# A Guide For Building
SUSTAINABLE SMART CITIES

Smart cities must fulfil the need for sufficient fresh water, universal access to cleaner energy, ability to travel efficiently from one point to another, sense of safety and security, among others. Smart cities need to be able to efficiently combine a smart physical layer (ability to use sensors to connect physical assets like buildings, public transportation, energy grid, etc) with a smart digital layer (increasingly mixing capabilities like Big Data, AI, the IoT and the like) to crunch data collected and turn it into actionable decisions on the field, in a cost-efficient way
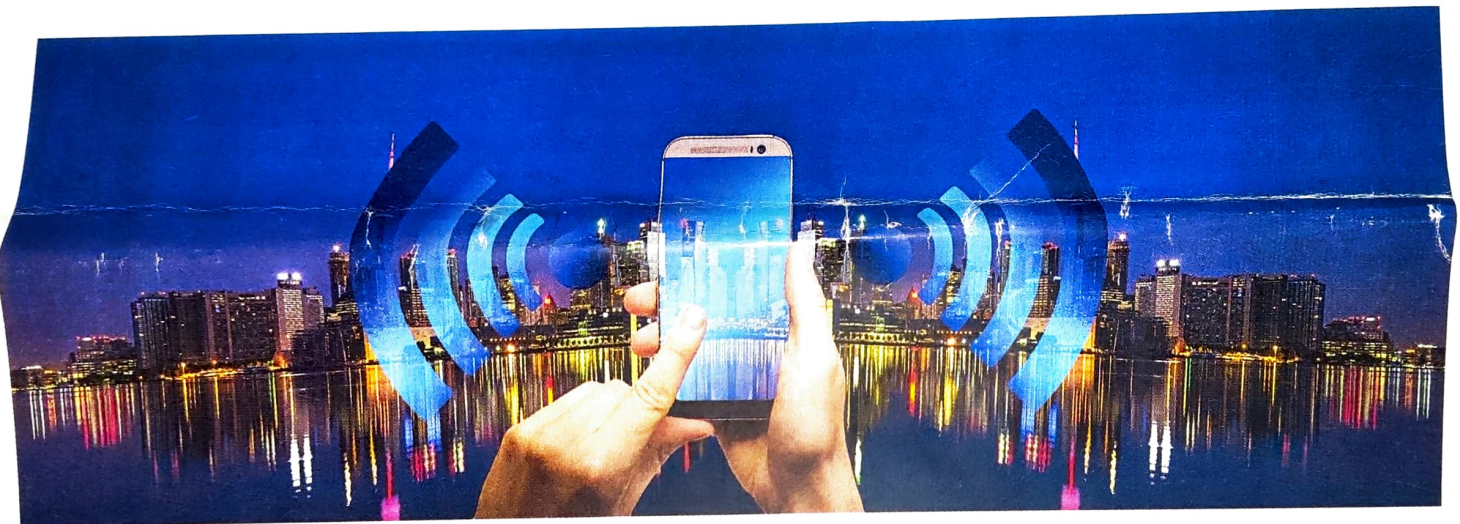
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Smart cities help create an urban environment for adapting to the needs of the population in the most environment-friendly, economically and socially-conscious way. These cities use data from people, vehicles, buildings and things to improve citizens' life and minimise the environmental impact of the cities. These are continuously monitored through the Internet of Things (IoT) to maximise efficiency. Smart cities operate as one big data-driven ecosystem to avoid accidents, emissions and congestion. These employ a combination of low-power sensors, wireless networks, and Web and mobile-based applications, and use technology and data purposefully to make better decisions and deliver a better living experience.

Smart cities are collaborative projects that bring together technology, industry and governments. Technologies used for smart cities should be able to share data in an efficient, secure and open manner. Successful smart-city projects collect, manage and use data to improve living and workplace standards. Application-driven data is used by both humans and artificial intelligence (AI) to deliver back innovation and efficiencies to the cities.

