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Smart City: A Key Enabler for Urban Efficiency

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ABSTRACT

In just 40 years, more than 70% of the world's population will live in urban areas. Therefore, cities around the world need smarter ways to operate and become more efficient and sustainable. This paper starts with an introduction to and the need for a smart city, with a focus on its two major components – Smart Infrastructure and Smart Utilities. These are the building-blocks of any city, and improving their efficiency brings immediate and visible improvement to the everyday life of people.

The paper further discusses some challenges of smart cities with possible solutions.

1. *Integration of conventional power with renewable energy: New technologies like weather forecasting and remote energy management can enable grid operator to evaluate the performance and need for a source of energy and make adjustments accordingly.*
2. *Meeting power requirements intelligently: Demand response and demand side management technologies can enable energy efficiency as a resource and a credible alternative to building more power plants to meet capacity needs.*
3. *Parallel operation of utilities and microgrids: Modern network management tools and advanced distribution management systems provide means to model, monitor, and manage microgrid-enhanced grids while ensuring safety and reliability.*
4. *Solving the riddle of network security: Smart cities can enhance cybersecurity when they implement the concept of cyber-defense, which uses a product's security features to create a cyber-strategy for defending an entire system.*

The paper concludes with a case study on Naya Raipur Smart City, demonstrating the implementation of a central platform integrated with connected products and solutions.

Keywords—Smart City, Urban Efficiency, Smart Grid, Smart Infrastructure, Energy Efficiency

I. INTRODUCTION

Cities are our fundamental building blocks. Throughout history, they have served as centres of innovation, advancement, civilization, and as facilitators of the social interaction necessary

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for the progress of humankind. It is only fitting that the next evolution of how we live, work, play, and interact is emerging within our cities.

In around30 years from now, 70% of the world’s population will reside in our cities (United Nations Department of Economic and Social Affairs Population Division, 2019). This rapid migration will push both current and future urban centres to their limitsand stretchindustrial and residential infrastructures beyond their breaking points.Urban infrastructures will need to better meet the challenges of city environments: energy and water scarcity; pollution and emissions; traffic congestion; crime; waste disposal; and safety risks from ageing infrastructures. The increased mobility of our societies has created intense competition between cities: for investment, for talent,and for jobs. To attract the most promising residents, companies, and organizations, as well as promote a thriving culture, cities must achieve three critical traits: become more efficient, more livable, and more sustainable.With the movement towards smart cities, the urban centres we live in can achieve these characteristics in both the short and long term.

Availability of Technologies

Smart cities need not be thought of as cities of the future. They can be the cities of the present. By the end of the current decade, many technologies critical to a smart city, including monitoring and sensor technologies, intelligent traffic systems, and energy management systems for buildings, will be deployed in various parts of our country. And while no single solution defines a smart city by itself, the technologies being put in place today are pieces of the smart city puzzle. While there are many challenges, the benefits are significant. Going beyond the obvious environmental benefits, the improvement of systems can contribute to social equality through universal access to a city’s public services. It can save lives by allowing for more immediate access to emergency services. It makes cities more resilient in times of crisis, allow cities to prepare for hazards, and help to restore city services from disruption in the wake of one. It creates new economic zones that drive growth and prosperity(Aoun, 2014).

II. MAJOR COMPONENTS OF A SMART CITY

Urban infrastructure and utilities are the two of the most important components of a city. Improvingtheir efficiency brings immediate, visibleimprovement to people’severyday life. This is the firststep on the transformation journey to ‘smart’.

Smart Infrastructure

Cities are not about technology but about people. The everydaylives of people are supported by the urbaninfrastructure andrelated systems. However, efficientinfrastructure is often invisible tocitizens and businesses. Infrastructure onlybecomes visible when systems fail and life becomes more difficult.

