Governments across the world are increasing their focus on the development of specialised urban agglomerations, termed as smart cities, which can provide a good quality of life and a clean and sustainable environment through the use of smart solutions. A smart city engages more effectively and actively with its citizens, has low resource consumption and continuously generates new business and employment opportunities. It capitalises on new technologies and insights from connected devices to increase the efficiency of its operations and improve service delivery.

The global smart cities market is increasing at a compound annual growth rate of 23.1 per cent and is expected to reach $1,201.69 billion by 2022 from $424.68 billion in 2017. India has emerged as a promising region for the development of smart cities with the launch of the government's Smart Cities Mission in 2015. The mission is touted to be one of the largest enabling policy mechanisms for a gamut of projects across the infrastructure and service industries, and aims to achieve massive urban transformation by enabling local area development and harnessing technology. The government has envisaged the creation of 100 smart cities with an initial investment of Rs 1 billion per city per year for five years (2015-16 to 2019-20). An equal amount is to be contributed by the state governments/urban local bodies.

ICT landscape in smart cities

The conceptual underpinnings of smart cities include a number of advanced information and communication technology (ICT) solutions that can enable key segments such as energy, transportation and waste management to leverage new technologies to deliver smart solutions to citizens. Essentially, the "smart" component of a smart city rests on the data captured by sensors, which is analysed using ICT to facilitate real-time decision-making and create citizen-friendly services and applications by the concerned authorities. Globally, a mix of communication and networking technologies including wired networks, wireless networks, satellite networks, transmission protocols, machine-to-machine (M2M) and internet of things (IoT) is being used to provide the requisite infrastructure for meeting the objectives of a smart city.

On the wireless connectivity front, most of the cellular networks globally are on 2G and 3G, while 4G penetration is increasing steadily. Significant activity has also started around the development of 5G standards, although the technology is unlikely to achieve commercial deployment until 2020. 5G technology aims to address some of the key future needs of smart cities with higher bandwidth, delivery and performance guarantees, adaptability, energy efficiency, and real-time capabilities. The other key attributes of 5G that will benefit smart cities include the ability to support a large number of connections, and quicker and more adaptive

response times that support time-sensitive applications. Further, ubiquitous Wi-Fi networks will also act as connectivity channels for smart cities. Sterlite Technologies, which has been selected to develop Gandhinagar as a smart city, will set up 400-500 Wi-Fi access points across the city. In Nagpur, Larsen & Toubro will deploy 136 Wi-Fi hotspots and establish 100 digital interactive kiosks at prominent locations. In the case of smart cities, traditional Wi-Fi systems are not ideal for outdoor connected devices as they lack adequate range and are energy intensive. In this context, a Wi-Fi HaLow (802.11ah standard) system has been developed to increase the range of connected devices and allow for low-power sensors to transmit small data packages over a low bandwidth link.

Another alternative wireless technology for smart cities is low power wide area network (LPWAN), which offers a multi-mile range and multi-year battery life. Besides, the LPWAN wireless network has unprecedented reach, enabling communications in deep water and up to 50 metres underground. This makes it suitable for use inside buildings. The LPWAN ecosystem is experiencing exponential growth with the development of technical standards and nationwide network roll-outs. According to industry estimates, by 2025, there will be 152 million connected LPWAN devices for smart water networks, transportation, waste management, environmental monitoring and public safety, up from less than 4 million in 2015. In India, Tata Communications has rolled out the country's first LPWAN based on LoRa (long range) technology, a wireless communication technology dedicated to IoT and M2M networks. It is a super-low-power and secure communications solution that helps in overcoming the high power consumption challenges of existing wireless solutions. It is also a powerful tool for mapping smart city applications and urban planning at a low bit rate.

In the wired broadband space, optic fibre cable (OFC), with its virtually unlimited capacity, is the perfect backbone for the delivery of high speed internet. The cities selected under the Smart Cities Mission have submitted budget proposals for citywide OFC deployments, ducting for OFC networks, deployment of OFC for command and control centres, and other OFC-related civil works. However, a key challenge with regard to the deployment of fibre infrastructure in smart cities has been that very few cities have explicitly mentioned fibre deployment as a key component of their development plan. This is because most cities expect telecom operators and other service providers to lay the fibre at their own expense.

Cloud computing in smart cities is also gaining widespread adoption as it provides a cost-effective way to store the massive amounts of data generated by connected devices. An emerging trend in this space is the use of fog computing, which refers to data processing within and at the edge of the network. The model offers cities ways to manage and monitor distributed infrastructure.

Opportunities for stakeholders

Smart cities present significant business opportunities for all players operating in the telecom domain – infrastructure players, network vendors, OFC manufacturers, Wi-Fi and internet service providers, and telecom operators.

As the smart cities programme gains traction, tower providers are set to witness accelerated growth in installations. According to Neelesh Kelkar, national head, smart cities, Indus Towers, the telecom tower industry can play a crucial role in designing and building smart cities by enabling a ubiquitous communication network and providing a citywide digital backbone for telecommunications. “Considering the high population density in urban areas, it is not feasible to erect a conventional steel telecom tower atop every building to avoid network congestion. Besides, the mushrooming of telecom towers on buildings becomes an eyesore and does not blend with city aesthetics. To address this challenge, tower companies have introduced innovative “smart poles”, which, when integrated with the concept of microcells, can become an enabler of ubiquitous network coverage in a smart city environment,” says Kelkar. The Coimbatore Municipal Corporation has collaborated with a leading telecom tower company and started a pilot project under which traffic signal poles at major city junctions will be transformed into smart poles. The Vadodara Municipal Corporation, under Vadodara Smart City Development Limited, has also tied up with a major telecom tower company to provide Wi-Fi service across 450 hotspots in the city and messaging systems to communicate information and messages to citizens.

Meanwhile, mobile operators are also upbeat about the smart city opportunity. For instance, Airtel Business has been in talks with various state governments to help them design smart cities. Airtel already provides customised m-governance solutions for video surveillance, traffic monitoring, public distribution systems, property tax collection and financial inclusion.

Equipment vendor Cisco has collaborated with several state governments for smart city projects in areas like surveillance and automation. The company has established a smart city surveillance system in Lucknow by deploying 280 cameras, 10,000 drones and night-vision mobile vans. Cisco has also established an Internet of Everything Innovation Centre in Visakhapatnam and is deploying technologies like smart Wi-Fi, smart safety and security, smart lighting, smart parking, smart transport, smart bus stops, smart kiosks, and smart education. Meanwhile, Microsoft has partnered with the Surat Municipal Corporation (SMC) to transform Surat into a smart city. SMC is working with Microsoft and its partners to develop solutions for water management and urban planning. The Bhopal Smart City Development Corporation has selected Hewlett-Packard Enterprise’s Universal IoT platform to create India’s first cloud-based

integrated command and control centre in Madhya Pradesh. The centre is expected to enable the monitoring and administration of civic utilities and citizen services through a central cloud.

The way forward

IT and telecommunications are the key building blocks of a smart city. According to Manojit Bose, chief knowledge officer, Pune Smart City Development Corporation, each of the cities selected under the Mission has earmarked a significant percentage of its budget for ICT. While this percentage varies from city to city, on an overall basis, it hovers at around 15 per cent. The real challenge now is to establish seamless interconnection amongst various users, devices, technologies and systems. In fact, for the Mission to be successful, it is crucial to address interoperability issues and reduce the complexity of different technical standards.