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A Survey on Wireless Sensor Network in Smart Grid Optimization

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ABSTRACT
Smart grids (SGs) are envisioned as future power grids to enhance the functionality of traditional power grids. The communication technologies in power grids suffer from connectivity problems due to dynamic topology changes, fading, interference, power consumption, packet loss, throughput and delay. In this paper we present the survey for the smart grid and the performance of smart grid for various applications.

Keywords: Smart Grid, Wireless Sensor Network, Neighbor area network, Quality of Service, IEEE.

INTRODUCTION

Wireless sensor networks and sensor actor networks are expected to watch over expensive equipment in Smart Grid, with sensors monitoring the environment for possible emergency events and communicating with actuators to take proper action when the event occurs. Failure in detection of an emergency event may result in breakdown of expensive equipment, and in some extreme cases, may even cost lives. Therefore, reliability is considered to be one of the most important issues in Smart Grid communications. To avoid such losses reliable and timely coordination of sensing results must be addressed [8]. The electric grid is currently facing massive changes in light of a combination of interrelated technical, political and economic drives. The most important of these changes deals with making the grid smarter by enabling the communication of relevant information across the entire network. This will help towards the creation of new services and applications with the goal of a more efficient, reliable, secure and cost-effective system in all the phases from generation to consumption [2]. Instant and reliable data transmission from power supplier to customers is of great significance in smart grid applications [3].

For example, WSNs can be deployed over various parts of the electric power grid (e.g., generation plants, power lines, renewable energy sites, etc.). Data related to the power usage, generation efficiency, and many other types of information can be measured, collected, and conveyed to a sink node (i.e., base station, operation center) for system and energy management issues [1].

The neighbor area network (NAN) which forms data transmission bridges between utility backbone and households in SG. It is one of the most important parts in power grid that contributes to the safety and efficiency of the whole grid. High reliability and QoS of NAN communications are critically required [3]. Multi-hop wireless mesh network (WMN) based on IEEE 802.11 can be a promising candidate for NAN since it can provide high-speed and reliable wireless data transmission in communication.

Smart grids have a multi-tiered architecture consisting of home area network (HAN), neighborhood area network (NAN), and wide area network (WAN), as shown in Fig. 1. The HAN encompasses the communication within a home,

which is relayed via a HAN cognitive gateway to the NAN. The NAN interconnects the HANs in a neighborhood area with each other and with a NAN cognitive gateway. The NAN cognitive gateway relays the NAN communication to the WAN, which interconnects the NANs with the power utility facilities and control units. Besides this three-tiered architecture, hybrid architectures, such as the advanced metering infrastructure (AMI), are also present [4].

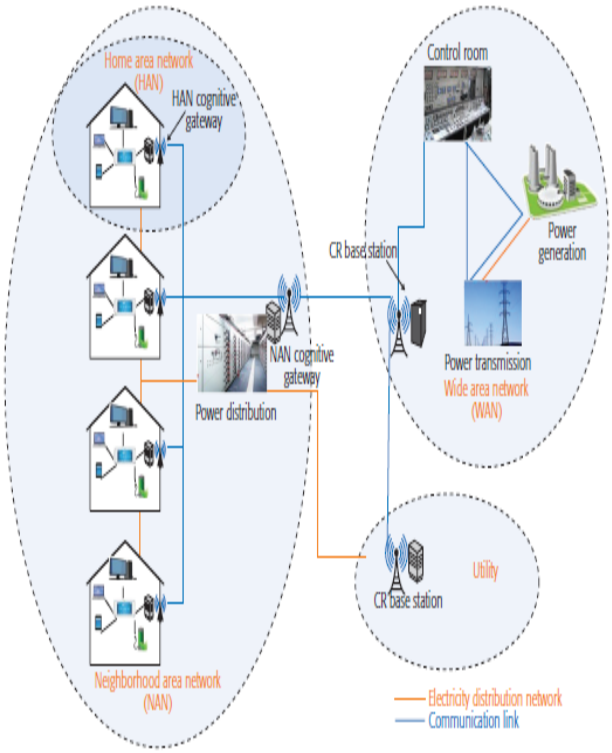

Fig. 1: Conceptual CR-based SG architecture [4].

The rest of this paper is organized as follows in the first section we describe an introduction of about the Smart grid and their applications. In section II we discuss about the Software Defined Networks. In section III we discuss about the rich literature for the packet optimization in smart grid using wireless sensor networks. In section IV we discuss about the problem formulation and statement as we getting from the rich literature survey, finally in section V we conclude the about our paper which is based on the literature survey and specify the future scope.