Making urban infrastructure efficient requires a combination of both Operational Technology (OT) and Information Technology (IT). Operational Technology, grounded in a deep understanding of the

underlying physical systems and processes, is designed to improve the performance of infrastructure (i.e., gas, water, power). Information Technology enables the extraction of meaningful, reliable data from the systems, allowing real-time management, faster decisions, better anticipation – and continuous improvement. The combination of these two very different worlds of OT and IT will deliver efficient infrastructures and open up new opportunities to develop innovative services and applications for citizens.

Technologies like an Integrated Management Platform that integrates real-time data from multiple sources in the urban infrastructure (CCTV, sensors, existing applications), across different areas (traffic, weather, pollution, construction, events, incidents), and several departments (police, fire, highway control, parking management) into a single platform.This allows operators to monitor transportation and with advanced data analytics, they are able to gather what impacts transportation, across the city, in real-time.

Smart Utilities

A smart energy consumer today is empowered by data. Through detailedinformation and controls provided by the utility, he/she now understands the real reasonswhy the energy billis going up, and sometimes cancompare with owners of similar houses. He/she alsoknows how to controlhis/her bill to the extent that he/she might even receive rebates from the utility forusing less energy or for usingenergy at specific times during the day when there is low demand.

From the control room of a power utility to the electrical outlets in the homes of consumers,technologyis making our use of energy smarter andmore efficient. Within the realm of power generation,distribution, and consumption, a multitude of existingoperating equipment is being enhanced throughtheintegration of sensors, information technology (IT),and communication subsystems, makingpower generation, delivery, and consumption more adaptiveand energy efficient.

The next phase in the energy evolution, especially with reference to utilities, begins withlearning how to leverage the exponential growthofdata. Almost 90 percent of all the data in the world hasbeen generated over the past two yearsalone. People and machines are gaining easier access to more and more intelligence, and they need solutions that connect to that intelligence and help them make sense or good use of thisavalanche of data.

Another important piece of a smart utility is improved asset management and operation. Even with limited asset information from substations, remote terminal units (RTUs), relays, transformers, meters, and transmission lines, utilities were once able to guarantee the safety and reliability of the grid. However, it has become more difficult to maintain these assets and prolong their lives as the grid faces increasing disturbances. Also, the operation of the grid was relying on an overdesigned system allowing a large margin of error and strong redundancy. With limited investment (CapEx) and with increasing pressure on operating cost (OpEx), utilities must turn to IT to better manage their assets(Gartner, 2016).

The ultimate goal is to be able to operate physical assets as close as possible to their physical limits. With asset management functionality spread across several software applications, grid owners have had to manage a tedious processacross multiple databases. This has often led toa decoupling from operation and planning andhas prevented strategic planners from depictinga holistic view and anticipating grid weaknesses.Utilities also often try to adapt assetmanagement systems (AMSs) initially intendedfor power stations (which are centralized) tomanagement of the grid (which is geographicallydistributed).Within grid infrastructures, thetopology of the network changes frequently anda vast amount of asset information is addedeach day through meters, home automationdevices, sensors, and other hardware.

For many years, traditionally, IT has been managing information for humans (e.g., customer database, billing systems, call-center software, workforce management tools); and OT, managing data for machines (e.g., metering data, transformers and switches status, relays position), both IT and OT, although coordinated in Supervisory Control and Data Acquisition (SCADA) software systems; remained distinct domains managed by different corporate resources. But this paradigm is undergoing a radical change as OT systems are now connected through recognizable Internet Protocol (IP) addresses to the same networks as IT resources. These new technologies can also allow new predictive models, where weakened assets can be both discovered and proactively replaced, saving hundreds of hours and tens of thousands of currency units or more per year.

III. CHALLENGES AND POSSIBLE SOLUTIONS

Following are some challenges of smart cities with possible technology solutions.

