

An Efficient Channel Selection and Power Allocation Scheme for TVWS based on Interference Analysis in Smart Metering Infrastructure

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Abstract: Nowadays, smart meter (SM) technology is widely effectively used. In addition, power allocation (PA) and channel selection (CS) are considered problems with many proposed approaches. In this paper, we will suggest a specific scenario for an SM configuration system and show how to solve the optimization problem for transmission between SMs and the data concentrator unit (DCU), the center that collects the data from several SMs, via simulation. An efficient CS with PA scheme is proposed in the TV white space system, which uses the TV band spectrum. On the basis of the optimal configuration requirements, SMs can have a transmission schedule and channel selection to obtain the optimal efficiency of using spectrum resources when transmitting data to the DCU. The optimal goals discussed in this paper are the maximum capacity or maximum channel efficiency and the maximum allowable power of the SMs used to satisfy the quality of service without harm to another wireless system. In addition, minimization of the interference to the digital television system and other SMs is also important and needs to be considered when the solving coexistence scenario. Further, we propose a process that performs an interference analysis scheme by using the spectrum engineering advanced Monte Carlo analysis tool (SEAMCAT), which is an integrated software tool based on a Monte-Carlo simulation method. Briefly, the process is as follows: The optimization process implemented by genetic evolution optimization engines, i.e., a genetic algorithm, will calculate the best configuration for the SM system on the basis of the interference limitation for each SM by SEAMCAT in a specific configuration, which reaches the solution with the best defined optimal goal satisfaction.

Index Terms: Channel assignment, channel selection, cognitive radio (CR), data concentrator unit (DCU), dynamic channel selection, genetic algorithm (GA), optimization, power allocation, smart meter (SM).

I. INTRODUCTION

SMART meters (SMs) are measurement devices used to communicate information for billing customers and to operate

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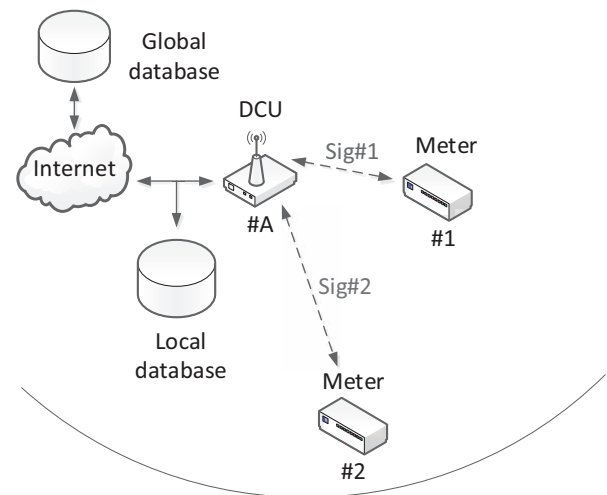


Fig. 1. Communication between smart meters and data concentrator unit.

their electrical systems. The use of these electronic meters came into service for the largest customers of the utility and gradually expanded to all customer classes over time. SMs are being developed to improve grid reliability and control energy efficiency in industrial and medical systems as well as in-home areas. The development of SMs has many benefits and increases efficiency, which has been shown to improve upon older electro mechanical meter technology. There are several SM systems that operate by wirelessly transmitting information, such as temperature alert systems, electromagnetic radiation measurement devices, home temperature control, or electric voltage controllers. SM systems aid in accessing and collecting data with high accuracy and timely billing and transmit via a local area network (LAN) to the data concentrator unit (DCU), as shown in Fig. 1. One DCU may act as a collector for retrieving data and as a controller when it may or may not carry out any data processing.

One advantage of the use of SMs is that its service coverage becomes much wider than other conventional techniques owing to the inherent propagation characteristics. Generally, a single DCU could cover as many as SMs in a certain region. However, a disastrous bottleneck for communication would undoubtedly occur if there were no intelligent channel selection and power allocation schemes employed. Therefore, we need to confine the number of SMs simultaneously transmitting in a certain available TV white space (TVWS) channel. Moreover, the number of simultaneous transmitting devices as well as their transmit powers are further limited depending on the locations and the oper-