A Resilient DAP Dynamic Selection Algorithm Based on Quality Aware Metric for Smart Grids

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***Abstract*—Smart Grids are the evolution of the current electric system to meet the challenge of increasing demands for energy in this century by integrating the eletric grid with data communication network. The challenge of this network is to fulfill safety requirements: reliability and resilience required in order to meet various types of services and applications. The use of wireless mesh networks can provide scalability and resilience to this communication network, but there are challenges that need to be evaluated and analyzed so that it is in fact a solution for communications in Smart Grids. This paper proposes an algorithm for dynamic selection of gateways in a muultihoming Smart Grid network improving performance when a gateway's fault occurs on congested environments. The results indicate that the proposed algorithm makes the routing protocol more ......**

Keywords*—*reliability, smart grid, wireless mesh networks (WMNs).

I. Introduction

Basically the current electrical system has an outdated hierarchical architecture that does not meet the future demands of energy consumption due to various limitations such as limited generation capacity, one-way flow of energy (generationtransportdistributionconsumption) and communication, low and deficient communication, the use of fossil fuels in power generation and reliability problems [1]. Modernization the existing electricity grid aims to solve these problems, improving efficiency, reliability and security, integrating the use of renewable energy produced by consumers, making the one-way flow in two-way flow for energy and communication [1], [2]. Two-way communication infrastructure is essential for Smart Grids [3], cause it needs to send commands and to receive information from its components and sensors in real time, with reliably, allowing monitoring, maintenance and control of the entire grid.

Smart Grids require two-way communication that has specificities of delay, bandwidth, frequency of updates, reliability, security and time response for each distinct application in their different fields [3]. Advanced Metering Infrastructure (AMI) is fundamental and the first step to realize a Smart Grid[4], [5]. Your security requirements should provide robustness and resilience to prevent or recover from cyber attacks or problems caused by interference, providing the stability and reliability to AMI communication. This communication may use available wired or wireless technologies that support the exchange information between components of AMI [6], [7]. Different types of technologies can be used: cellular technology [8], WiMAX, ZigBee [8], RF Mesh [9], IEEE 802.11-based Wireless Mesh Networks (WMN) and PLC [10].

PLC (*Power Line Communication*) is the most used wired technology [6], but has limitations. In case of failures, such as physical disruption of power lines, would not be possible to maintain communication between AMI components [11]. Wireless networks offer more benefits than wired networks such as lower cost, ease of deployment and the available signal in a large area [8].

Among all wireless technologies WMN has advantages compared to single-hop infrastructure network architecture, because it communicates in multi-hop way that extends the coverage of the network and allowing communication with alternative paths in case of failures in links [9], [12].

O desafio adequar as WMN aos requisitos de comunicao requeridos pela AMI, onde centenas de medidores se comunicam com a Central de Processamento atravs dos DAP (*Data Aggregation Point*) que so os *gateways* desta rede. A grande quantidade de ns o principal desafio para uma WMN [13], j que neste ambiente pode-se ter mais de 100 medidores associados a um DAP que podem simultaneamente enviar dados causando congestionamento na rede. Uma forma de mitigar este problema o uso de mltiplos DAP. [3] cita problemas relacionados s condies de propagao do ambiente externo que proporcionam atenuaes, interferłncias e variaes, alm de estarem sujeitas a ataques.

O protocolo de roteamento tem que ser capaz de encontrar rotas confiveis para no degradar a performance e poder atender aos requisitos da AMI. Os equipamentos de comunicao sem fio tłm a capacidade de operar em diversas taxas de transmisso e so sensveis s condies de propagao gerando outro desafio para o roteamento e para sua mtrica. Esta ltima deve levar em considerao as oscilaes que a qualidade dos enlaces sofre e a taxa de transmisso do enlace para uma avaliao coerente dos custos.

Neste trabalho dado os problemas enfrentados pelo roteamento em WMN para atender aos requisitos de comunicao da AMI, propomos um algoritmo de seleo dinmica de DAP para a comunicao entre medidores e a Central de Processamento (*headend*). Neste problema, assume-se que cada medidor pode se conectar, atravs de mltiplos saltos, a um conjunto de DAP. O objetivo principal deste algoritmo, denominado *DAP Dynamic Selection Algorithm* (DDSA), aumentar a confiabilidade e a resiliłncia com a utilizao de mltiplos DAPs pelos medidores melhorando com isso a performance em ambientes congestionados e com interferłncias, j que possvel a escolha de rotas menos congestionadas ou de outros DAP em caso de quebra de rota.

O restante desse texto est estruturado da seguinte forma. A Seo 2 descreve as particularidades da rede de dados da AMI e seus desafios. A Seo 3 apresenta trabalhos relacionados. A Seo 4 apresenta e explica o princpio de funcionamento do DDSA. A Seo 5 apresenta os resultados obtidos nas simulaes. A Seo 6 conclui o artigo e apresenta ideias de trabalhos futuros.

II. Background

A. AMI

B. AMI

III. Related Work

A. Routing Metrics

IV. DDSA (DAP Dynamic Selection Algorithm)

V. Performance Evaluation

A. Simulation Environment

B. Simulation Results

VI. Conclusion

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