Managing And Integration Of Renewable Energy Sources

One of the biggest challenges on the roadmap to create smart cities and a smart grid is the responsibility (and an obligation, in some cases) to combine conventional power sources with alternative energy in order to lower the impact on the environment and to secure additional energy for the future(Schneider Electric, 2016).

Most renewable energy sources are very diffuse and scattered, while energy demand is more intense, such as with heat pumps, and load centers are more concentrated, such as cities. New targets for renewable energy sourcedeployment can be met with accurate and highlynetworked sensors, actuators, and managementsystems. Poorly or partially instrumented networksdownstream of secondary substations will needto be upgraded. Network architecture designed

when generation was centralized and at timeswhen there was little if any communication and intelligence in networks must be reinvented to accommodate for dispersed production not necessarily close to the new load centers. And the variable nature of most renewable generation, as well as the emergence of significant new loads like electric vehicles (EVs), can complicate load balances on lines, leading to voltage instability and even failures.

Possible solutions: New technologies, including weather forecasting software and remote management, are redefining the impact of renewable energy sources. A grid operator can now evaluate the performance of an individual wind turbine and make adjustments from a control center thousands of kilometers away. Improved operations management and streamlined maintenance plans are also yielding a greater return on investment.

In general, the price of renewables is coming down. As such, this will continue to be a strong driver for the need to manage and integrate renewable energy sources in to the grid. The cost of solar has never been more competitive with fossil fuels than it is now, both in terms of its physical equipment and the actual market rate. Hydro has proven to be a highly predictable energy resource and a worthy replacement for backup diesel power plants due to its immense storage capabilities.Without question, renewableenergy integrationwill bring more advantages thandrawbacksfor utilities that move toward the smart grid.

Using Energy Efficiency As A Resource

With the growing population and rising energy demands, by 2030, India would require 850

GW of installed capacity to meet its powerrequirements(Central Electricity Authority, 2019). This figure translates to the fact that around 850 MW capacity addition is required every week, for the next 10 years.Renewable energy resources, which need to be a part of the solution, and where India has done reasonably well, may not scale up sufficiently and in time to bridge this demand-supply gap. Therefore, we will have to rely on the cheapest, cleanest, and most abundant source of energy, i.e. energy efficiency.

With transmission and distribution losses of around 21%(Central Electricity Authority, 2019); where comparable numbers for China, US and UK are in the range of 6-8%, there cannot be a better context and a more compelling business case for a smarter grid and utility system. When it comes to end-uses, business as usual practices can cost-effectively get far more efficient, as, for example:

- Commercial buildings in India, for example, consume around 250-300 kWh/sq.m./year on average, while there are examples of best practice private sector office buildings that have been built cost effectively and are operating for over 7years at 80-95 kWh/sq. m./year.
- Typical air-conditioning utilization in commercial buildings in India is around 20 sq. m. per ton of refrigeration, while off-the-shelf, cost-effective technologies can get us to around 50-60 sq. m. per ton of refrigeration.
- A best-in-class hotel or hospital is 50% less energy intensive than an average hotel or hospital in India.
- A best-in-class steel plant is 30% less energy intensive than an average steel plant in India.

Possible Solutions: The energy industry's business model has remained fundamentally unaltered over the last few decades. Now imagine a world where a typical business or industry or home is aware about its energy consumption, and is actually in a position to generate revenue through the energy it does not consume. As part of smart grid modernization initiatives, new programs are being launched or expanded that encourage energy users to adjust their consumption in response to pricing signals, penalties, or curtailment requests. Due to this potential flexibility, energy-consuming loads and any on-site energy generation capabilities are now considered important distributed energy resources (DERs), critical to helping balance the grid. The term "demand management"is used to describe one of the major changedrivers in the industry today. "Demand" refers toeverything behind the energy meter or any load pulling electricity from the network; and "management" applies to the level of control over that load. The goal of demand management is to provide utilities with an alternative to building more power plants to meet capacity needs. By having the ability to modify energy use on the demand side through smarter technology, awareness, and energy-efficiency improvements, utilities can both save money and accommodate the demands of the future.

