades or forming partnerships to expand into other layers of the technology value chain, especially the platform layer, and (where relevant) becoming comprehensive providers of smart city solutions. For example, Celicom in Malaysia transforming Hulu Kelang into a smart city shows strategic involvement, from decision-making to providing technological infrastructure and platforms, along with leadership in sandbox initiatives. This approach demonstrates a high degree of involvement and leadership in the smart city offering. Similarly, Reliance Jio in India has developed complete solutions for smart city projects, and in South Africa, Vodacom acquired a majority stake in IoT.nxt to strengthen its capabilities beyond connectivity.

In many cases, there are opportunities for operators to invest in in-house expertise and capacity building. While it may not be necessary to establish dedicated smart city divisions, it is essential for operators to cultivate a team of specialists throughout the organisation to support different aspects of urban development. Operators should integrate these competencies across verticals, such as M2M communication, cloud-based services, open data management, cross-functional capabilities and urban consultancy. This includes providing guidance on the selection of suitable network connectivity based on the local context and budget. In many cases operators can benefit from developing an in-depth understanding of the cities they seek to engage with, and ensure their solutions are customised to meet specific needs and can be adapted to local socio-economic conditions.

Local tech startup ecosystems are key in developing new and tailored smart city offerings. This is equally relevant in the smart city sector, where global solutions, including those from countries with comparable structures, may be unsuitable due to local social, economic or cultural factors. Harnessing the potential of the local tech startup ecosystem for smart city development may entail active investments and incentives provided by governments, fostering industry collaborations—such as with operators to enhance the scalability and visibility of their solutions—and encouraging their participation in sandboxes designed for smart city solutions to promote innovation. Operators can also leverage ecosystem relationships as they have connections to device makers, cloud service providers, and end users, which can be used to accelerate adoption and integration of smart city technologies.

Accelerated efforts are needed to close the digital divide and ensure the design and implementation of smart solutions are inclusive. End users, both individuals and businesses, are an essential part of the smart city ecosystem. Smart cities are developed for residents, and the advantages of technology-driven urban development need to reach all societal segments to promote social cohesion and economic growth. Broad inclusion also safeguards vulnerable residents and enhances the overall resilience of cities, such as for disaster warning or waste management solutions. In many cases, improving handset affordability is a key pillar

of closing the digital divide. Since 2024, the GSMA has been working with international organisations and financing institutions, such as the World Bank Group, the International Telecommunication Union (ITU) and the World Economic Forum Edison Alliance, to accelerate access under the GSMA Handset Affordability Coalition. MTN South Africa's drive to offer 1.2 million handsets at ZAR 99 ($5.4) is an example of operator-led initiatives to address the challenge.[148] Some examples of how cities are fostering inclusion in smart city solutions include:

- **South Africa** – eThekwini Metropolitan Municipality deploys NB-IoT smart water and electricity meters in townships, ensuring prepaid access for low-income households and allowing users to pay for regulated services over time instead of relying on more costly arrangements.
- **Indonesia** – Jakarta's smart city Qlue app, which was supported by the GSMA Innovation Fund, allows residents, including those in informal settlements, to report issues regarding flooding or waste through smartphones or community kiosks.[149]
- **Kenya** – M-PESA is embedded in Nairobi's smart city ecosystem, enabling low-income individuals to pay for utilities, transportation and other services with a USSD, not requiring smartphones.

4.5 Harnessing smart cities for climate and development outcomes

Smart city approaches can offer significant opportunities to policymakers in LMICs aiming to advance inclusive development and climate resilience. While the risk of smart city projects becoming high-cost, high-tech, elite enclaves detached from wider national development challenges is real, smart city solutions – when thoughtfully applied – can be transformative by improving urban service delivery, optimising infrastructure use and strengthening the ability of cities to adapt to environmental and demographic pressures.

To realise these potential gains, it is important to go beyond the hype and big project announcements to focus on specific interventions and use cases and rigorously evaluate their development and climate impact. Monitoring and evaluation should be a core component of tracking the impact of smart city interventions and would allow policymakers to adapt interventions to local realities. More research is also needed to help guide decision making and support policymakers to navigate a range of potential use cases, product offerings and financing arrangements, and their underlying trade-offs.

Policymakers face complex decisions about where to invest limited public resources and how to ensure that technology deployments address real needs rather than create new forms of inequality or exclusion. There is also the risk of technological determinism, where smart city models are driven more by vendor solutions than local priorities. Policymakers must weigh short-term innovation gains against long-term sustainability, governance capacity and community ownership. The challenge is not just to deploy technology, but to embed it within inclusive planning processes, robust institutions and adaptive regulatory frameworks.

148. Mobile World Live. (2025). MTN to offer 1.2M cheap 4G devices. Media.
149. GSMA. (2021). Impactful Innovation: Insights from evaluating Qlue. Report.

Officials involved in India's Smart Cities Mission highlighted a common challenge associated with smart cities solutions. In India, the sectors with major demand and supply gaps (water, waste and sanitation) have been identified as those least attractive for private sector participation.[150] Policymakers should think about reforms that could make priority sectors more appealing to the private sector, while also clarifying which policy priorities cannot be solved with private sector funding. Strengthening PPPs could encourage clear frameworks for potential private sector partners and encourage the adoption of innovative approaches and new technologies.[151]

Regulatory frameworks need to find the right balance between providing sandboxes to test emerging use cases, while establishing strong safeguards against potential risks as solutions scale up. Smart surveillance and data collection – often core components of smart city platforms – raise concerns about privacy, accountability and the potential misuse of citizen data in contexts with weak regulatory oversight. With data increasingly held and generated by private companies, it is also critical that governments explore new frameworks and partnership models to responsibly access private sector data for public policy priorities, such as urban planning and land use.

