Wireless Communication Techniques, the Right Path to Smart Grid Distribution Systems: A Review.

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Abstract —The quality and reliability of electric power supply are the key indicators for the comfort of a society. Hence, to serve customers with high quality electricity, the Supervisory Control and Data Acquisition (SCADA) system is being used in the distribution system (DS) for power monitoring and control. The SCADA is feed with operation data like current and voltage via Feeder_Remote Terminal_Units (FRTUs). The FRTUs are capable of triggering actions to detach the portion of DS experiencing an unusual condition. Nevertheless, the existing grids do not operate at their optimal capacity due to the usage of one way data communication installations. Thus, to optimize the operation of the legacy power distribution grids, the innovation of the state-of-the-art communication techniques play a vital role—leading to the creation of smart grid Systems. This paper reviews the development of wireless communication technologies envisioned as full-duplex information exchange medium in the on-going development of Smart Grid Systems.

Keywords—Society; Key indicator; Distribution System; Wireless; Smart Grid; SCADA; Feeder_Remote Terminal_Units; Full-duplex.

I. INTRODUCTION

The innovative electrical grid is one of the leading infrastructures indispensable for the luxury of a Nation [1]. Nevertheless, the present electric utilities frequently fail to provide reliable power to consumers; as they often, experience lengthy service disturbances due to installation failures, lightning strikes, natural catastrophes, etc. [2]. Therefore, to overwhelm these glitches, a new electric power system named "Smart grid" has arisen. In smart grid, the power distribution grid monitors, control, protects and automatically enhances the operation of its interconnected devices from the generation plant to the distribution system. Lots of wired and wireless communication technologies are available for smart grid systems but the cutting-edge wireless communication techniques offer the advantages of low_cost and ease set-up products, ad hoc and extensive network built-up that wired technologies do not afford [3].

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II. SMART GRID DISTRIBUTION SYSTEM STRUCTURE

A classic Smart grid structure has inferior and higher layers [3]. The inferior layer contains: (i) the generation zone/power plant, (ii) the transmission zone encompassing the regional control center (RCC) and the substation automation system (SAS), (iii) the distribution zone comprising the distribution control center (DCC) and the distribution automation system (DAS), and finally, (iv) the customer zone including the Distributed Energy Resources (DER) plant automation as well as domestic and industrial customer automation systems. The upper regulatory layer contains: (i) the regional system operator, (ii) the energy service provider and (iii) the power market. Nevertheless, the electrical grid design, the power voltage and frequency depend on regions. Hence, the typical frequency for Europe and most of Asia Countries is 50 Hz while 60 Hz is for North America [4]. In Malaysia, the power grids transmit the electricity from high_voltage (HV) to low_voltage (LV) across medium_voltage (MV) as follow:

1) ***LV:*** 1 to 1000volts (240V for single phase and 415V for phase to phase)
2) ***MV:*** 1000 to 100000volts (11kV, 22kV, 33kV and 66kV)
3) ***HV:*** 100000volts upwards (132kV, 275kV, 500kV)

The DAS controls and manages the power flow, the status of interconnected devices and faults in the distribution systems. Hence, to enhance the features of the DAS, the supervisory control and data acquisition (SCADA) system is implemented for automatic fault detection and quick remedy for any distressed grid in the distribution systems [5]. Fig.1 presents a classic smart grid distribution system.