The Concept Layer, Feature Layer and Landing Layer of Ubiquitous Internet of Things in Power System

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Abstract. With the deep reform and development of energy and power industry and the arrival of the era of Internet of everything, the ubiquitous Internet of Things in power system (IOTIPS) emerges as the times require. However, what is the implication of ubiquitous IOTIPS? What are its inherent attributes? How to get results in information system, digital economy and new business model? These problems have become the current focus of the important issues. This paper considers the above three dimensions.

1. Introduction

With the rapid development of mobile Internet, everything is “online”, and the era of Internet of everything has come. People, information, technology, machines and terminals all connect with each other in a specific logical relationship. Such interconnection enhances efficiency, expands horizons, renews perception, changes habits, and profoundly affects the structure of people and society as well as the relationship chain between things and equipment for a long time. In this context and trend, the ubiquitous IOTIPS has aroused hot discussion in the industry during the “two sessions” in 2019.

In January 2019, State Grid Co., Ltd. officially proposed in two sessions the construction of hub, platform and sharing enterprises, and the construction of the ubiquitous IOTIPS on the basis of the Strong Smart Grid to constitute the energy Internet that integrates energy flow, business flow and data flow. At the same time, three major development tasks in 2019 were put forward, pointing out that the construction of ubiquitous IOTIPS was the core task of implementing the strategic goal of “three types, two networks and first class in the world”. In the next few years, the State Grid will continue to build and operate the Strong Smart Grid with ultra-high voltage (UHV) as the backbone and coordinated development of power grids at all levels, and constantly improve the capacity of energy and resources allocation and the level of intelligence. Meanwhile, it should make full use of modern information technologies such as “Big Data, Cloud Computing, Internet of Things, Mobile Internet, and AI” to create a ubiquitous IOTIPS with comprehensive state perception, efficient information processing, convenient and flexible application.

On March 8, 2019, State Grid Co., Ltd. convened a system-wide special working meeting to make overall deployment arrangements for the construction of the ubiquitous IOTIPS, and accelerate the implementation of the strategy of “three types, two networks and first class in the world”. This meeting marked that the construction horn of the ubiquitous IOTIPS has sounded.
2. Concept Layer of Ubiquitous IOTIPS

The meaning of the Chinese word “Fan” is extensive and diverse. Therefore, the word “ubiquitous” must be the existence of a variety of forms, logic and relationships. The concept of ubiquitous IOTIPS should be said to be a very broad and upper-level concept, which can be understood as being electrically centric or a carrier, involving power lines, main network and distribution network, equipment, information systems, new energy supply, new energy vehicles, power side, power generation side, and user-side terminals, connecting everything. The algorithms and barriers between systems and between data are broken through. Each link of power systems is identified, supported and applied to each other.

At present, there is no unified understanding of the definition of ubiquitous IOTIPS in academia and industry. However, from the general direction, to informationize all the links of traditional power production, transmission and consumption and to link and connect with each other are ubiquitous IOTIPS. In the future, the information technologies such as “Big Data, Cloud Computing, Internet of Things, Mobile Internet, and AI”, digital technology, and blockchain technology should be used to penetrate and integrate with the new generation of power system, connect people, machines and things in all aspects of energy and power production and consumption online in real time, fully carry and connect the whole chain of power grid production, transmission, operation and consumption, connect enterprise management and customer service business, and connect the power production side, transmission side, energy storage side, user side and so on. The terminal layer shows the interconnection ability of all things, the network layer shows the communication ability everywhere and from time to time, and the platform layer shows the ability of mining, analyzing and managing the panoramic equipment and data flow.

In fact, in some European countries, there are similar concepts for the ubiquitous IOTIPS. However, at present, most of them are demonstration projects. These projects only add a layer of ICT network on the basis of the grid that is the information and communication technology, to realize the interaction between load and renewable energy, as well as other functions. It can be said that they are relatively partial and modular experiments.