For example, a grid operator could switch off a piece of equipment at a factory for a few seconds in order to thwart the need for bringing a marginal peaking unit online. In another example, a home-owner could remotely configure a load of washing machine to run during off-peak hours, based on real-time data from the utility. The trick is to do this automatically, and not usingday-ahead or hour-ahead signals for voluntary load reductions. This is the concept of automated demand response where individual processes within facilities can be controlled and managed as part of a real-time demand response portfolio across multiple sites. On the demand side, this approach can save users money through load flexibility, either for curtailment or for consumption stimulation. On the supply side, the utility can improve the reliability, efficiency, and sustainability of the energy supply, without necessarily relying on a decrease in total energy consumption. Also, demand management, by matching controllable demand closer to variable generation, will enable a higher integration of variable renewable generation in the mix.

Another important piece here is making the most of data analytics. Once data is collected from an advanced metering infrastructure (AMI), utilities can successfully move to the final (and perhaps most critical) phase of their demand management program, i.e. data analytics. Data analytics converts otherwise meaningless data into valuable learnings, which ultimately leads to maximum efficiency across the grid. Not surprisingly, data analytics often starts at the end-user level. Once utilities collect data from their AMI, for example, they can analyze and discover patterns in customer energy use and then create unique user profiles based on historic behavior trends. With these profiles, utilities can predict future energy consumption patterns and target their demand management programs at the consumers with the biggest potential for efficiency improvement, curtailment, etc. Traditional metering provides one reading per month (or every two months) per meter. Smart meters, on the other hand, report every 15, 30, or 60 minutes and not only one set of data but about 10 (see the table on the opposite page), leading to 1,000 to 10,000 times more data. So, in addition to remote data collection, which is a source of productivity for the utilities, these meters yield data that can lead to new services in several areas when using analytics software, like outage management, voltage optimization, power factor management, asset management, and transformer load management. On the end-user side, some advanced services can be: revenue assurance, load forecasting, customer segmentation, proactive alerting, and personalized communication.

Microgrids – HavingUtilities And Microgrids Co-exist

What is a microgrid, exactly? The term has been used for years, but there is much debate over the true definition. Contrary to some popular notions, a microgrid is not just backupgeneration but is a robust, 24 by 7 by 365asset that provides primary energy services to asingle critical facility orcommunity of residential,commercial, and industrial customers. Amicrogrid can provide backup generation, but itoffers additionalintricate services as well.

Although microgrids are conceptually similar to large grids, their small size makes them prone to instabilities. For example, the largest generation asset in the main grid represents less than 3 percent of total generating capacity, in a microgrid it might be more than 20 percent. This creates a single contingency impossible to mitigate without shedding load and operating the local grid close to stability limits without reserve margin. Also, because a large share of microgrid generation relies on variable renewable energy, such as wind and solar, it might have little spinning reserves. Wind turbines and solar inverters use static power electronics that usually cannot provide kinetic reserve (like a rotating engine would), which is vital to maintain frequency and dampen fluctuations.

Also, some other issues are related to system protection, when distributed generators provide power beyond the needs of local loads, that power could flow back into the grid. But unlike the transmission grid that connects large, centralized power plants, the distribution system was not designed for bi-directional power flow. When a fault occurs in the MV or LV part of the grid, today's protective relays assume that power is flowing in a single direction from a known source to end consumption points. Even with reverse power relays in place to isolate the microgrid for a MV fault, the coordination of the distribution system scheme can be violated. Therefore, managing real and reactive power and frequency of interconnected generators can be challenging.

Possible Solutions: Modern networkmanagementtools like Advabced Distribution Management System (ADMS) can help ensure safe and reliable operation for microgrid-enhanced grid, and will allow both the distribution system and interconnected microgrids to perform at their best.

