
White Paper on

SMART CITIES – HOW R-APDRP ASSETS CAN BE LEVERAGED FOR BUILDING SMARTER CITIES IN INDIA

About India Smart Grid Forum

India Smart Grid Forum (ISGF) is a public private initiative of the Ministry of Power (MoP), Government of India for accelerated development of smart grid technologies in the Indian power sector. ISGF was set up in 2010 to provide a mechanism through which academia, industry, utilities and other stakeholders could participate in the development of Indian smart grid systems and provide relevant inputs to the government's decision making.

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1. Background

The rise of cities has grown over millennia, and have evolved over time as places where the entirety of human activities and services concentrate, spanning multiple modes of transportation, water supply, electricity, telecommunication and internet, schools and colleges, hospitals, markets and businesses, other resources and services across people with varied skills. As cities evolved with more and more facilities and services, they became more and more attractive to people from rural areas leading to even faster urbanization. Rapid growth of cities has led to the creation of metropolitan regions - clusters of cities in a region. In order to efficiently administer these growing cities, providers of infrastructure services (utilities) and governments are increasingly using IT solutions which has coined the term “smart cities”. There are several definitions for smart cities varying from *“instrumented, interconnected and intelligent”* to the one that *“use smart computing technologies to make the critical infrastructure components and services which include city administration, education, healthcare, public safety, real estate, transportation and utilities – more intelligent, interconnected and efficient”*. Fundamentally, information becomes an enabler for improvements, which spans better measurements, better analysis, and better action (automation, where feasible).

In most cities in the developed world, the municipalities or city councils are responsible for providing all infrastructure services and there is single ownership. City authorities plan to use IT and automation systems to instrument and integrate all infrastructure and services to optimize the assets as well as use analytical tools to predict usage, behaviour, maintenance, emergencies and other incidents.

New smart cities would feature:

- a. Geographical Information System (GIS) that will be shared by all stakeholders in a secure environment.
- b. Robust telecommunication network(s) with high speed data services which can be shared by all IT and automation systems across domains such as utilities (electricity, water, gas), traffic, security, healthcare, education, entertainment etc. – a single infrastructure can actually enable multiple (and competitive) providers if required, similar to how a single road allows multiple delivery companies and vehicle manufacturers.
- c. All Infrastructure pieces are instrumented with smart sensors that send live data to designated devices – smart electricity grids, smart water systems etc.
- d. All utility services are automated, monitored and controlled in real-time which optimizes both assets and operations.
- e. Intelligent transportation systems are coordinated; location information and real-time route optimization systems guide travellers to most efficient routes/modes and avoid congestions and make parking easy and fast.
- f. Digital security systems act as virtual shields against any rule violations and provide instant information to emergency services such as fire, police, ambulance, municipal agencies etc.

- g. Data from all sources is shared by all stakeholders as agreed and smart analytical tools predict incidents before they occur.
- h. Broadband networks and wireless video solutions will put patients at home face-to-face with doctors/clinicians in the hospitals.
- i. Education and training programs are delivered online to targeted groups and ecommerce services cover all daily needs of citizens.
- j. Reduced commuting by citizens as many services are “contactless”.
- k. Electrification of mobility, with fleet operations being the low hanging fruit, permit creation of virtual power plants
- l. Intelligent buildings with rooftop PV and EV Charging facilities integrated with automation systems of the electric utility participating in the demand response market.
- m. Use of gas grids to power micro gas turbines.
- n. Demand Response would strengthen negawatt market and IT infrastructure permit its aggregation for meaningful dispatch.
- o. Energy independence in long term and “intelligent energy harvesting” that would recycle incoming energy flows.
- p. Seamless payment system for all services.

2. Smart Cities in India

In the Indian context where cities do not have a single owner for all their services, it would be a herculean task to integrate all infrastructure and services on a common platform. However, a beginning can be made by extending the available digital platform of one domain (say power) to offer services in other domains (say water, gas, internet, security etc.). The smart cities in India can be in two categories – existing cities that should be made smarter by integrating all services on digital platforms; and new cities that would be built as smart cities with integrated communication, IT and Automation architecture. This would essentially cover the following:

1. Building GIS data of all infrastructure and services in an integrated fashion by one designated agency (with rules for sharing, security, etc.)
2. Smart electricity grids that ensure 24x7 stable electricity to all citizens
3. High levels of renewable energy mix that is integrated with the power grid
4. EV charging infrastructure and ability to operate large fleet of grid-connected EVs as virtual power plants (VPPs)
5. Efficient water distribution network with leakage detection systems and safe gas distribution networks
6. Integrated billing systems for a variety of services (electricity, water, gas, internet, house tax etc.); common consumer care centers and user friendly payment platforms
7. Intelligent transportation systems - coordinated operation of traffic lights, alerts on congested routes in advance, common cards for toll payments etc. which also extends to improved public transportation.

8. Digital security systems integrated with emergency services (police, fire, ambulance, municipality etc)
9. Electrification of mobility, with fleet operations being the low hanging fruit, permit creation of virtual power plants
10. Intelligent buildings with rooftop PV and EV Charging facilities integrated with automation systems of the electric utility participating in the demand response market
11. Demand Response would strengthen negawatt market and IT infrastructure permit its aggregation for meaningful dispatch.
12. Energy independence in long term and “intelligent energy harvesting” that would recycle incoming energy flows.
13. Sharing of data between various domains and building smart analytical tools
14. Seamless payment system for all services

While building new cities and new neighbourhoods, it is possible to build all these in an integrated fashion, it is a tougher task to integrate the same in existing cities with different owners for different domains. The silver lining is that there are hardly any existing IT and Automation systems in most infrastructure domains in India which eliminates the risk of legacy systems with proprietary databases and protocols that cannot readily be integrated with one another.

