NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE
School of Computer Science and Engineering
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Building Agents for Power Trading Agent Competition (TAC)

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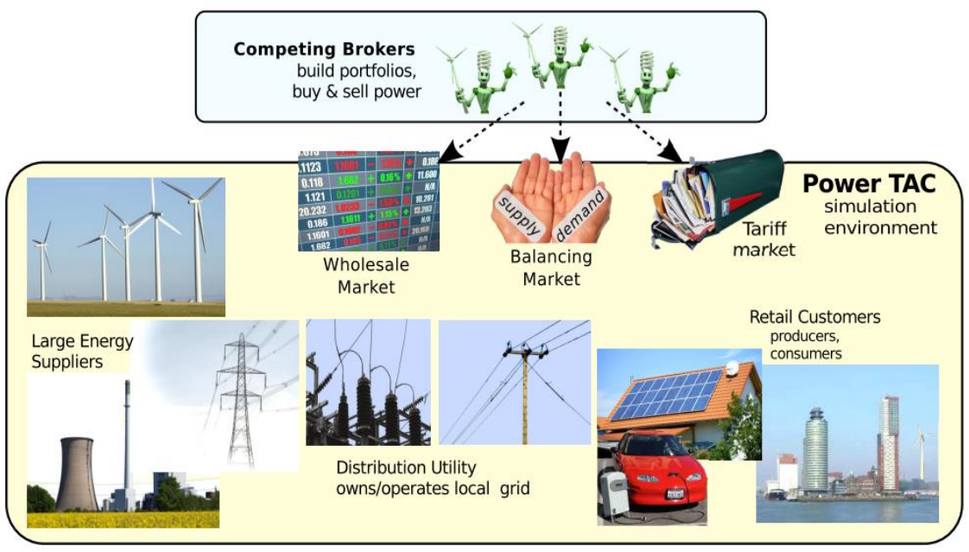
Introduction:

PowerTAC platform provides a simulation environment to study the behaviour of smart grids driven by autonomous brokers seeking efficient energy pricing and logistics. PowerTAC let agents interact with 3 markets, wholesale market, balancing market and the tariff market.



The agent manages power portfolio with both suppliers and producers, aiming to earn a profit from trading activities. The grid punishes agents for inefficiency or imbalances in their portfolio through the balancing markets and grid mechanism.

Project objectives:

This project attempts to create an agent that can beat other strategies from past competitions.

Methodology:

- Predicting usage and production from market participants using modified seasonal autoregressive integrated moving averages (SARIMA)

$$D_{t+n} = \sum_{\alpha=-2}^{\alpha=0} w_\alpha((D_{t+\alpha} - D_{t+\alpha-24}) + (D_{t+\alpha-(24-n)}))$$

$$\text{where } w_\alpha = \int_{i=\alpha}^{i=\alpha+1} \lambda e^{-\lambda|i|}$$

- Identifying ideal customer segments and pricing using statistical analysis of customer usage and models(Fig 1).

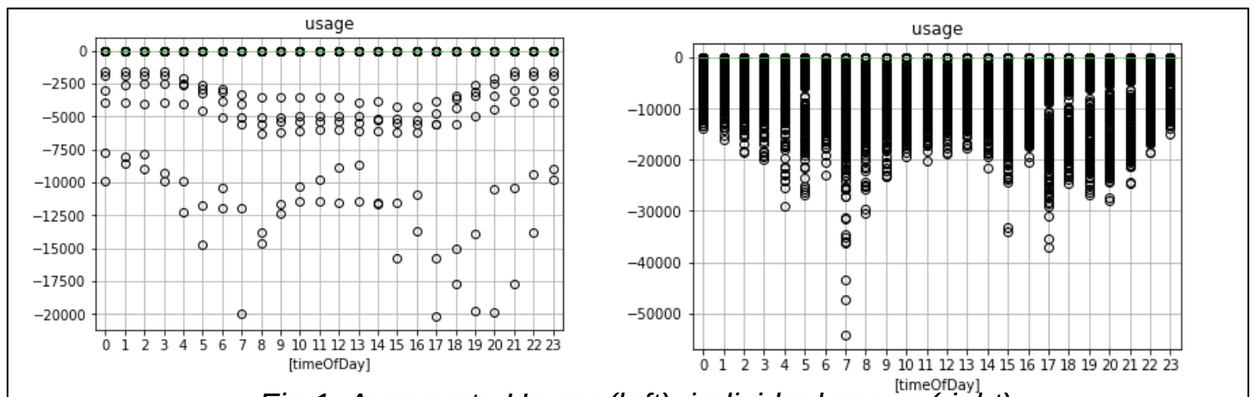


Fig 1: Aggregate Usage (left), individual usage (right)

Results:

