EnerPort
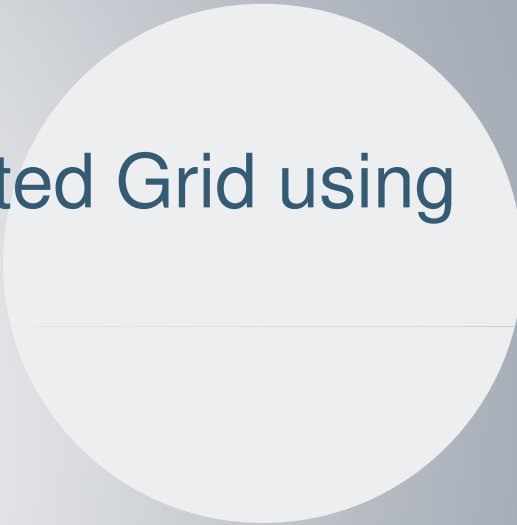
Peer to Peer Energy Trading in the Distributed Grid using Blockchain Technology

DR. SUBHASIS THAKUR

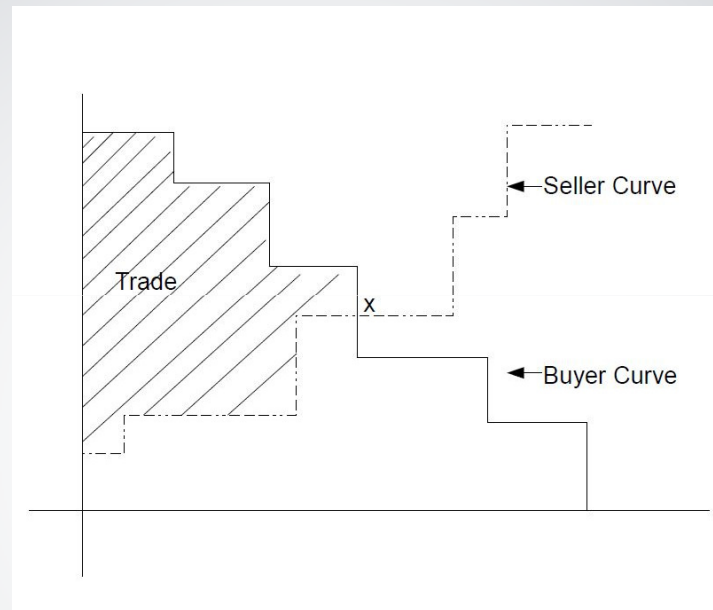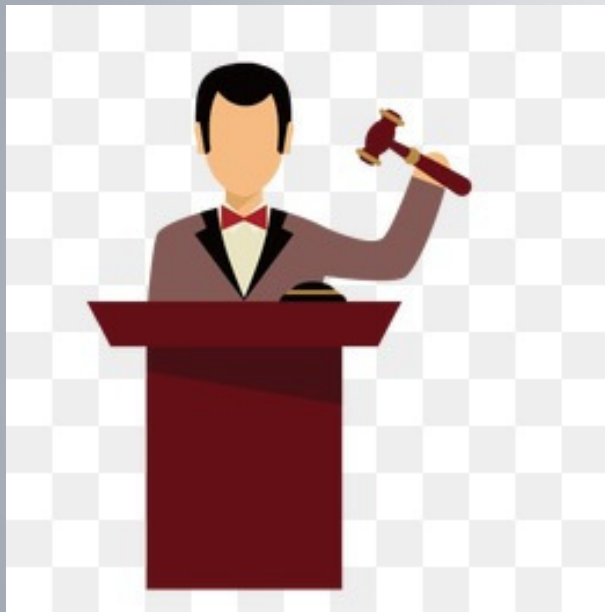INSIGHT CENTRE FOR DATA ANALYTICS, NUIG

SUBHASIS.THAKUR@NUIGALWAY.IE

ENerPort

- **Blockchain based marketplace for renewable energy trade.**

- **Collaboration among NUIG, IERC, Systemlink Technologies, MSemicon and Verbatm**

# Blockchain Based Marketplace : AUCTION

- **Double auction**
- **Winner determination problem**
- **Distributed double auction**
  - **Multiple double auctions.**
 - **Asynchronous execution**

