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DUAL LAYERED MULTI AGENT SYSTEM FOR LOAD MANAGEMENT DURING ISLANDED OPERATION OF A MICROGRID

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ABSTRACT
This paper proposes a novel dual layered multi agent system (MAS) control architecture for distributed control of a microgrid. The proposed MAS controller provides islanding capabilities to a microgrid during disturbances in the main utility grid. During islanded operation, the MAS is able to maintain the supply to the most critical local loads. If the priority levels of the loads change after loads are shed, the MAS is able to reassign power to the revised most critical load/s. The MAS is developed using the JADE platform and is implemented on a microgrid test-bed simulated in MATLAB/SIMULINK. The obtained results validate the capability of the MAS control architecture in controlling and protecting the microgrid.

KEY WORDS
Distributed control, intelligent agents, intentional islanding, load management, microgrid, and multi agent systems

1. Introduction

The ever increasing demand for electrical power has been a major challenge for the electrical supply authorities worldwide. The present grid systems which have mostly been built over the last century are rapidly aging. These legacy grid infrastructures are becoming increasingly congested and are seen as incapable of meeting the future energy needs of an information economy. The renewed interest in mitigation of climate change through reduced Green House Gas (GHG) emissions has ushered in a need of greener generation and utilizing renewables in the energy mix. Therefore, these power systems have to become smarter, more reliable and more robust in taking on renewable energy sources without losing stability and efficiency.

Smarter microgrids are an answer to this situation. Their capability to house local embedded generators as distributed generation and be locally controlled, offers various advantages over legacy systems [1]. In order to realize the potential of such smarter systems, a high degree of distributed control is required [2]. As a novel method in providing this flexible distributed control requirement, Multi Agent Systems (MAS) are stepping forward.

This paper proposes a novel MAS which provides a scalable and robust distributed control architecture for microgrid application. The MAS model is designed using the JADE platform and is implemented on a simulated test-bed in MATLAB/SIMULINK. Rest of the paper is organized as follows. An introduction to micro grid applications is given in Section 2. Section 3 gives a brief overview of MAS and discusses the applications in microgrid applications and different architectures used. A novel dual layered architecture is presented in Section 4. Simulation results of a conceptual microgrid operation based on the proposed MAS model is discussed in Section 5. The conclusions are presented in Section 6.

2. The Growth of Microgrids

Centralized bulk generation facilities are giving way to more distributed and small scale generation. Distributed generation (DG) introduces the capability of embedding a wide range of low emission and potentially lower cost generation options. Such options can include internal combustion engines, micro-turbines & non-conventional renewable energy sources such as solar photo voltaic, wind, biomass, mini/micro-hydro and even waste-to-energy systems. These smaller generation technologies allow the sources to be placed optimally with respect to the loads, thus reducing emissions and transmission losses, while also allowing for local control instead of central dispatching [1], [2].

Such DG systems provide the potential to take a sub-system approach in working with microgrids. During a disturbance in the main grid, local generation and their loads can separate from the utility and isolate the microgrid from the disturbance, without undermining the integrity of the main utility grid. This isolation is carried out at a single point of connection to the main utility known as point of common coupling. This capability, known as islanding, requires high reliability and flexibility from the microgrid. These requirements can be met by having peer-to-peer control and plug-and-play capabilities for each entity within the microgrid.

A conceptual microgrid model is shown in Fig. 1. This can be either a small scale distribution network or an electrical system of a building. Certain loads, which

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