By conducting customer data analysis, we identified profitable customer segments and devised a pricing strategy that lures competitors to compete for low profit areas. We win the game in by forcing other competitors to maintain low tariff (left). This was despite the competitors having similar level of energy delivered (right)

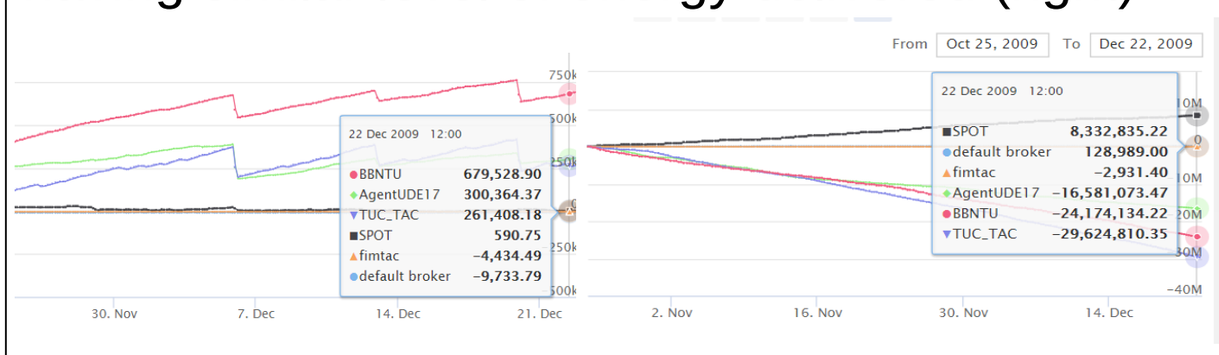


Fig 2: Cumulative Money (Left) and Energy Provided (Right) against time

This was made possible with the addition of efficient portfolio balancing due to accurate prediction of customer usage leading to a lower contribution to overall imbalance compared to other competitors (Figure 3, left).

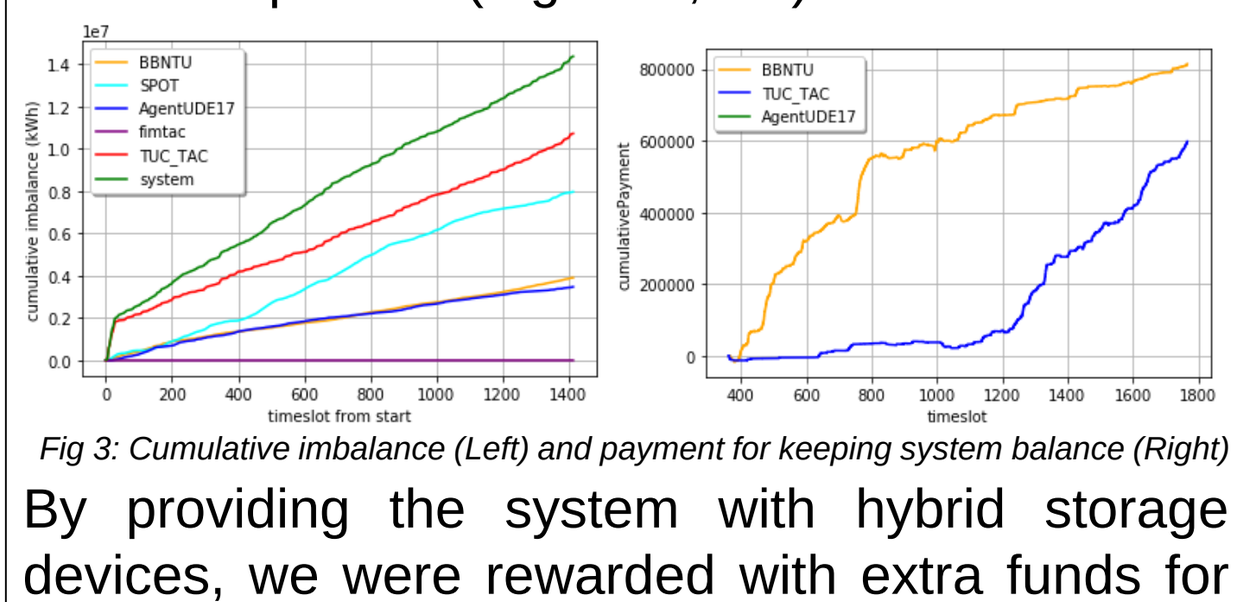


Fig 3: Cumulative imbalance (Left) and payment for keeping system balance (Right)

By providing the system with hybrid storage devices, we were rewarded with extra funds for keeping the system balanced (Fig 3, right).

An interesting by-product of this strategy lies in the maximization of customer's benefit as BBNTU forces the market to compete aggressively for customers at low prices.