Why a city needs to be smart

Cities are a pillar of our economic growth. But these can have several inefficiencies with the growing popu-
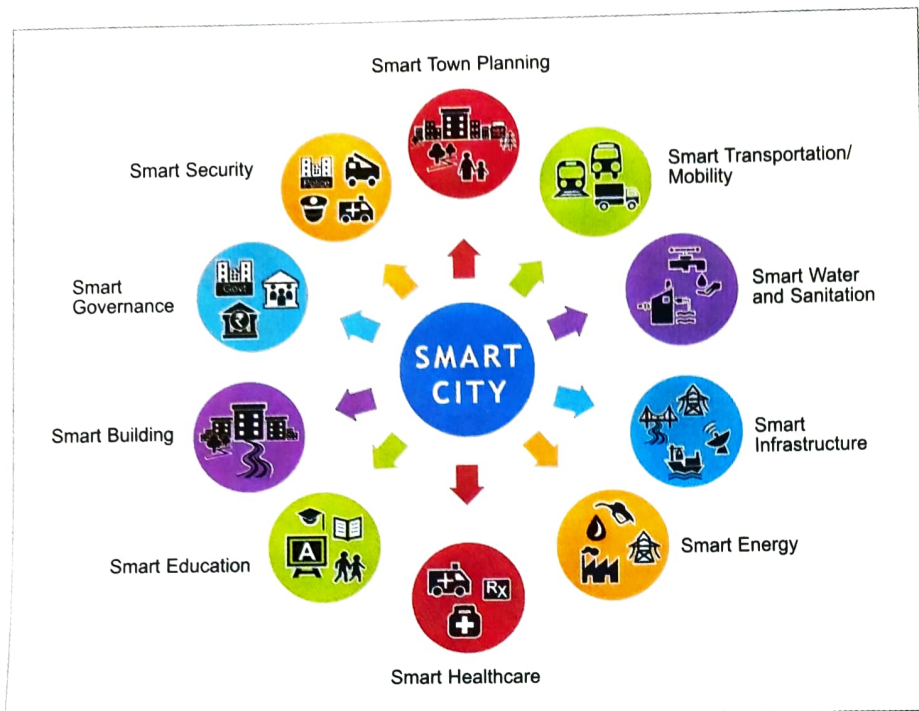
Fig. 2: Smart city development areas (Credit: www.rolta.com)

deploy, operate and monetise carri-er-grade IoT connectivity on their own. *These networks turn out to be key assets that cities want to control, financially and/or operationally,* and that can be combined to power a growing diversity of use cases. Considering their budget challenges, cities are also looking for a better trade-off between financial sources and possible business models over time. Opting for a relevant alter-native like low-power wide-area networks (LPWAN) and selecting a partner that can quickly and easily adapt to evolving collaboration models enable cities to address both their technical needs and financial challenges."

Developing a sustainable city

To build future-ready smart cities, there are a few fundamental things that are required to establish a stable and adaptable framework.

Smart infrastructure. This is required to establish a foundation for digital economic development. Heating, energy usage, lighting and ventilation in buildings are man-aged and optimised by technology. Water-leakage detection and water potability monitoring are integrated into smart buildings. Rooftop gardens or side vegetations are integrated into building designs to produce oxygen and absorb carbon-dioxide.

Smart infrastructure also includes city-wide Wi-Fi for public use to pro-vide real-time information on traffic congestion, parking spaces and other amenities. The aim of smart parking is to reduce both car emissions and traffic.

Smart roads are prepared for autonomous vehicles and self-driving car traffic system integration. With smart drainage systems and filtra-tion, cities could drastically improve local living conditions. Smart light-ing control systems reduce energy consumption, carbon emissions and maintenance costs, while providing a safe environment.

Security. Creating cities that are affordable and safe should be the priorities. This ensures secure and efficient operation of critical applica-tions developed for the smart cities, which rely on constant connectivity to volumes of data from stationary and moving sensors, which is transformed into useful information through data analytics to provide a better quality of life. Failure to secure this data can cause extreme damage.

Be it a residential complex, market, school, hospital, district centre or public transport, suste-nance of any urban setup is impos-sible without robust security meas-ures. But with the advent of AI, the concept of a smart city is viable as well as feasible. AI has empowered security to automatically learn and detect crimes.

Sustainable energy. Solar panels are integrated into building design, replacing traditional materials. Solar and wind energy can be collected throughout the day by fully inte-grating these into roads, buildings and residential areas. Smart grids are used for energy consumption monitoring and management. These conserve energy in places that might not need power and then send it to areas that may need even more power.

A building can become entirely self-sufficient by using technology like solar windows. Unused energy generated can be offered to vehicles in the local area. By 2060, cargo will travel through hyperloop and will be moved rapidly around the world in smart containers that know their contents and their destination. Ports themselves will be automated, run-ning on renewable energy and having zero carbon emissions.

Development of smart cities will require more energy, so the focus should be on sustainable energy sources. For example, cities can pave the roads with some kind of material that converts solar energy into electricity. Automobiles can be equipped with solar panels on roofs. Autonomous, environment-friendly, efficient transport can save time and money, too.