3. Leveraging R-APDRP Assets

All state owned electricity distribution companies (Discoms) in India are implementing a set of basic IT and Automation solutions under the ongoing R-APDRP scheme of the Ministry of Power. Some of the digital assets created under this program that already covers 1401 towns can be leveraged to build smarter cities at lower marginal costs.

IT and Automation Systems built under R-APDRP can be leveraged by other infrastructure services providers is briefly explained below:

1. GIS Map of the Towns: All electrical assets (33kV, 11kV and Low Voltage lines and substations) and consumers are mapped on a digital map and the Discoms are updating this system on a regular basis to capture changes/addition to the electrical network as well as new consumers/buildings. This digital map can be effectively used by other infrastructure services providers for planning as well as operation and maintenance of their systems. This will be very useful for planning the laying of water supply and sewerage lines, telecom cables, gas pipe lines etc. It can also be used for planning of road network. As the simplest example of how a good GIS system can help beyond a single domain – if one knows the routing of underground power cables, then the same can be synergized to other utilities that would need to dig up roads (like water, sewage, telecom, etc. – thus one should, in the future, never interrupt other services for adding new connections/lines/pipes).
2. Billing and Customer Relationship Management (CRM) Systems: State of the art Billing and CRM systems have been implemented in all these towns and the

consumers have multiple options to make their payments. There are also Consumer Care Centers at strategic locations and interactive consumer portals. Discoms have regular interactions with their customers on – meter reading, bill distribution, payment collection, attending to complaints, information on planned outages etc. Large number of consumers are already using the consumer portals. All water and gas consumers are electricity consumers also. The Billing and CRM systems of Discoms can be used for collection of water and gas bills, house taxes and other municipal dues, and can even be extended to private utilities such as cable TV, internet, telephone, etc. This not only reduces the overall collection cost, but also facilitates higher compliance in timely payment. If the consumer wishes, he/she could even opt for a consolidated bill across all such services.

3. SCADA/DMS System: For larger towns with population of 4 lakhs and above (about 100 towns), Discoms are implementing SCADA/DMS systems for monitoring and controlling the real-time power flows. The field infrastructure and dedicated communication bandwidth for SCADA/DMS can be leveraged to automate the water and gas supply networks as well.
4. Common Command and Control Center: Moving forward, a common command and control center that can handle the complaints from consumers for all their grievances related to electricity, water, gas, internet etc. can be created. The incoming calls (on single number) can be diverted to the respective teams responsible for each domain and their crew. The IT and communication infrastructure and cost can be optimized to a great extent. It will boost customer satisfaction to a great extent as they do not have to knock at different doors for each service.
5. Outage Management Systems (OMS) and Mobile Workforce Management (MWFM): OMS and MWFM can be shared by electricity, water, gas and internet/ other services providers.
6. Application Integration: All the applications of all interconnected domains can be integrated and the data can be shared and dashboards can be made available to operators, managers and policy makers to effectively plan and manage the city.

4. National Smart Grid Mission (NSGM)

Ministry of Power issued a Smart Grid Vision and Roadmap for India in September 2013 which envisages transformation of the entire Indian power system to a smarter grid by 2027. In order to achieve the goals envisaged in this roadmap it is proposed to launch a National Smart Grid Mission (NSGM). Under the NSGM it is proposed to build about 50 smart cities in the country leveraging the existing R-APDRP infrastructure and new systems that would essentially be implemented for first building smart grids and then extending the systems to other domains.

The framework for these smart cities would be:

- 10-15 cities will be selected in the first group that would be eligible for 30-50% funding from GoI based on their performance under R-APDRP, Solar City schemes etc. Here the detailed planning, preparation of feasibility report, technology trials (PoC), development of integration framework, development of business case and financing models, program monitoring etc. will be done under NSGM
- 10-15 cities under PPP model in which a leading private sector company takes ownership and builds the systems on 50-25-25 model: 50% funding by the private player, 25% by respective state government and 25% by GoI
- 20-25 cities by respective state governments for which NSGM will do the hand-holding and provide other support

Selection of the cities in each region/states under the above three categories would be carried out in consultation with all stakeholders.

5. Coordination with other Ministries/Programs

This initiative can be dovetailed with JNNURM, Solar Cities Program, National Mission on Power Electronic Technologies, DMIC, National Mission on Electric Mobility, National Water Mission, National Mission on Enhanced Energy Efficiency, etc. for improved efficacy and asset/cost optimization.

6. Summary

The concept of a Smart City is gaining popularity, but the main challenge becomes how to start the process, and coordinate it. Instead of treating this as an IT project, it makes sense to anchor this around Energy and Power, for the below reasons:

- 1) IT is an enabler, a means to an end. The services and outcomes are really the end-goal
- 2) Power is a critical human need, and spans the entire multitude of operational, logistical, and philosophical needs for public utilities and services. It is neither as profitable as telecom, nor as loss-making as water/sewerage. It is neither entirely a public good (basic human right) like water, nor a purely commercial commodity.
- 3) The scale and scope of both power and underlying efforts (from R-APDRP to Smart Grids) make this utility a logical anchor for all other functionalities