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IoT Architecture for Smart Grids

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***Abstract*— The tremendous advances in information and communications technology (ICT), as well as the embedded systems, have been led to the emergence of the novel concept of the internet of things (IoT). Enjoying IoT-based technologies, many objects and components can be connected to each other through the internet or other modern communicational platforms. Embedded systems which are computing machines for special purposes like those utilized in high-tech devices, smart buildings, aircraft, and vehicles including advanced controllers, sensors, and meters with the ability of information exchange using IT infrastructures. The phrase "internet", in this context, does not exclusively refer to the World Wide Web rather than any type of server-based or peer-to-peer networks. In this study, the application of IoT in smart grids is addressed. Hence, at first, an introduction to the necessity of deployment of IoT in smart grids is presented. Afterwards, the applications of IoT in three levels of generation, transmission, and distribution is proposed. The generation level is composed of applications of IoT in renewable energy resources, wind and solar in particular, thermal generation, and energy storage facilities. The deployment of IoT in transmission level deals with congestion management in power system and guarantees the security of the system. In the distribution level, the implications of IoT in active distribution networks, smart cities, microgrids, smart buildings, and industrial sector are evaluated.**

Keywords*— *Internet of things (IoT), Internet of energy (IoE), Renewable energy, Active distribution networks, Smart grid 2.0.

I. Introduction

Internet of things (IoT) refers to an informatics network which connects various objects and elements of a system to each other using advanced ICT and advanced embedded systems including digitalized sensors, meters, and controllers. In this regard, IoT has the fame of the third revolution in information technology. Internet of energy (IoE) represents an upgrade of IoT which deals with the combination of ICT and energy ecosystem. In this study, the deployment of IoT in the smart grid's components will be discussed. Smart grid denotes an electricity supply network that uses digital communications technology to detect and react to local changes in usage. IoT in smart grids refers to the ability of all components in a smart grid to share information through any kind of wired or wireless network. IoT is regarded as an indispensable part of the implementation of smart grids and materializing smart cities and smart buildings schemes [1].

Regard to the presence of a large diversity of devices, equipment, energy forms and their corresponding inherent behavior, variability of some parameters in energy field, and unpredictable or chaotic nature of some phenomena, it is necessary to transfer and analyze a big amount of data in near real-time and to make decision with a brief delay. The data should be quickly and securely shared with corresponding destinations and the required actions must be taken automatically. Thus, the solution is to equip components with IoT-oriented technologies to take advantages of information technology in the form of networks. IoT-based devices are those that equipped with electric boards encompassing microcontrollers and microprocessors with the ability of share of information which can be sensors, meters or controllers. Besides, the correctness and validation of information must be ensured which may be threatened by deliberate cyber-attacks or unintentional interruptions (disturbances). Nowadays, a new concept is propounded that is called the second generation of smart grids (smart grid 2.0) and refers to the next design of smart grids which will be implemented from 2020 [2]. This concept has meaningful distinctions with the current smart grid concept. In smart grid 2.0, the interactions between supply-sides and demand-side will be mounted utilizing advanced smart metering infrastructures, the share of energy and its correlated information between competent players using informatics infrastructure, and the plug & play capability, which denotes the ability to deliver energy even by small-scale generation resources (e.g. V2Gs). Plug & play capability indicates that a demand-side electricity source is able to inject power to the grid as easy as plugging in a plug into an outlet. Such consumers that are able to play the role of power providers are called "prosumers" [3]. Currently, the ability of connection or disconnection of distributed generation at each desired moment is not possible.