3. Feature Layer of Ubiquitous IOTIPS

3.1 Connection

Connection is an important element of Internet thinking. Especially in the era of mobile Internet, connection means information, connection means service, and connection means value. Only when there is connection, can there be data flow and value chain. Connection is the most basic feature of ubiquitous IOTIPS. Without connection, there would be no Internet of Things, and data and value would not be generated. The core of ubiquitous connection is demand. On the basis of demand, interconnection often leads to new functions and effectiveness. To tap and analyze the potential according to certain needs will bring about a step-by-step ecological win-win situation and incremental value.
Fig2. Data generation source and data acquisition method

3.2 Grid

The ubiquitous IOTIPS is a multi-dimensional, multi-level, and all-round interconnection, namely, network interconnection. All kinds of equipment and facilities, data resources, personnel management and other elements are interconnected, thus forming a grid connection. The core of the grid is the power grid, which includes not only the main network of all levels of power grids, but also the urban and rural distribution networks. The human-machine-equipment-cloud interconnection inside and outside the power grid is actually the grid connection of power grid infrastructure, personnel and their environment identification, perception, interconnection and control. Its essence is to realize the combination of information sensing devices on various physical devices and communication information resources, so that related objects can perceive and respond to each other, so as to form a more intelligent integrated whole of power production, transmission, service and other links.

3.3 Reconstruction

The construction of ubiquitous IOTIPS is an important cross-professional, cross-regional and cross-system great project, which will bring about the subversion and reconstruction of all aspects of the power system. The fundamental and systematic exploration and innovation will certainly break the original processes, standards, rules and so on, connect the production side, circulation side and consumption side of power grid resources in a brand new way, take the user demand as the guide, take the interconnection as the means, take the business pain point blind area as the breakthrough, optimize the allocation of energy, data, equipment, technology, talent and other elements, and bring high quality development of power grid.

3.4 Sharing

In recent years, the wind of sharing economy has blown up in the capital market and emerging service fields. Sharing has changed people’s traditional cognition of equipment, facilities, resources and services, and has played a green, energy-saving and sharing economic model and social relationship system. Since the “ubiquitous IOTIPS” has the hub-type and platform-type features, centers on all aspects of the power system, applies modern information technology and advanced communication technology, and realizes the interconnection and human-computer interaction of all aspects of the power system, the original professional barriers, information asymmetry and system non-integration of the power system must be broken. Only by achieving data sharing, business integration and professional integration among different majors, business modules and business processes, can the goal of an intelligent system that comprehensively perceives the state of ubiquitous IOTIPS, processes information efficiently and applies conveniently and flexibly be achieved.

At present, the State Grid Co., Ltd. implements the isolated operation of the internal network and the external network, which brings the key resistance to information and data sharing. Therefore, the prerequisite of building a ubiquitous IOTIPS is security, including system security, network security, technology security, equipment security, personnel security, etc. Under the precondition of security, only by opening the internal and external networks and building the system cloud, can the real sharing be realized.
4. Landing Layer of Ubiquitous IOTIPS

4.1 Integration of Energy and Information

Focusing on the goal of the construction of “three types and two networks” and the construction of world-class enterprises, the scientific and technological advantages of all parties are used to introduce information technology, chip technology, artificial intelligence technology, remote sensing mapping technology, edge technology, block chain technology, etc. into the manufacturing, equipment, services, technologies, etc. in the field of energy, reshape the process, innovate the application, focus on end-to-end integration, and upgrade the transformation of power grid construction and operation, so as to truly realize the transformation from manufacturing to intelligent manufacturing.

4.2 Win-Win between New Industry Form and New Ecology

Ubiquitous IOTIPS will gather huge amounts of equipment and data, and carry out ubiquitous interconnection and value reconstruction for them. In addition to upgrading and adding value to the traditional business of power grid, the development of new business for terminal customers should not be neglected. For example, the solution of the whole energy system of smart community, the energy supply scheme of smart transportation, the energy use of users and energy efficiency analysis, and the smart home and energy management consultation are all the landing direction of ubiquitous IOTIPS. For example, the intelligent vehicle networking has connected 80% of the public charging piles and more than 40,000 electric vehicles in the whole society. Such resource collection not only provides simple and extensive charging supply for the customer side, but also extends to vehicle services, energy management, even parking services, navigation services and other new ecology. For example, in customer service, the business volume of traditional electricity service and hotline service should be further compressed. Based on the construction direction of mobile Internet and ubiquitous IOTIPS, the text service, new media service, and remote audio and video service which are preferred by young customers will show a spurt of growth, thus generating new forms of customer service.

5. Conclusions

The construction of ubiquitous IOTIPS is a long-term, systematic and arduous task. The understanding of the connotation of ubiquitous IOTIPS is also a gradual, continuous and clear process. The characteristics of link, grid, reconstruction, sharing and empowerment of the above analysis will become more and more obvious with the deepening of research and the continuous progress of the construction. The continuous integration of traditional power industry and energy, information, commerce and digital will incubate a more intelligent ubiquitous IOTIPS. In a word, the construction of ubiquitous IOTIPS has a promising prospect.

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