Intelligent Infrastructure: Investment Imperatives

October 2021

Executive Summary

The development of smart cities – enabled, powered, and integrated through digital technologies – is expected to be one of the 21st century's crowning achievements.

Intelligent infrastructure lays the groundwork for a network of partnerships dedicated to running an urban centre that not only uses technology to improve its own operations, but also establishes new relationships with citizens, businesses, and non profits. It integrates different technologies, governments, and societies to enable smarter economy, mobility, environment, living, and governance.

Intelligent infrastructure has self-driving cars that recognise one another, bridges that detect their own weaknesses, and power grids that exchange data with home appliances. In a nutshell, it's about all cyber-physical infrastructure systems that make cities smart.

However, the evolution of smart cities is likely to require more than just technological advancements. Continued progress is contingent upon the establishment of a positive relationship between the government authorities and the private-sector partners. Both players have to collaborate in transforming the vision of connected, efficient, 24x7 citizen services into reality.

This report illustrates the assets, attributes, and market snapshots of the Intelligent Infrastructure ecosystem. With society slowly progressing towards zero-carbon footprint, the subjects of sustainability and its attainability have gained paramount importance. On a societal level, it all starts with an intelligent infrastructure.

Intelligent infrastructure: Key challenges shaping future demand

1 By 2050, **68%** of the world's population is expected to live in cities. Cities cover **2%** of the planet but use **75%** of its resources[3]

4 By 2025, an estimated **US$34 trillion** is expected to flow into the development of smart cities.[4] In the US alone, cities are expected to invest **US$3.3 trillion** to maintain infrastructure standards[5]

7 Net zero carbon footprint mandates for **44 countries** and the **EU by 2050**[1]

2 Growing need for efficient waste management: **~300 million tons** of plastic waste produced every year; **~18x** greater industrial waste generation than municipal solid waste globally[10]

5 About **70%** of investment opportunities for smart city growth are currently expected in smaller cities whose current infrastructure investment is less than **US$1 million** per year[6]

8 **3.4 billion tons** of waste generation expected **by 2050**, rising from **2 billion tons in 2016**[2]
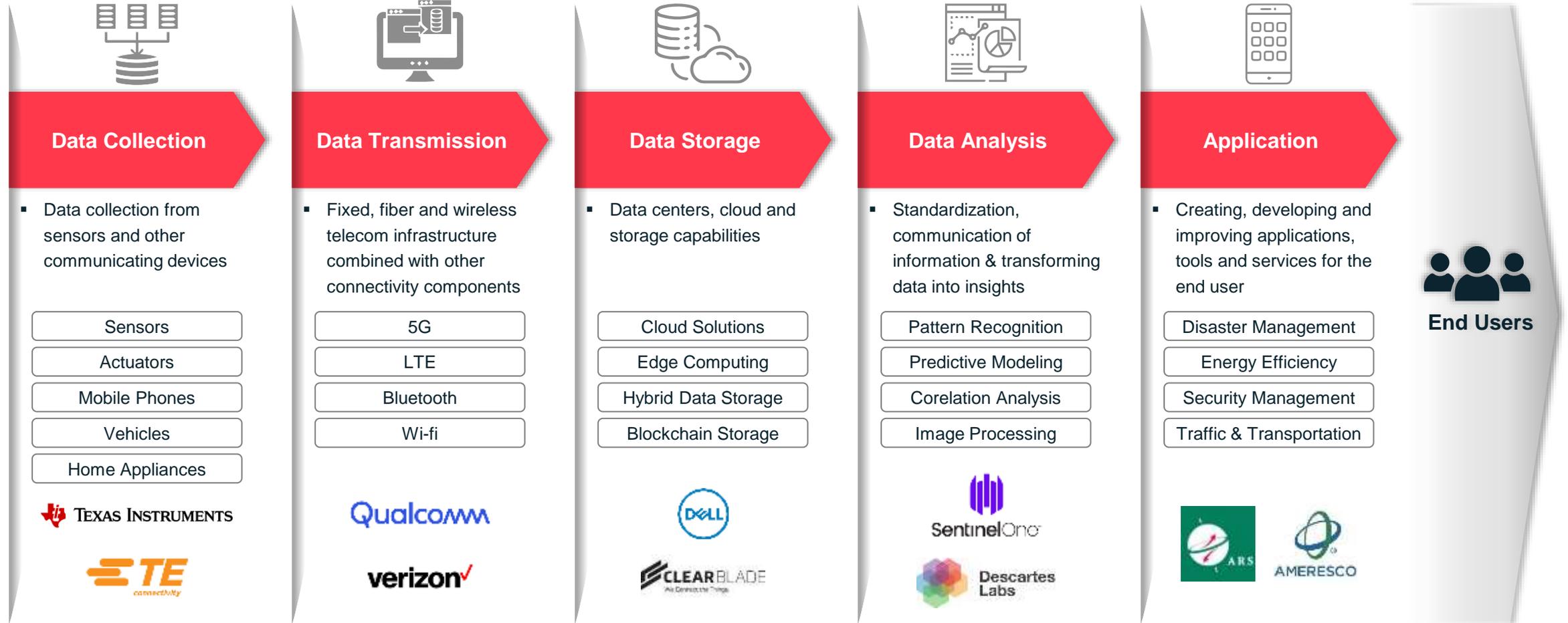
3 Pressing need to address global climate change: **~2.3 parts per million (ppm)** of global atmospheric carbon dioxide increase per year during the last decade[7]