Microgrid subsystems rely on some core technology components in order to function as users intend. The variable nature of the renewable resources (e.g., solar and wind) that support microgrids necessitates a seamless integration of network, generation, storage, metering, and software infrastructure.

Sensors and automation provide the control mechanisms required to improve load distribution and help accommodate millisecond changes in the network. Smart meters deliver real-time information about consumption and trends. Smart generation contributes to overall stability thanks to ancillary services. Predictive modeling software helps in forecasting and resource allocation when it comes to operating and maintaining a healthy microgrid.

These technologies provide the basis for reduced energy loss, improved service quality, strengthened resiliency, higher renewable penetration, and — in some cases — deferred investments in substations and networking equipment on the main grid.

Solving the riddle of network security

Over the past decade, the demand for digitized, connected, and integrated operations hasincreased across all industries. Compared to the IT industry, although theenergy industry is late to theconnectivity game, the pressing need to improve critical powerdistribution infrastructure uptime is accelerating therate of change in this domain.

While it is easy to gloss over the need for a network- or cyber-security; one needs to keep in mind that due to increased digitization, cyber security is going to be one of the biggest challenges for a smart city, and in particular for a smart utility or grid.

In the United States,energy is one of the top three sectors targeted for cyberattacks. In 2016, 20% of the total cyber securityincidents reported in the US, were from the energysector (Deloitte, 2018). In India, at least 30 suchevents are reported on a daily basis (Live Mint, 2019).Now that cyber security is a top-of-mind concern,utility stakeholders are applying processes fromtheirIT peers and are investing to put their infrastructuresecurity house in order. Within substations,proprietary devices once considered for specializedapplications are now vulnerable. Sensitiveinformation (such as online documentation thatdescribes how these devices work) can often beaccessed via the internet by anyone, including by thosewith a malicious intent to cause disruption.

Possible Solutions: A four-point approach can be established to maintain cyber secure systems:

- Conduct a risk assessment – The first step involves conducting a comprehensive risk assessment based on internal and external threats. By doing so, operational technology (OT) specialists and other utility stakeholders can understand where the largest vulnerabilities lie, as well as document the creation of a security policy and risk mitigation.

- Design a security policy and processes – A utility's cyber security policy provides a formal set of rules to be followed. The purpose of the policy is to inform employees, contractors, and other authorized users of their obligations regarding protection of technology and information assets. It describes the list of assets that must be protected, identifies threats to those assets, describes authorized users' responsibilities and associated access privileges, and describes unauthorized actions and resulting accountability for the violation of the security policy. Well-designed security processes are also important. As system security baselines change to address emerging vulnerabilities, cyber security system processes must be reviewed and updated regularly to follow this evolution. One key to maintaining an effective security baseline is to conduct a review once or twice a year.
- Execute projects that implement the risk mitigation plan – Select the cyber security technology based on international standards to implement security policy and proposed risk mitigation actions. A "secure by design" approach that is based on international standards like IEC 62351 and IEEE 1686 can help further reduce risk when securing system components.
- Manage the security program – Effectively managing cyber security programs requires not only taking into account the previous three points, but also the management of information and communication technology asset life cycles. To do that, it's important to maintain accurate and living documentation about asset firmware, operating systems, and configurations. It also requires a comprehensive understanding of technology upgrade and obsolescence schedules, in conjunction with full awareness of known vulnerabilities and existing patches. Cyber security management also requires that certainevents trigger assessments, such as certain points in asset life cycles or detected threats.

Electric utilities can experience great cyber security successes when they collaborate with dedicated teams of OT specialists. They implement the concept of cyberdefense, which uses a vendor's product security features to create a cyber strategy for defending an entire plant or process.

References for work done in these areas

The following examples describe the work done in the aspects discussed above, worldwide and in India, for implementing the technologies mentioned in the previous section.