Blockchain Based Marketplace : AUCTION

Result of double auction

Supply token
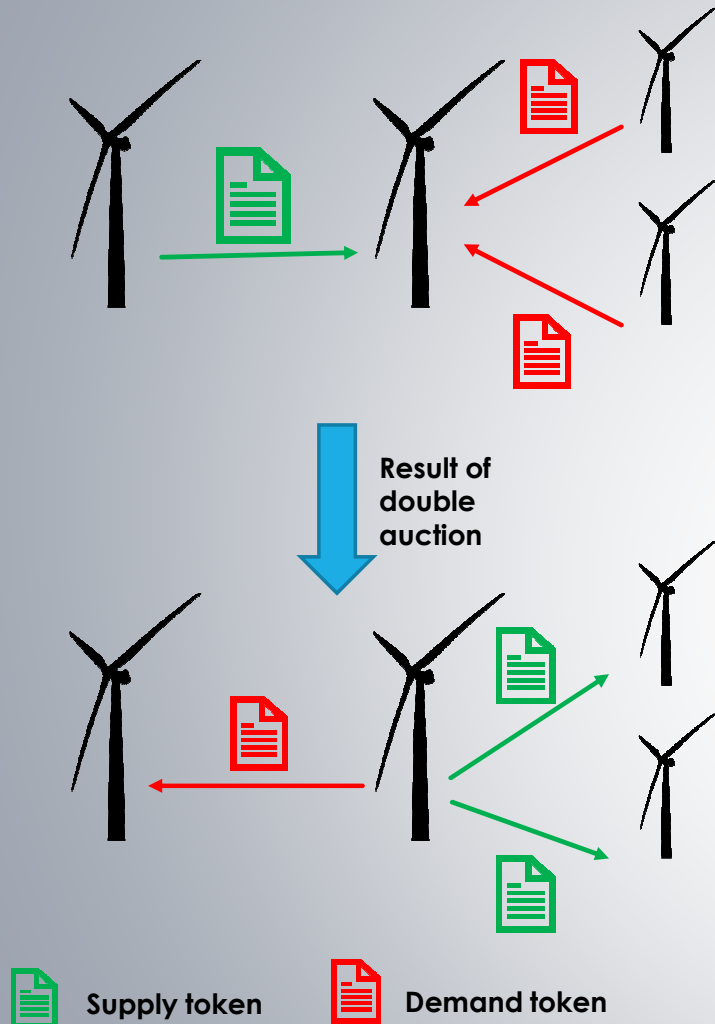
Demand token

- **Microgrids form blockchain peer to peer network.**
- **Energy demand and surplus information are expressed as transactions.**
- **Demand token and Supply Token.**
- **Any microgrid can execute double auction winner determination algorithm if it has unspent tokens.**
  - **If it can not solve the double auction then it forwards the tokens to a neighbour.**
- **Based on the result of double auction, supply and demand tokens are exchanged.**

