Abstract

Utility companies in developed economies are looking to leverage the Internet of Things (IoT) to improve the development and operation of smart grids. However, an IoT setup cannot exist as a standalone web and needs many supporting IT services, translating into opportunities for IT service providers and benefits for utilities and their consumers.
The Role of IoT in Smart Grid Deployment

Since 1999, when the idea was first presented by Massachusetts Institute of Technology¹, IoT has been adopted by governments in the US, Japan, China, Korea, and the European Union for various purposes. For instance, all utilities in the EU must compulsorily have smart meters. The US government also began transitioning to smart grid technology from 2007.²

Making smart grids 'smarter' with the IoT

Deploying multi-level implementations
The IoT’s IPv6 addressing system helps cope with the multi-layered architecture of the smart grid at multiple levels (the object layer level, communication layer level, and application layer level). This way, smart meters can communicate with a host of other objects and applications connected through the smart network.

Overcoming data readability and interoperability challenges
Deploying smart grids involves integrating numerous IoT sensors into the infrastructure. Since these devices communicate with each other, the challenges of data readability and interoperability increase.

Managing load and demand response on a smart grid
To minimize human intervention and lower electricity consumption and costs, IoT allows embedding each device in the smart grid with a wireless sensor that responds optimally to environmental changes. For instance, wireless sensors are used to remotely operate devices, such as switching on/off the air-conditioning, heating, or ventilation.

Challenges and Opportunities in Implementing IoT-enabled Smart Grids

Implementation of the IoT in smart grids comes with its own set of challenges, which open up opportunities for IT service providers.

Data leakage: Appliance usage data collected by smart grids and stored in the utilities central server is accessible to employees and regulators and increases vulnerability to threats. For instance, burglars can access air-conditioning usage data of a home, understand if residents are in or out and stage a break in.
Cyber-attacks: Cyber-attackers can manipulate the data transferred in a grid, forcing sensors to make incorrect decisions, causing widespread equipment damage and financial losses. The Stuxnet worm was used to corrupt the PLC circuit and hamper machinery operation in Iran, damaging a fifth of Iran’s nuclear centrifuge.

Unreliable internet connectivity: In order to ensure smooth smart grid operations, utilities need uninterrupted and fast connectivity, and may try to create their own network infrastructure for critical appliances, incurring high implementation costs.

Lack of data management capability: It is estimated that 116 million smart meters will be sold globally by 2023. Transferring, storing, and analyzing such huge amounts of data will require data center and data analytics software implementation capabilities.

Scope of IT Services in IoT-enabled Smart Grids

There are several opportunities for IT service providers to participate in the implementation of IoT-enabled smart grids.

Solution for IPV6 mapping: Legacy technologies such as X10, European Installation Bus, RFID, and Controller Area Network are not compatible with IPv6. Service providers can define the IPv6 mapping process for native addressing of the loads and other devices connected to the grid by the IoT.

Data analysis software: The IoT provides access to meaningful insights and instruction stimuli for near real-time demand response management and load management in a smart grid. Service providers can create efficient analytics software to analyze data streams generated by IoT sensors and send feedback to the grid for further necessary action.

Security solutions: Wireless devices are prone to virus attacks leading to data distortion and legal complications for the utilities. Service providers can create effective security solutions.

Data center services: The huge volume of data generated by a smart grid has to be stored and accessed dynamically. Service providers can supply cloud-based data storage facilities for effective smart grid implementation.
Prosumers contribute to the grid through household renewable generation units such as rooftop solar plants. On a bright sunny day, when there is a surge in power supplied by such prosumers, the grid should be able to best utilize this extra power. Artificial Intelligence can play a crucial role in this aspect by predicting the actions of various players and simulating the cascading effect they will create.

**Network topology:** Smart meters share data with IoT devices in a home setup using network topology. This data allows consumers to conserve energy and lower their utility bills. As different countries use different network topology standards, service providers can develop more efficient systems.

**Artificial intelligence:** A smart grid includes a large number of unconnected discrete objects (such as smart meters, smart sensors, wireless controllers and others), the output of which produces a ripple effect on the grid, impacting other players.

Artificial intelligence service providers can:

- Enable discrete grid objects to alter their power consumption in response to dynamic price changes
- Develop simulation and prediction tools to measure the system-wide ripple effect of deploying pricing mechanisms and energy management processes

**Conclusion**

**Understanding the Implications before Implementation**

While the IoT can lead to large scale improvements, some technical, legal, and economic aspects have to be dealt with carefully.

From a technical aspect, new software is required to efficiently analyze the myriad amount of data that will be generated by thousands of IoT sensors. In addition, internet connectivity must be economically viable, stable, and pervasive, and should comprise innovative routing algorithms for error-free data transfer.

We need to develop new standards to support automation for widespread adoption of IoT. However, given that many countries are starting to roll out smart grid programs, service providers that step in at this stage will get an irrevocable early mover advantage.

**References**


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