Digitalisation and automa-tion. Smart cities use IoT devices and sensors to gather and analyse information across the infrastructure. This helps city authorities to intelli-gently manage their assets, increase efficiency, revolutionise transport, reduce costs and enhance the overall quality of life for residents.

Management. This is the last but the most important stage of building a smart city. It requires a platform that features AI and machine learn-ing to monitor and improve smart city projects.

Smart monitors and controls across all aspects of city life are set to transform the urban landsacpe
- Transport
- Environment
- Buildings
- Infrastructure
- Utilities
- Life

1. Green Buildings
Rooftop gardens or vegetation on the side of buildings to help insulation, absorb CO_2 and produce oxygen

2. Building Management
Automation and optimisation of services such as heating, energy usage, lighting and ventilation

3. Perimeter Access Control
Controlling access and monitoring of restricted areas with CCTV, intruder detection and alarms

4. Rooftop Wind Turbines
Wind turbines built on top of high-rise buildings or integrated into the building design itself

5. Air Pollution Control
Controlling CO_2 emissions of factories and monitoring car pollution

6. Building-Integrated Photovoltaics
Solar panels integrated into the building fabric to replace conventional materials

7. Smart Grid
Energy consumption monitoring and management

8. Chemical Leakage Detection
Detecting leakages and waste of factories in rivers

9. Real-Time Updates
Instant traffic updates sent to smartphones to help route-planning and avoid congestion

10. Vertical-Axis Wind Turbines
Helical twisted wind turbine towers across the city for efficient use of space

11. Waste Management
Monitoring rubbish levels in containers to optimise refuse collection routes

12. Smart Parking
Monitoring availability of parking spaces across the city

13. Earthquake Early Detection
Monitoring specific places susceptible to tremors

14. Potable Water Monitoring
Monitoring the quality of tap water across the city

15. Wi-Fi
Citywide free Wi-Fi for public use, including Wi-Fi on the Tube/Metro

16. Water Leakage Detection
Detecting liquid presence outside tanks and pressure variations along pipes

17. Landslide and Avalanche Prevention
Monitoring soil moisture, vibrations and earth density

18. Fast Lanes
Intelligent, adaptive fast and slow lanes for walking and cycling

19. Traffic Control/Smart Roads
Monitoring vehicles/pedestrian levels to optimise or divert traffic according to conditions

20. Smart Lighting
Intelligent and weather-adaptive streetlights

21. Electric Transport
Electric vehicles and public transport, with charging stations across the city

22. Structural Health
Monitoring vibrations/material conditions in buildings and infrastructure

23. Fire Safety
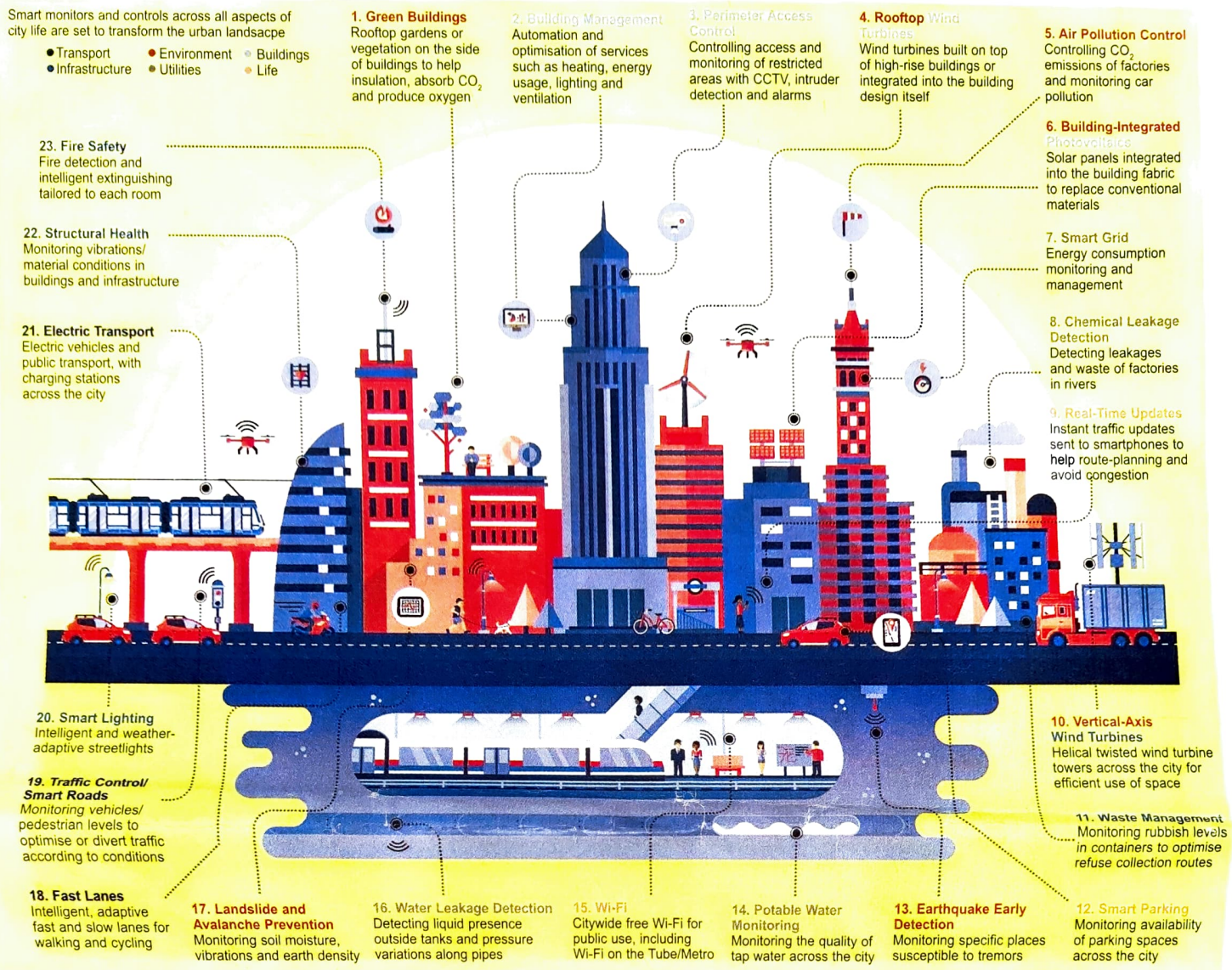Fire detection and intelligent extinguishing tailored to each room