6 Growing need for managing resources efficiently: Global natural resource consumption expected to double from 2015 to 2050[8;]; about **75%** of global energy consumption and 80% of global CO_2 emissions occur in cities[9]

1. International Energy Agency; 2. International Finance Corporation; 3,4. United Nations; 5. World Bank; 6. Forbes; 7. Climate.gov; 8/9 United Nations Environment Programme (UNEP); 10. International Union for Conservation of Nature (IUCN)

Intelligent infrastructure: Opportunities vary across the value chain

Data Collection

- Data collection from sensors and other communicating devices

Sensors

Actuators

Mobile Phones

Vehicles

Home Appliances

TEXAS INSTRUMENTS

TE connectivity

Data Transmission

- Fixed, fiber and wireless telecom infrastructure combined with other connectivity components

5G

LTE

Bluetooth

Wi-fi

Qualcomm

verizon

Data Storage

- Data centers, cloud and storage capabilities

Cloud Solutions

Edge Computing

Hybrid Data Storage

Blockchain Storage

DELL

CLEARBLADE

Data Analysis

- Standardization, communication of information & transforming data into insights

Pattern Recognition

Predictive Modeling

Corelation Analysis

Image Processing

SentinelOne

Descartes Labs

Application

- Creating, developing and improving applications, tools and services for the end user

Disaster Management

Energy Efficiency

Security Management

Traffic & Transportation

ARS

AMERESCO

End Users

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Intelligent Infrastructure: Smart city applications in action (1/2)
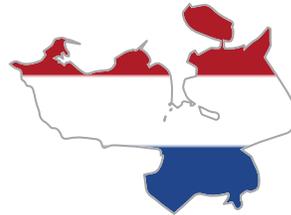
Application

Objective

Sensors for Smart Parking– Amsterdam

- To cut down on traffic congestion, Amsterdam has deployed sensors across the city to monitor traffic flow and inform car drivers on available parking spots along with related parking fees. The implementation of the system led to a 43% decrease in the time needed to find a parking space.

- The project, part of the larger Smart City goals of the Dutch government, followed a finding that on average a third of Amsterdam drivers were engaged in finding parking, leading to congestion.