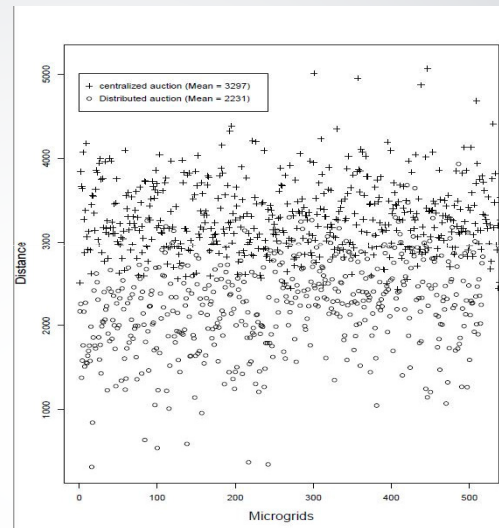DR. SUBHASIS THAKUR, INSIGHT CENTRE FOR DATA ANALYTICS

Blockchain Based Marketplace : AUCTION Results
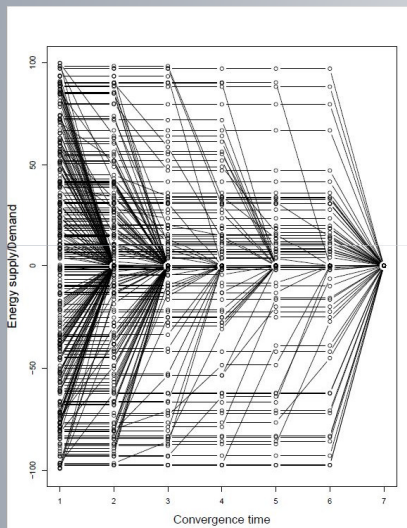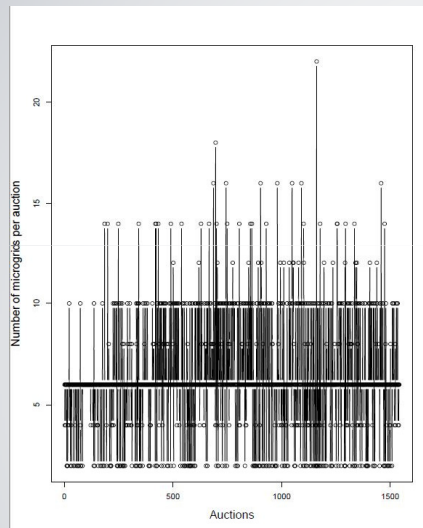

Convergence

Computational load

Distances among matched microgrids

- **Distributed Double Auction converges quickly (80% demands are meet in two steps)**
- **Computational load is evenly distributed and approximately 1-2% of computational load of a centralized auction.**
- **Matches local microgrids for energy exchanges.**

Marketplace using blockchain : Coalition Formation

Coalition 1   Coalition 2
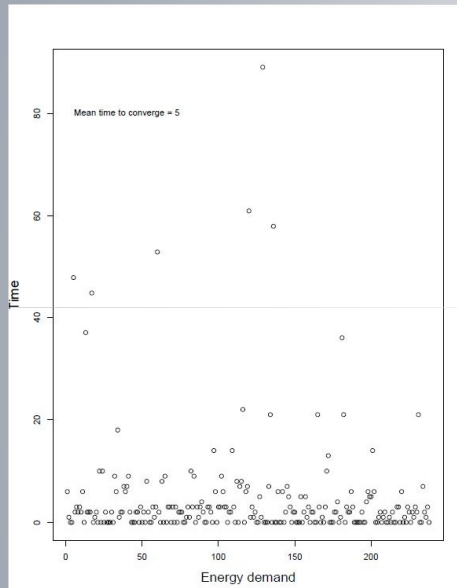
Coalition 3
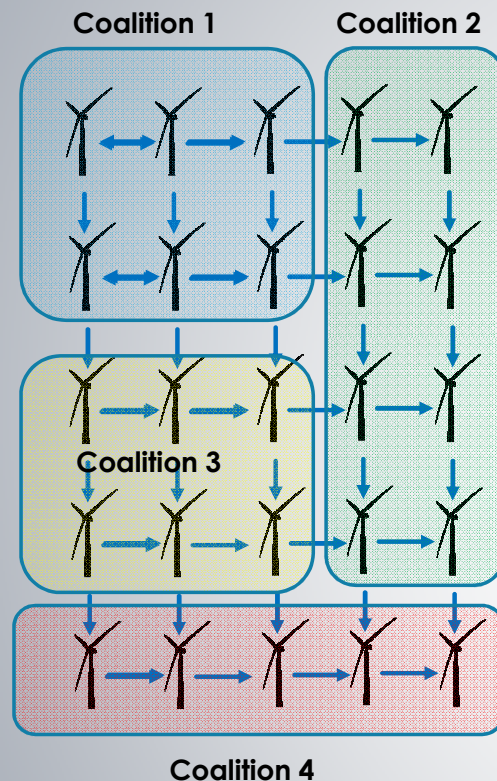
Coalition 4

- **Coalition structure generation = Partition over microgrid network**

- **Microgrids in each group exchange energy**

- **Minimize total energy deficiency or surplus**

- **Stability of the partition**

- **Multiple asynchronous executions of coalition structure generation algorithm.**