Fig. 1: Smart solutions for smart cities (Credit: www.weforum.org)

lation due to migrators from less-developed cities and villages. Cities can be called developed when there is availability of good education, healthcare facilities, job opportunities, transport facilities, sanitation facilities, and good law and order practises to provide safe and secure places to live.

Making a city smart means utilising digital technology and data to solve such problems as traffic management, waste management, monitoring available parking spaces, controlling humidity and temperature levels in the environment, maintaining quality of tap water, waste-water management, sound monitoring and so on.

Cities can be smart but still not livable. Hence, the aim of making smart cities should be to use technology as a tool to deliver sustainable solutions. Technologies like the Internet, the IoT, smartphones, smart meters, smart plugs, smart taps or showers, and other networks of sensors can be used to develop such cities.

What makes a city smart

Smart cities must include infrastructure that helps provide a better quality of life for its citizens. Adapted smart solutions should create a cleaner and more sustainable environment. Data helps in accessing patterns or inefficiencies to improve living standards for the citizens. The same data can be used to better plan the cities in the future and create a framework for smart cities that constantly get more efficient over time.

Smartphones help provide instant information about transit, traffic, health services, safety alerts, community news and everything else needed to know about the cities, in real time. These provide notifications about the best times to travel, personalised energy usage, tips for improving eating habits, etc.

Stephane Dejean, chief marketing officer, Kerlink, says, "From rural towns to bustling metropolises, municipal officials around the world are facing increasing challenges raised by climate change, population growth, appropriate infrastructure development and access to basic sanitation. Leveraging IoT networks, authorities can streamline the use of city infrastructure and deliver tailored services to citizens, while monitoring critical indicators.