Electricity Supply Board (ESB) Ireland: has some 200+ turbineswith a 300 MW capacity in 19 windparks scattered across Ireland and U.K.Remotely managing such resources is the challenge ESB wasfacing. Integratingtheir variable output, subject toweather fluctuations, into the grid with fullcompliance to the grid codes requirements is another challenge posed by theimpacted Transmission System Operators(TSOs) and Distribution System Operators(DSOs).

A Renewable Control Center (RCC) solution consolidates the data required for monitoringassets’ performance (suchas turbines’ and substations’), enriches it with weather forecasts,displays it in a very intuitive way tothe operators, andenables sharing it in real time with the TSO, DSO, andaggregators. With the help of RCC, the operator isnever further away than two or three clicks from allthe data he/she needs. With intra-hour information andforecast of wind farms output, and by having theability to remote control battery andcapacitors, ESB can support the DSO on managingvoltage, power congestion, peaks, cable temperature, and energy losses. And with RCC’s openness, scalability, and provision to connect to thirdparty applications, ESB will also be able to accommodate its upcoming wind farms.

Walmart Store, Pennsylvania: Utilities and grid operators are eager for fast-responding energy assets that can shed power use within minutes or alter second-by-second consumption to help keep the grid humming at the right frequency.

A new way has been successfully tested for doing just this by using a Walmart Supercenter in Pennsylvania, the OpenADR standard for automated demand response, and the internet. The project was done with the grid operator PJM Interconnection to take demand response signals and translate them into web services for simple dissemination over the internet — messages that Walmart’s building management system (BMS) could turn into fast-responding energy control. That’s an important step in showing that these specialized grid operator commands could use the internet for some or part of their task and reach all the systems and devices that are connected to it. This offers considerable advantages over the typical demand response system, which involves giving days or hours ahead notice to facilities to turn down energy use. Now, ways are being explored to scale up this fast-acting demand response functionality.

Burbank, California: BurbankWater and Power (BWP) needed to find a reliable way to manage load, DERs, distributed storage systems, moretraditional generation, and variable renewables in order to balance supply and demand.Burbank found its solution by building and managing a microgrid with the advanced Power Control System (PCS) forautomatic generation control load forecasting and with renewable forecasting reinforced by anintegrated weather intelligence system. The PCS-managed microgrid allows Burbank to optimize scheduling and dispatch of distributed generation, and of both conventional supply and demand-sideresources, to better control inadvertent interchanges and reduce reliance on externalgeneration. By saving costs, primarily due toload shifting monetized through demand response, the Burbank microgrid solution is estimated to deliver a net present value of $37 million (INR 2.6 billion).

Work done in India: A pan-India project and a pilotis under progress, based on these technologies.

- EESL Smart Meter Integration project – A Head End System (HES), which is essentially an Advanced Metering Operation (AMO) software solution to integrate and acquire data from 5 million smart meters is being installed currently in India. Other functionalities of the software solution are establishing two-way communication with the smart meter, remote controlling & re-configuration of the meter, and event messaging. This project,using AMO solution, is aimed at improving billing efficiency, increasing DISCOM revenues, peak load optimization through demand-side management (DSM), better network reliability and efficiency, and optimization of power procurement cost.
- IELECTRIX –Indian and European Local Energy Communities for Renewable Integration and the Energy Transition –is a pilot project funded by European Union, and is being implemented in collaboration with TATA Power in India. The project, using smart grid or utility technologies, is aimed at demonstrating integration of renewable energy sources and a microgrid with the conventional power grid. The pilot will also see the demonstration of demand response and demand side technologies, along with a condition monitoring solution for the grid. The pilot, which is to be demonstrated in New Delhi, is expected to be completed in the next three years.