# Marketplace using blockchain : Coalition Formation
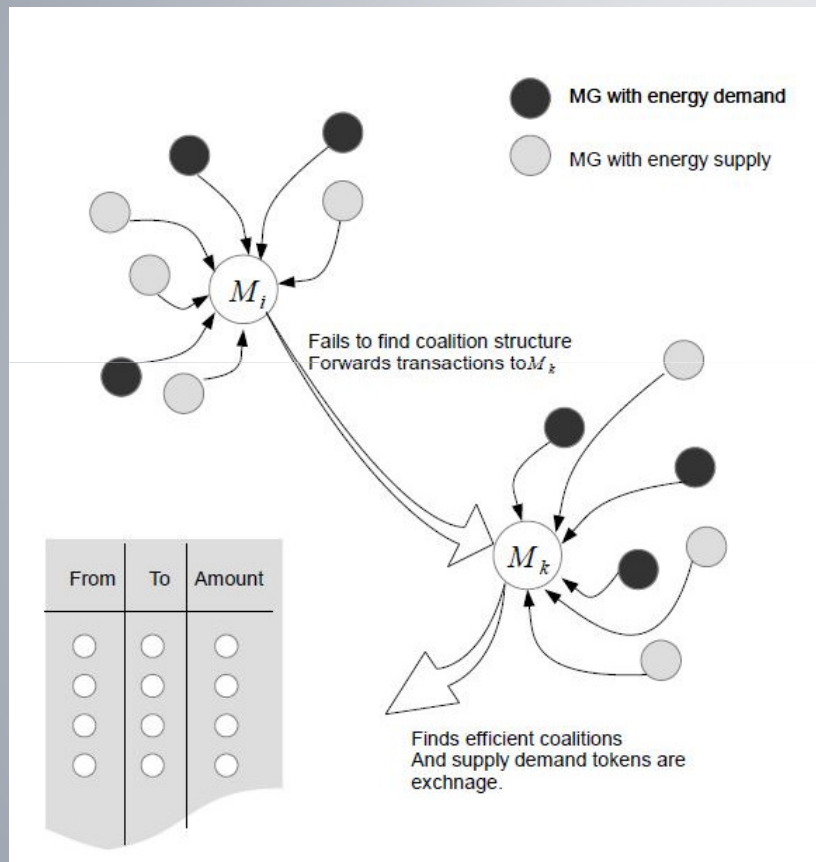
- **Supply tokens and demand tokens.**

- **A microgrid expresses its energy surplus or deficiency as a transaction to a neighbouring microgrid.**

- **Any microgrid will attempt to solve the coalition structure generation problem for its unspent tokens.**

- **If a Microgrid can solve find the partition then it makes token exchange accordingly.**
  - **If it fails then it forwards the transactions to a neighbour.**
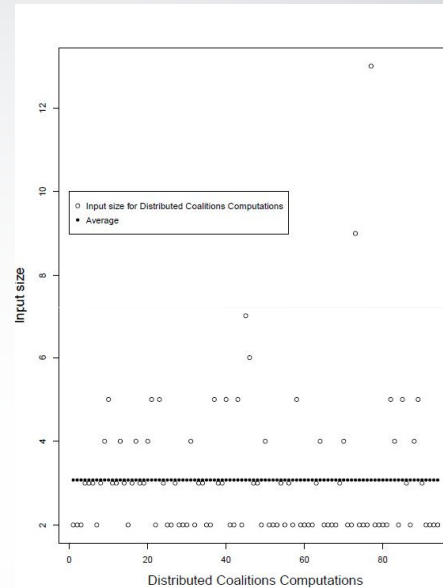
Marketplace using blockchain : Coalition Formation - Results