II SOFTWARE DEFINED NETWORKS

The idea of software defined networks (SDN) has emerged from the need for programmable networks [5]. Traditional networks, such as Internet, are not much programmable. The building blocks of Internet are the devices such as switches, and routers which need to be configured by the network operators. Network operators implement policies on these devices so that these devices respond to network events a particular application. However, the configuration and implementation of policies are done manually and not flexible enough to interact with the dynamic environment of the Internet and new emerging applications. Here SDN with its "programmability" feature separates the hardware from the control decisions. In simple words, network devices, such as switches or routers, become forwarding devices and the software defined controllers led the network intelligence [6]. SDN has been proposed to monitor and manage the communication networks globally. The applicability of SDN in different domains is not new. SDN has been applied to data centers, wide area networks (WAN), enterprises, optical networks, wireless networks [17], wireless sensor networks, and under water sensor networks (UWSN) [5].

III RELATED WORK

In this section we discuss about the rich literature survey for the packet optimization in smart grid using wireless sensor networks**.**

[1] In this study, they construct a detailed link layer model by employing the characteristics of Tmote Sky WSN nodes and channel characteristics based on actual measurements of SG path loss for various environments. A novel mixed integer programming framework is created by using the aforementioned link layer model for WSN lifetime maximization by joint optimization of transmission power level and data packet size.

[2] This paper has provided an overview on the role satellite communications can play in different smart grid scenarios. The use of satellite solutions is becoming more and more economically feasible, as the cost of the satellite equipment and the prices of the relevant services are continuously

decreasing. In addition, satellite communication services are distance insensitive and scale well with the increase of the area to cover, making them attractive for deployments over wide areas.

[3] In this paper, they first propose a hybrid wireless mesh protocol (HWMP) based neighbor area network (NAN) QoS aware routing scheme, named HWMP-NQ, to meet the QoS requirements by applying an integrated routing metric to route decision with effective link condition probing and queue optimization. To further improve the reliability of the proposed HWMP-NQ, they present a multi-gateway backup routing scheme along with a routing reliability correction factor to mitigate the impact of routing oscillations.

[4] In this article, they evaluate the requirements and key design challenges for routing and MAC protocols in the CR-based smart grid. they also provide a review of research carried out to date for routing and MAC protocols for the CR-based smart grid. Cognitive radio technology can facilitate communication in smart grid applications through dynamic spectrum access.

[5] This article serves as a comprehensive survey on SDN-based smart grid. In this article, they first discuss taxonomy of advantages of SDN-based smart grid. They then discuss SDN based smart grid architectures, along with case studies. Their article provides an in-depth discussion on multicasting and routing schemes for SDN-based smart grid.

[6] In this paper they presents the honey bee mating optimization-based routing and cooperative channel assignment algorithms have been proposed. The developed framework significantly decreases the probability of packet loss and preserves high link quality among sensor nodes in harsh smart grid spectrum environments. The proposed approach performance has been evaluated in terms of packet delivery ratio, delay, and energy consumption demonstrating that it has successfully addressed the QoS requirements of most of the SG applications presented.

[7] In this paper, they consider the utilization of TV White Spaces (TVWS) by small Cognitive Radio (CR) network operators to support the communication needs of various smart grid applications. They first propose multi-tier communication network architecture for smart metering applications in dense urban environments. Their measurement campaign, without any competition from other CR operators, reveals that the communication architecture can achieve more than 1Mbps data rates using the free unlicensed TVWS spectrum.

[9] In this paper, they study the joint optimization of control and communication systems incorporating their efficient abstractions practically used in real world scenarios. The proposed framework allows including any non-decreasing function of the power consumption of the nodes as the objective, any modulation scheme and any scheduling algorithm. They first introduce an exact solution method based on the analysis of the optimality conditions and smart enumeration techniques.

IV PROBLEM STATEMENT

Instant and reliable data transmission from power supplier to customers is of great significance in smart grid applications. With the driving force from industry, the SG has developed from one-way communication system of Automated Meter Reading (AMR) to bi-directional communication system of Advanced Metering Infrastructure (AMI) [2]. There are various challenges in the smart grid area such as Channel Access Delay, Duty Cycle and Control Overhead, Packet optimization, power consumption, Error etc.

V CONCLUSIONS AND FUTURE WORK

The success of smart grid underlie on an efficient, reliable, flexible, and globally managed communication system, which help to assist Smart Grid in providing these services in a timely manner. In this paper we have discussed case studies and literature survey on the use of smart grid and their performance in various field foe a particular applications.

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