Creating 'Sidewalk Equity'– Boston

- The City of Boston has undertaken a radical approach to maintaining sidewalks. It teamed up with local agencies to analyze existing sidewalk-related complaints against data on wealth and income disparities and areas that saw the most pedestrians. The initiative uncovered important insights such as wealthier areas had a higher number of complaints compared to poorer ones that often had sidewalks in worse shape.

- The initiative followed a review of 1,600 miles of sidewalks and a mandate to seek more efficiencies with repair works.

Source: Boston.gov

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Intelligent Infrastructure: Smart city applications in action (2/2)

Application

Objective

CareTech– Fukuoka, Japan

- The city of Fukuoka has partnered with local community, IoT networks, and service providers, to help monitor the elderly and people who suffer from dementia. The solution, known as "CareTech," includes daily check-ups, calls, text messages, IoT-based monitoring solutions and GPS devices to search for any missing seniors

- Japan has a rapidly ageing population. By 2025, an estimated 100,000 elderly people will require long-term care, with half of them suffering from dementia. That necessitates the need for efficient and sustainable schemes that leverage advanced technologies.

Harnessing Data– Singapore

- Singapore-based home monitoring solutions company ConnectedLife, combines smart technology such as IoT, motion and sound sensors, data analytics and AI, with 24/7 personal assistance for continuous monitoring of those living with chronic conditions. It also facilitates early detection and interventions, providing insights to health providers and agencies.

- Singapore's growing elderly population requires services to support independent living and quality care. The initiative, a citywide data platform, supports better decision-making and planning by harnessing data to enhance services and create economic value.

Source: World Economic Forum

Intelligent Infrastructure: Sub Sectors and Key Players

Smart Buildings

Key Trends
- Safety and security management solutions are leading this space
- Rising deployment of advanced access control systems, video surveillance systems, and fire and life safety systems

Attributes
- Building automation
- BIM
- Leak/gas detection
- Access controls
- Smart HVAC

Long-Term Drivers
- Accelerated adoption of BIM, remote monitoring, and automation of environmental controls and utilities
- Advancements in machine intelligence and biometric technologies

Key Players

Honeywell · SIEMENS Ingenuity for life · Schneider · ABB · IBM

Smart Mobility

Key Trends
- Declining hardware costs, evolution of network communication technology, high mobile adoption and internet penetration technologies such as 3G/4G/5G, WI-FI, radio-frequency identification (RFID), and embedded systems
- Security concerns, lack of standardisation, data liability, and lack of return on investment remain key challenges

Attributes
- ADAS
- Electric vehicles
- Security, alert and protection systems

Long-Term Drivers
- More adaptive, intelligent transportation system (ITS)
- "Greener" and pedestrian-friendly solutions
- The proliferation of autonomous/connected vehicle technologies

Key Players

Ford Go Further · QuaLix · TOYOTA · TOMTOM · BOSCH

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Intelligent Infrastructure: Sub Sectors and Key Players

Smart Energy

Key Trends
- Shift towards efficient energy technologies in China, the US, and the UK likely to increase market demand for smart grids, e.g., India plans to replace 250 million conventional meters with smart meters by 2022
- Constraints of high capital costs and integration of complex technologies are seen as major challenges during the initial phase

Attributes
- Automation, monitoring, and optimisation of energy distribution
- Real-time grid updates
- Electricity generation integrated with renewable solar and wind

Long-Term Drivers
- Advancements in real-time data analysis, sensors and communication technologies, safety and environmental monitoring

Key Players

Honeywell · L&T · Itron · ABB · GE

Smart Water

Key Trends
- Growing population, increasing urbanisation, and aging infrastructure are driving growth for smart water management
- The American Water Works Association suggests that reparation, maintenance, and expansion of any water services are likely to cost around US$1 trillion in the next 25 years

Attributes
- Water network management
- Water loss management and leak detection
- Geographical-information-system-based solution
- Storm water and urban flooding management

Long-Term Drivers
- Long-term and sustainable demand for efficient, sustainable, and reliable critical infrastructure/public services for waste, water, and power sectors