Convergence
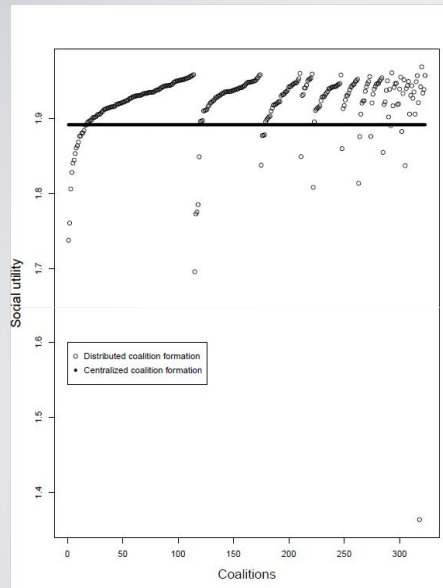
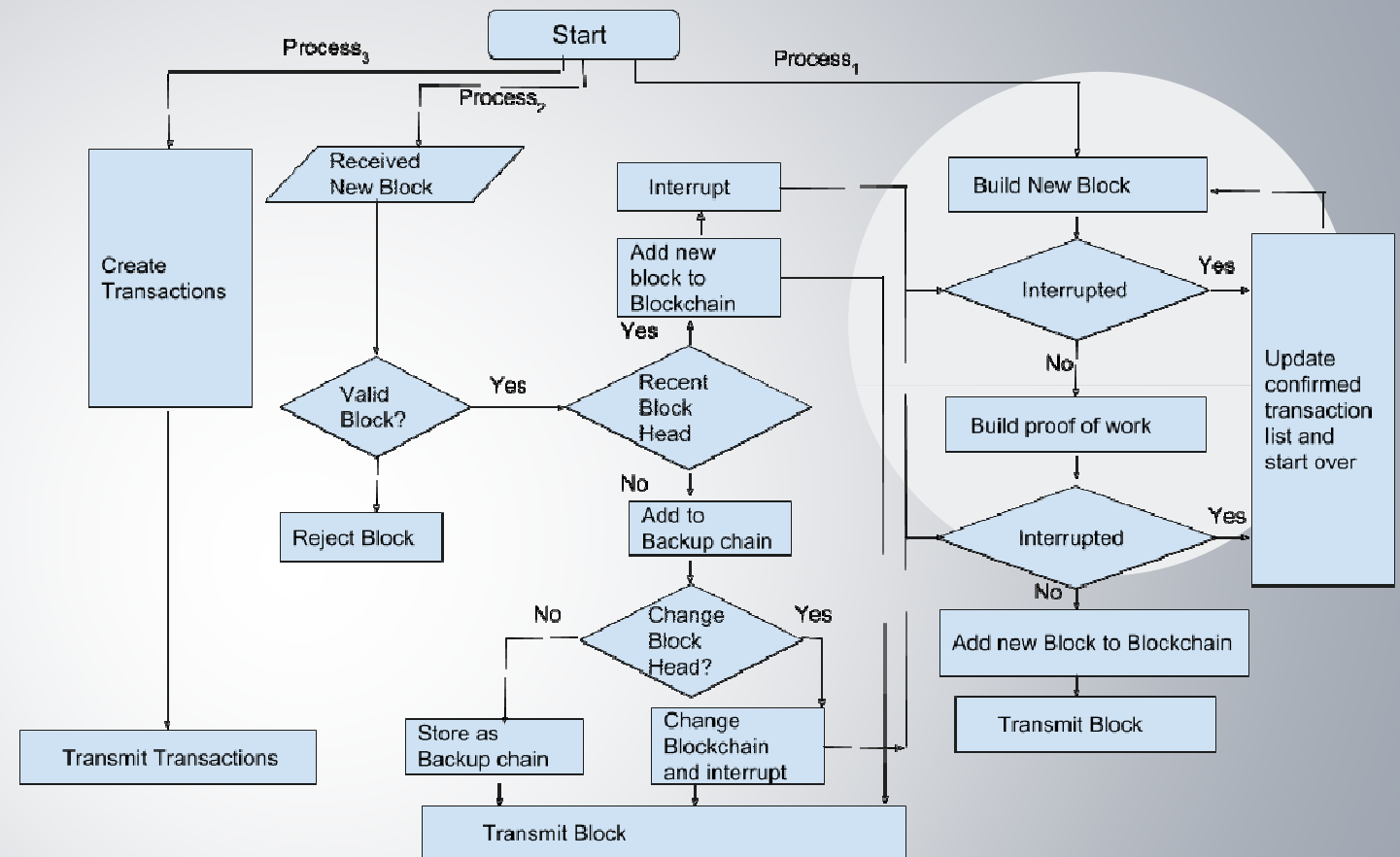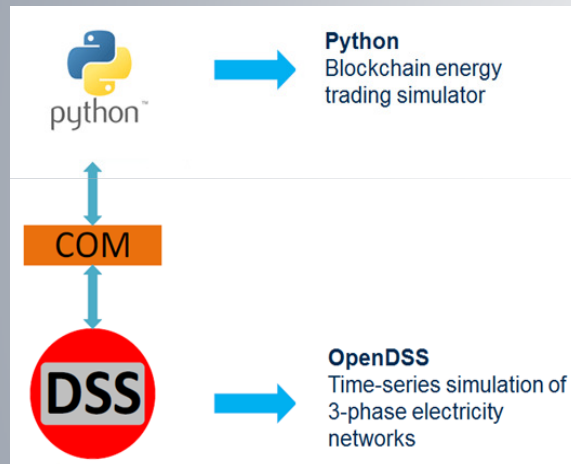Quality of coalition structure

Computational load

- **Distributed coalition structure generation algorithm converges quickly (80% in 2 steps).**