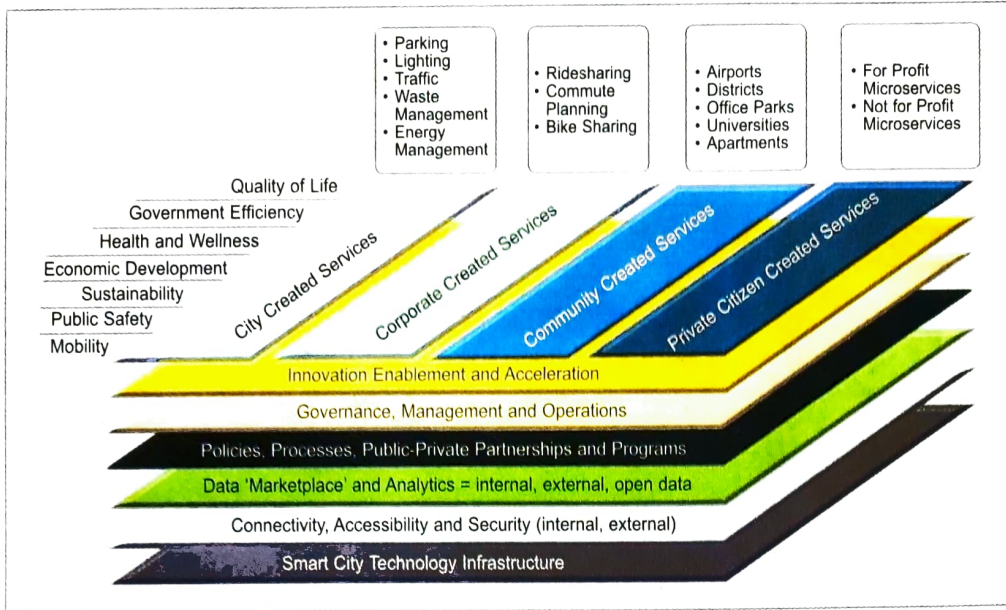"Cities now have the opportunity to easily, flexibly and cost-efficiently

Fig. 3: The smart city ecosystem model (Credit: www.strategyofthings.io)

Initiatives for making smart cities

A prime example here is managing energy use in buildings—heating, air-conditioning and lighting—while maintaining comfortable room temperatures, monitoring facility status like occupancy and availability. These end-to-end solutions offer user-friendly apps on officials' smartphones and provide programmed, automatic rule-based responses to changing environmental or weather conditions. Monitoring and counting the movements and whereabouts of building occupants or citizens in public areas also bring an effective smart-city application. The same way, LoRaWAN's native geolocation capability also enables cities to track their assets.

Sustainability is a critical aspect of smart-city networks. Outdoors, cities can leverage low-power wide-area (LPWA) sensors and networks for traffic monitoring, streetlighting, parking availability, waste collection in addition to noise detection, like gunshots, and environment sensing.

In Kakinada, India, Kerlink's Wirnet TM stations are powering a comprehensive, ambient air-quality monitoring system designed by Oizom that monitors air and noise pollutions and other environmental hazards.

Chengyang is a smart city project established by Huawei. It converts a wasteland into arable land capable of growing seawater rice using a combination of sensors, wireless and deep learning technologies. It feeds 80 million people using previously unusable land. This innovation is now being applied in other parts of the world.

India Maven, a smart-city solution provider from Pune, provides smart solutions in the fields of water and energy metering, lighting, agriculture, ambulance tracking, medical wearables, firefighting, city-pollution monitoring, smart parking, renewable energy management system and intelligent traffic management.

Dejean adds, "With increasing vital IoT deployments for cities, utilities, airports, harbours, farms, manufacturing plants and other sectors, we have LoRaWAN IoT connectivity building block. We also have industrial-grade network infrastructure—indoor and outdoor carrier-grade range of LoRaWAN gateways—with a full suite of user-centric value-added services that empower cities of any size to efficiently manage their IoT connectivity. The Wanesy Management Center, Kerlink's Wanesy Geolocation and Wanesy Device Management solution value-added services can help cities not only manage/locate their assets and remote sensors, but also help them improve the services they grant to their citizens, like traffic information, parking availability, weather forecast, public-

building attendance and public-private partnerships (PPP)."

Smart City Expo World Congress is looking to establish frameworks that will shape the collaborative approach to establish smart cities of the future. Its theme for 2018 was to determine how to structure smart cities in a future-proof and innovative manner.

International Electrotechnical Commission (IEC) Market Strategy Board brings together chief technology officers of leading companies to guide city planners and regulators, and develop standards in an effort to move cities to greater smartness.

Many places have a number of projects implemented on the ground, but these do not scale up because there are no steps taken at the national level or by individual government bodies. As more and more people are migrating towards cities, it is essential to develop a sustainable environment to make these places worth living. Human behaviour as a city dweller is changing, so everything has to be taken into account, including building material, climate, technology and so on while designing and building the cities of tomorrow.

Conclusion

Smart cities must fulfil the need for sufficient fresh water, universal access to cleaner energy, ability to travel efficiently from one point to another, sense of safety and security, among others. Smart cities need to efficiently combine a smart physical layer (ability to use sensors to connect physical assets like buildings, public transportation, energy grid, etc) with a smart digital layer (increasingly mixing capabilities like Big Data, AI, the IoT and the like) to crunch data collected and turn it into actionable decisions on the field, in a cost-efficient way. These cities need to meet the needs of current and future generations, and to maximise benefits while minimising the negative aspects of their daily living. EFY