Key Players

SUEZ · Schneider · SIEMENS · PENTAIR · MAAS GLOBAL · INNOVIZ TECHNOLOGIES

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Intelligent Infrastructure: Sub Sectors and Key Players

Tech Enablers

Key Trends

- Four groups of technological factors, i.e., the "4Cs", are expected to drive progress in smart cities: Connection between things and people, Collection of data for context awareness, Computation in the cloud, and Communication by wireless means
- The technological evolution depends on the economic context—smart economy in smart cities. The concept includes smart urban design and development, economic development, strategic planning, advertisement of the cities, and branding

Attributes

- Autonomous connected vehicles
- ICT infrastructure (5G, low-power WAN)
- Blockchain
- Electric-vehicle infrastructure
- IoT
- Cloud Edge
- Fog computing
- Open Data
- Big Data Analytics
- New Cybersecurity Tech

Long-Term Drivers

- Moore's law and low-power WAN modules to drive production of low-cost data analytics platforms, connected sensors, actuators, and switches
- Standardisation in app interfaces and greater interoperability
- Impact of Blockchain in urban governance initiatives

Key Players

CISCO · GE · HUAWEI · BOSCH *Invented for life* · FOXCONN

Govt. Tech

Key Trends

- Engagement between local authorities and citizens providing a digital, transparent, and personalised experience using blockchain, smart contracts, smart communications, data encryption, and other technological advancements
- Use of artificial intelligence (AI) to manage common non-emergency requests

Attributes

- E-government
- Digital public administration
- Urban education
- E-services

Long-Term Drivers

- More government-to-citizen (G2C) smart transactions
- Civic engagement platforms

Key Players

verizon · TESSERA · greencity solutions · UPS · Google Cloud

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Intelligent Infrastructure: Merger and Acquisition (M&A) Landscape

While many cities have explored specific smart infrastructure initiatives, there are few large-scale deployments. Instead, applications to address critical issues unique to certain locations are garnering attention. However, smart city agendas may soon be reaching an inflection point as many municipalities begin to utilise benefits, attracting investment from public as well as private players and spurring innovation and rapid deployment. This presents an opportunity for M&A activities, especially around the key themes outlined below:

IoT	▪ The increasing emphasis on IoT capabilities in the technology industry is one of the primary drivers enabling smart cities. Several majors are trying to expand their "smart city" capabilities by investing in IoT platforms. The acquisition of Sensity by Verizon and the US$1.6 billion purchase of Jasper Technologies by Cisco are two such examples
Application	▪ Application solution areas such as smart lightning, smart parking, and smart waste are expected to see greater acquisition activities. Recent deal examples include the acquisition of street lighting software Streetlight.Vision and that of nCourt, a provider of payment technology to state and local governments, by Providence Equity and GSV, respectively
Analytics	▪ In the analytics space, some of the more niche analytics providers in the smart city space are expected to be acquired as part of a broader platform offering from bigger players. For example, Urban Engines, a specialist in the use of advanced analytics for the Internet of Moving Things, is now part of Google Maps
Wireless and Remote Monitoring	▪ With the rapid advancements in WAN and 5G technologies, the sector is ripe for investments. Recent acquisitions include those of ADS Security by Vector Security and Centralite Systems by Ezlo
Renewable Energy Infrastructure Management	▪ Amidst deepening concerns over the fossil fuel industry's climate strategy, global investors have greatly increased their spending in the renewable energy infrastructure market. Some of the recent deals in the space include the acquisition of MaxGen Energy Services and World Wind & Solar by Pearce Services

Marquee Deals			
Target	**Buyer**	**Sub Sector**	**Size (US$)**
Sensity	Verizon	Sensors and network controls for street lighting systems	NA
Jasper Tech	Cisco	IoT platform	1.4 billion
Ring	Amazon	Consumer electronics	1 billion
Nest	Google/ Alphabet	Consumer electronics	3.2 billion
Sensus	Xylem	Remotely managed data solutions for utilities	2 billion
Verisure	Hellman and Friedman	Smart alarms	-