Another critical challenge is technology lock-in – a scenario in which cities become dependent on proprietary systems that are expensive to maintain, difficult to upgrade or incompatible with future innovations. To avoid this, governments must prioritise interoperability – ensuring that systems and platforms work together across vendors and departments. Open standards, modular design and locally managed data systems are essential to building flexible, future-proof urban technology ecosystems. In this context, the growing adoption of DPI architecture across LMICs could help ensure that public services are not hostage to proprietary systems, while promoting inclusive, adaptable and sustainable digital ecosystems.

We look forward to continuing to support cities in LMICs to harness digital innovation for economic development and climate action. The GSMA sees a unique and important role for MNOs in the responsible adoption of smart city solutions in LMICs. Mobile operators have strong track records in these markets, understand the local context and have demonstrated their role as partners of governments in achieving national development priorities. With revenues from traditional revenue sources declining, mobile operators are increasingly aiming to reposition themselves as digital service providers. Some commercial priorities, such as digital platforms and super apps, payments as a platform, cloud and IoT enterprise and public sector solutions, as well as AI and big data, can serve the smart cities agenda. Building successful partnerships between MNOs, government, startups and other private sector innovators will be key. As the GSMA, we look forward to continuing to provide recommendations and best practices to support these partnerships and drive the smart cities agenda.

150. WEF. (2016). Reforms to Accelerate the Development of India's Smart Cities Shaping the Future of Urban Development & Services. Report.
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Annex

To better understand the technological underpinnings of smart city solutions, the following table breaks down the core layers of an IoT architecture.

IoT layer	Key functions	Key players	Examples
Hardware layer (sensors, devices and infrastructure) This layer includes physical devices such as sensors, actuators, cameras, smart meters and other IoT-enabled hardware that collect data from the urban environment (e.g. traffic, air quality, energy usage).	Data collection, environmental monitoring and basic processing at the edge	Device manufacturers	Cisco, Siemens, Honeywell, Bosch and Texas Instruments produce IoT sensors and hardware
		Chipset providers	Qualcomm, Intel, NVIDIA and Arm supply the processors and chips powering these devices
		Networking hardware providers	Nokia, Huawei and Ericsson provide gateways, routers and other connectivity hardware
Connectivity Layer This layer ensures seamless communication between IoT devices and the cloud or data centres. It includes wired and wireless networks such as 5G, Wi-Fi, LoRaWAN and NB-IoT.	Data transmission, network reliability and low-latency communication	MNOs	Verizon, AT&T, Vodafone and China Mobile provide cellular networks (e.g. 5G)
		LPWAN providers	Sigfox, Semtech (LoRa) and Actility specialise in LPWAN connectivity
		Satellite providers	Starlink (SpaceX) or Inmarsat for remote or back-up connectivity
Platform layer (data management and middleware) This layer includes IoT platforms that aggregate, store and manage data from devices. It provides middleware for device management, data analytics and integration with applications.	Data storage, real-time processing, device orchestration and API enablement	Cloud providers	Amazon Web Services (AWS IoT), Microsoft Azure IoT, Google Cloud IoT and IBM Watson IoT
		Specialised IoT platforms	PTC ThingWorx, Siemens MindSphere and GE Predix
		Open-source platforms	Companies or communities behind platforms like Eclipse IoT or OpenRemote
Software and analytics layer This layer focuses on processing and analysing the vast amounts of data collected to derive actionable insights. It includes AI, ML and visualisation tools.	Predictive analytics, optimisation and decision-making support (e.g. traffic flow predictions, energy efficiency)	Analytics firms	SAS, Splunk and Tableau (Salesforce) for data visualisation and insights
		AI/ML providers	Google (TensorFlow), IBM and NVIDIA offer AI tools for smart city applications
		Specialised smart city software	Companies like Schneider Electric (EcoStruxure) or Hitachi (Lumada)

IoT layer	Key functions	Key players	Examples
Application layer: This layer delivers end-user applications tailored to specific smart city use cases, such as smart transportation, waste management or public safety.	User interfaces, citizen engagement, and operational dashboards for city management	Vertical solution providers	Uber or Lyft (smart mobility), Veolia (waste management) and Philips (smart lighting)
		Smart city integrators	Accenture, Deloitte and Capgemini build custom solutions for cities
		Citizen-facing apps	Startups or municipal governments often develop apps for public services (e.g. parking or transit apps)
Services layer: This layer encompasses consulting, implementation, maintenance and managed services that support the deployment and operation of smart city solutions.	Key functions: system integration, cybersecurity, training and ongoing support	Consulting firms	McKinsey, BCG and PwC advise cities on smart city strategies
		System integrators	IBM Global Services, Wipro and Infosys handle deployment and integration
		Cybersecurity providers	Palo Alto Networks, CrowdStrike and Symantec secure IoT ecosystems
End user layer (stakeholders and consumers): This layer includes the ultimate beneficiaries of smart city solutions – governments, businesses and citizens.	Adoption, feedback, and use of smart city services	Municipal governments	City planners and administrators
		Businesses	Retail, logistics and utility companies leveraging smart city data
		Citizens	Residents using apps or services like smart parking or energy monitoring

Endnotes

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