Blockchain-Based Software for Power Systems Decision Making

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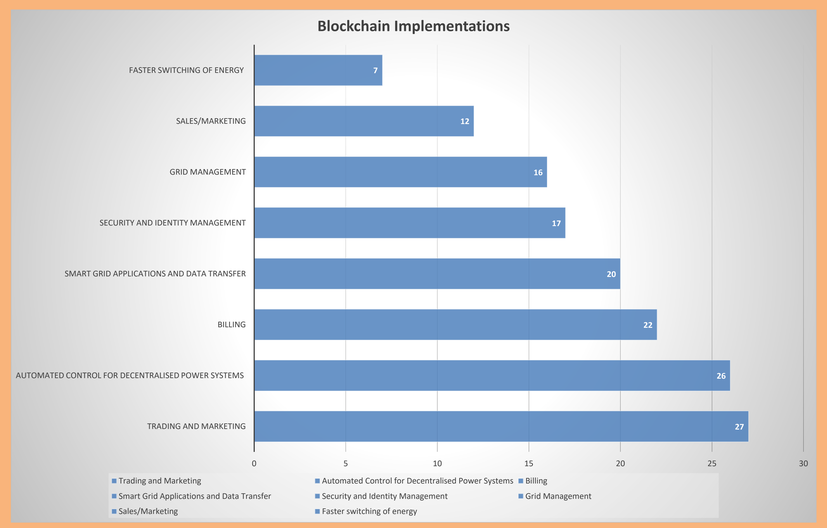
ABSTRACT

Power system operational decision-making during natural disasters is a challenging task, because of the control center lacks the knowledge of the component availability due to damages to the communication systems. In this project, we implement a blockchain-based decision-making algorithm and allow the system to track the status of their component even with communication system failures. Our research up to this day has focused on developing a power system operational decision-making algorithm based on optimal power flow, which is a crucial task in the decision-making process of generation dispatch. So far, we have experimented using Pyomo library for python and Gurobi solver in order to solve for DC optimal power flow (DCOPF), and the tools enable us to solve DCOPF problems computationally efficiently. We have begun the process of expanding the algorithm to solve ACOPF, which is a more realistic model for power system operational decision-making and a computationally challenging task. In the future, we will embed the ACOPF-based decision-making algorithm into a blockchain system, allowing the system to make educated decisions based on the availability of system components during natural disasters.

INTRODUCTION

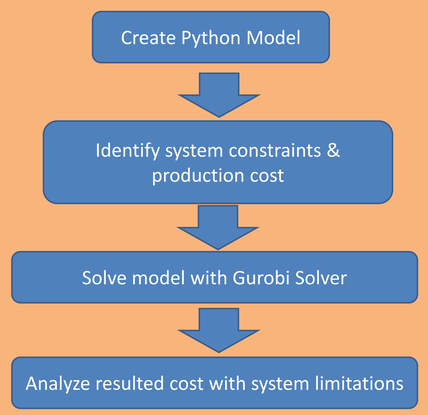
- Blockchain technology is becoming wider and wider, allowing industries to track information more accurately and faster.
- Implementation of a blockchain-based algorithm will allow power generation facilities to track status of a power network components even with partial communication system failures.



A graph describing the current implementations of blockchain in power systems

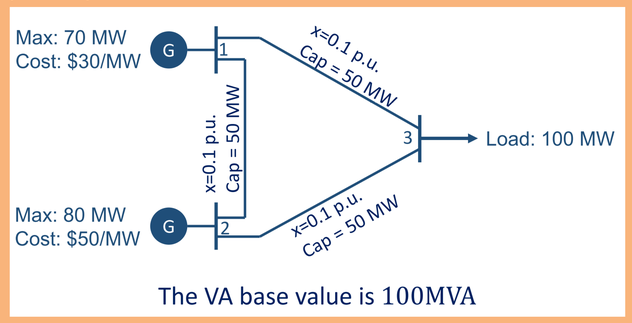
- Interaction of blockchain with Optimal Power Flow, which is a optimization problem that best describes the adequate production of power while complying with components constraints.
- Minimizing the cost of the generation of power to supply the required loads.

AC/DC OPF PROCESS



METHODS

DC-Optimal power flow:



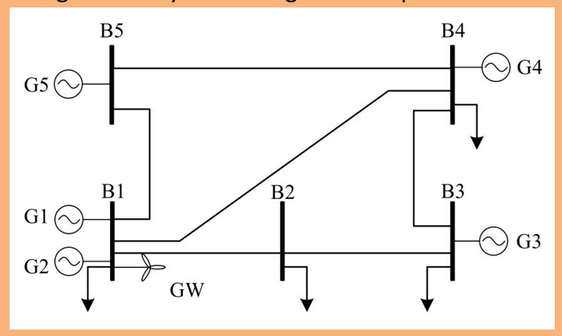
- 3 Bus system with 2 generators
- Solving system for optimal power flow using DC-OPF analysis.
  - Power transfer is lossless.
  - Voltage magnitudes in the system are all the same.
  - Assume angles to be very small.

COMPUTATION RESULTS

- Cost of Generation: $4000.0
- Generator 1: 50MW, Generator 2: 50MW.
- This DC-OPF concepts can be applied to larger power network systems.

AC-OPTIMAL POWER FLOW

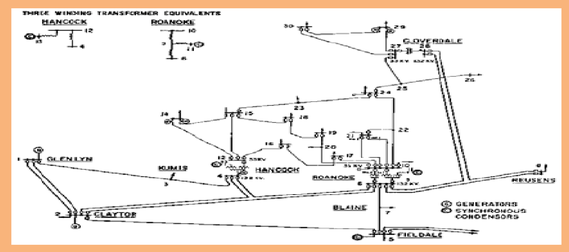
- Solving a 5 Bus system using MATLAB power.



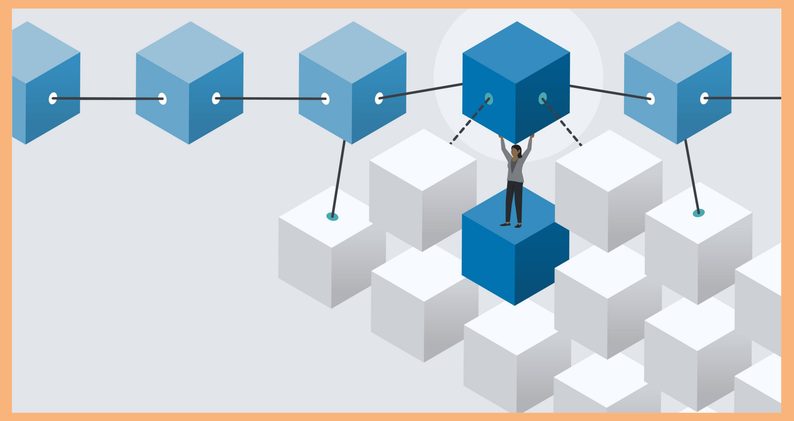
- Time to Solve: .29s
- Cost of Generation: 17551.89 $/hr.
- Generator 1: 157.59MW, Generator 2: 0MW.
- Generator 3: 324.50MW, Generator 4: 0MW
- Generator 5 470.69MW

FUTURE WORK

- After having analyzed the methods use by Matpower to solve ACOPF we will be developing an algorithm as it was done for DCOPF.
- Be able to solve larger power network systems.



- Combined Blockchain based algorithm for system component tracking with decision making AC-OPF algorithm.



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