Source: Capital IQ, Internal RocSearch research

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Intelligent Infrastructure: Recent M&A Activity

	Target	Buyer		Deal Type	Sub Sector	Deal Size (In US$)
	Control4 Corp.	Wirepath Home Systems		Private-equity- (PE-) backed	Automation and networking systems	693.6 million
	KeyW Holdings	Jacobs Engineering Group		Corporate	National security solutions	946.2 million
	ADS Security	Vector Security		Corporate	Wireless and remote monitoring	
	Centralite Systems	Ezlo		PE-backed	Wireless connectivity	
	Alvarado Manufacturing	Dormakaba Holdings AG		Corporate	Electronic equipment and instruments	
	MaxGen Energy Services	Pearce Services		PE-backed	Renewable infrastructure monitoring	
	World Wind & Solar	Pearce Services		PE-backed	Renewable energy infrastructure maintenance	
	Pilot Power Group	Boyne Capital		PE	Research and consulting	
	SitelogIQ	AEA Investors		PE	Construction and engineering	433 million

Buyer Sentiment
- PE firms and strategic acquirers have prioritised meeting short-term operational needs while assessing COVID-19's medium- to long-term impact
- Financial sponsors have unprecedented quantities of cash to deploy, with many indicating they may opportunistically acquire complementary businesses for portfolio companies

M&A Valuations
- A recent survey found that the majority of M&A dealmakers expect valuations to stay steady or increase in the next six months, driven by a robust deal appetite and rise in the number of special purpose acquisition companies (SPACs)
- High-quality enterprises that have the potential to gain from a post-pandemic economy are likely to remain appealing and fetch a premium

Debt Markets
- Lenders are valuing existing credits and relationships and are more open to smaller deals (e.g., add-ons) and higher pricing
- Concerns about company liquidity and finance add to persistent concerns about COVID-19's impact on the debt markets

Source: Capital IQ, Internal RocSearch research

Intelligent Infrastructure: Likely Impact of COVID-19

Short-Term Impact

- Because of ongoing travel restrictions, public transportation and parking facilities are expected to continue to see reduced utilisation
- Accelerated adoption of contactless and mobile payment and ticketing technology in public transit is likely
- Demand for integrated, touchless sensors and biometrics technologies is likely to increase, enabling real-time health monitoring and safe movement of people in public spaces
- Investments in the smart grid and connected utilities are expected to remain largely intact as system providers adjust to shifting demand between commercial and residential loads
- As an alternative to costly building demolition, businesses are increasingly likely to look to retrofit existing facilities with advanced air filtration and other smart building technologies, such as voice-activated systems
- Demand for warehouse technologies and asset tracking tools is likely to increase as businesses seek greater visibility and control over their supply chains
- As consumers flock to delivery services and e-commerce shopping, autonomous last-mile delivery technologies are expected to see rapid growth

Long-Term Impact

- Increased automation of activities across intermodal logistics and transportation is expected to be required to meet the demand for safer and contactless logistics
- COVID-19 is expected to emphasise predictive maintenance and data security even more, enabling smart and remote building management
- Continued growth is likely to be fuelled by sustained growth in e-commerce demand and associated investment from manufacturers and logistics providers, as consumers continue to demand extraordinary levels of online shipping
- Innovative technology solutions with low upfront costs and rapid payback are likely to capture a larger share of infrastructure spending
- Increased single-occupancy vehicle commuting, particularly in cities and surrounding suburbs, is likely to increase the importance of intelligent transportation systems and parking solutions
- Budget constraints may push cities to collaborate with technology companies to fund smart city projects and generate new revenue streams
- With operational efficiency and employee safety remaining management teams' primary concerns, demand for telematics and asset tracking is expected to continue to grow

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