Title: A decentralized MAS framework for sequential power supply restoration of smart grids

Agents: Switch Agent, Bus Agent, Line Agent, DG Agent, Bus Block Agent, MG Agent.

Switch Types: Sectionalizer, Circuit Breaker, Earthing Switch.

**A Decentralized Multi-Agent Approach for Service Restoration in Uncertain Environment:**

1. Uncertainty of load demand and renewable distributed generators. Forecast by generating scenarios using Monte Carlo simulations. Maximum Likelihood method is employed to estimate the maximum likelihood of all the expected solutions.
2. heuristic rule-based technique for restoration of nodes. 12 Step MAS.
3. use of electric vehicles and battery energy storage as flexible sources of energy to alleviate the uncertainties in the system

**A Fully Decentralized Multi-Agent System for Intelligent Restoration of Power Distribution Network Incorporating Distributed Generations:**

1. This system includes only one type of agent: bus agents. They have no topology information and only neighboring BAs in the system are allowed to communicate with each other. A depth-first communication mechanism (DFCM) is used to ensure each BA can obtain necessary information from the others
2. For each BA, its adjacent BAs are classified to upstream BA, downstream BA and equal BA according to the power flow relationship. Each BA has two operation modes (inter-connected mode and island mode) and three states (normal operation state, waiting-for-restoration state and de-energized state)
3. After fault isolation, the system may be split into several sub-systems. We classify these subsystems to S region, R region and T region according to the power flow relationship. The leading BAs of the three regions are called as SD-BA, RD-BA, and TD-BA, respectively. When the BA leader receives any fault information, it will firstly judge the region type (S, R or T), then take action according to its region type.
4. Three-step service restoration.
5. Island Mode Test, cascading failures and integration of BES

**A Multiagent Design for Power Distribution Systems Automation:**

1. Proposed MAS is composed of zone agents (ZAs), feeder agents (FAs), and substation agents. In this framework, ZA locate and isolate the fault based on the locally available information, and assist the FA for reconfiguration and restoration. FA can solve the restoration problem using the existing algorithms for the 0-1 knapsack optimization problem
2. A novel Q-learning mechanism is also introduced to support the FA in decision making for restoration. The design is illustrated by the use of case studies of fault location, isolation, and restoration
3. Eight step FLISR
4. Online and offline agent Q-learning approach
5. Comparison of centralized, decentralized and hybrid restoration schemes

**A multi-agent approach for service restoration with distributed generation**

1. Multiple fault scenarios, topology independent nature, robustness to change of objective priority.
2. An agent is able to react to changes in the environment to solve complex problems. They possess the key properties of reactivity, pro-activeness and sociability.
3. Switch, control and DG agents.
4. Load priorities, maximize restored loads, and minimize switching operations, node voltage constraints, generation constraints, radiality constraints.

\* **Agent Based Restoration with Distributed Energy Storage Support in Smart Grids**

1. The agents possess three key characteristics, namely autonomy, local view, and decentralization.
2. Switching Agent and Distributed ESS agent. Teams consist of agents. Switches connect teams.
3. Each Agent has a list of possible states e.g. Distributed ESS Agent (POWERCHARGE mode, POWER DISCHARGE mode, or VOLTAGECONTROL mode), Switch Agent (Normal, Abnormal, Transient and Restoration).
4. Switch (SWI), breaker (BRK), and sectionalizer (SCT).

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