IV. CASE STUDY: NAYA RAIPUR SMART CITY

India’s First Integrated Green Field Smart City, Atal Nagar, has emerged to become one of the best-planned smart cities and is wholly equipped with an Integrated Command & Control Center ensuring the overall integration of smart transportation, surveillance, citizen applications, end-to-end smart grid solutions, end-to-end water management system and integrated building management system. This transformation is being supported by connected products of more than 100,000 I/O points, edge control, applications, advance analytics, and services. Following is a brief description of the solutions implemented.

Integrated Command and Control Center

An open, scalable, and interoperable software platform has enabled integrating an interactive centralized command and control center which can monitor and control the entire city operations. With the adoption of IT and OT technologies, connected devices, edge control software, and apps &analytics, Atal Nagar accomplishes the complete objective of a Smart City.The command and control center application has been developed using an intelligent system platform and is deployed with integration of smart elements such as the smart gird, smart water systems, smart building systems, LED street lights, rapid transport tystem, CCTV surveillance, E-Governance solutions, energy management and help desk. Above all, it is the first command center in India that uses an IT/OT convergence to allow real-time integration withSupervisory Control & Data Acquisition System (SCADA) systems that can identify and manage critical incidences like real-time water leakages, asset management and power outages. The high capacity fiber backbone, smart network and data center makes the comprehensive infrastructure ready for adding on layers of ‘smartness.’ The advancedasset management system is also availableto manage all the major assets in the city.All the systems supporting the smart city operations arerobust, resilient and scalable.

Smart Water Management

The city of Atal Nagar has been integrated with a centralized water SCADA system to enable the monitoring and control of the entire water supply and distribution network. It has the ability to predict the water distribution network’s hydraulic and water quality parameters, and is equipped to raise an alarm when there is a deviation from threshold values. The system is enabled to have water leakage detection and management. With a smart water management system installed, the city also has assured safe, efficient, and pressurized water supply.

Smart Building Management System

The Smart Building Management System (BMS) centrally monitors and controls various services like air conditioning system, water supply, ventilation system, fire detection and suppression system. It is also equipped to control and monitor the power supply, access control and visitor management system. The BMS is equipped to notify the central command and control center of any potential threats and emergencies.

Smart Grid System

The smart grid system powered by connectivity, increases overall efficiency of the complete electrical infrastructure, making it a reliable, scalable and highly secure grid that works in closed loop to provide an uninterrupted power supply. This smart distribution management system optimizes the network infrastructure in real-time resulting in efficiency improvement for better profitability, reduced carbon footprint and improved end-user satisfaction.

Smart Governance System

In order to bring accountability and transparency to the governance system, the Smart Governance system provides a single window access to all Atal Nagar Vikas Pradhikaran services through a common portal. The system integrates the various applications of different departments like the land records, e-district services, town and country planning application, Samvad application and the Airport Authority of India. Apart from this, citizens can register complaints and grievances through web portal, mobile app and the help desk.

Smart Surveilance System

High definition cameras have been installed across the city which includes normal surveillance cameras, automatic number plate recognition cameras and speed detection cameras. The software analyzes the video in real-time to provide incidents like loitering, congestion, abandoned objects, improper parking and wrong way.

Intelligent Transport Management System

The existing IT enabled bus services have been integrated into the Integrated Command & Control Center (ICCC) to enable city administrators to track bus movement, plan frequency of buses as per demand and receive alarms in case of breakdowns, fire and emergency. The driver information is made available to the ICCC operator to communicate in the event of an emergency. The system is scalable to accommodate additional bus fleets and shelters added in the future.

V. CONCLUSION

With the increase in world urban population and rising energy demands, cities around the world need smarter ways to operate and become more efficient and sustainable.Smart city, being a cornerstone for urban efficiency, has various components like smart infrastructure and utilities. Although there are challenges in implementing these concepts, butwith the help of technology, it’s possible to ovecome the roadblocks. This paper has talked about some of those possible solutions and with some global success stories, some projects in India, and a case study on Naya Raipur smart city, it has showed how we can and are moving beyond a conceptual level, when it comes to implementation of smart city technologies.

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