- **More efficient coalition structure generation w.r.t centralized approach.**

- **Computational load is negligible (1-2% of centralized approach).**

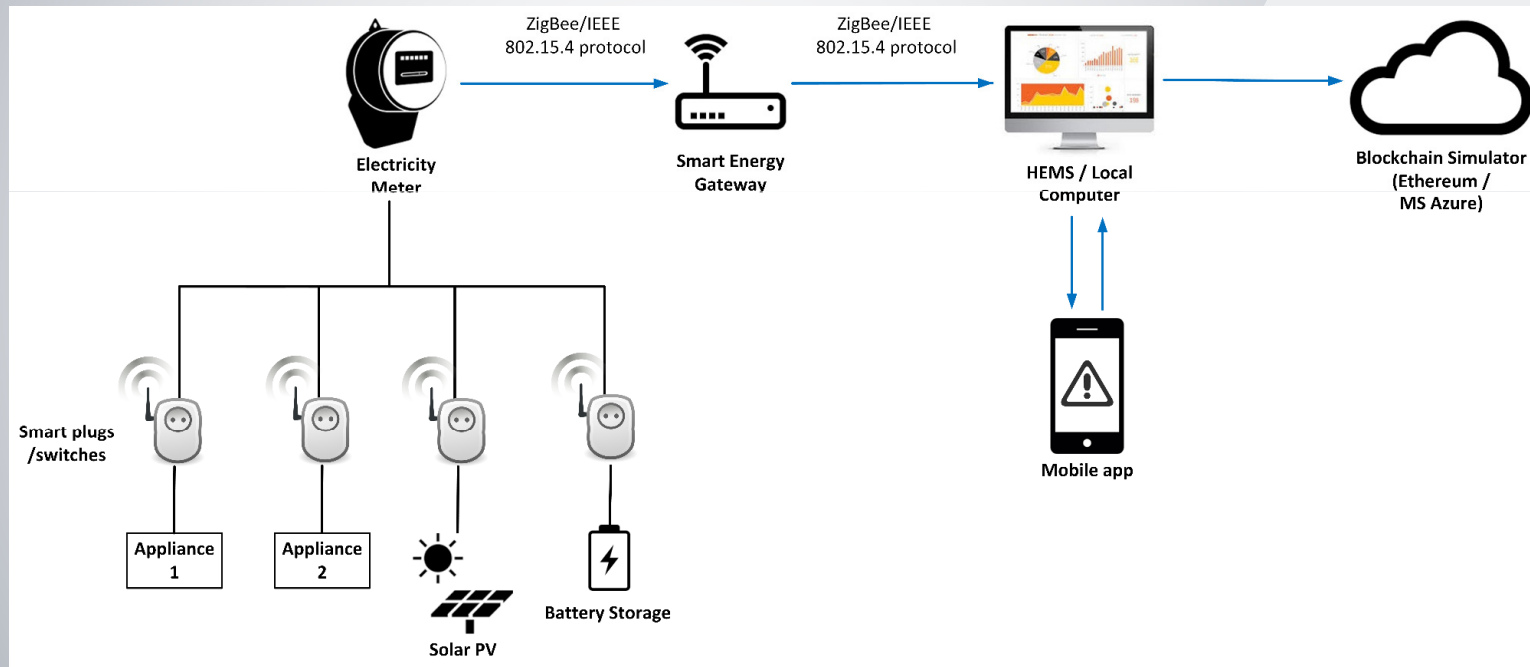# Co-simulation of blockchain transactions and electricity networks

Marketplace using blockchain – Payment System

- Payment via crypto-currency
- Payment in collaboration with energy providers.

Smart Home Bench Demo

Small-scale bench demonstration of P2P-enabled smart home

Figure: Smart home P2P Blockchain trading bench demo architecture

▶ Dr. Subhasis Thakur, Insight Centre for Data Analytics

Blockchain Research @ Insight - NUIG

Blockchain for International Payments

Steal label & introduce fake product with stolen label in Supply chain
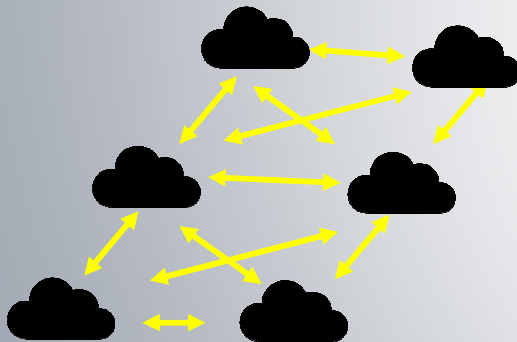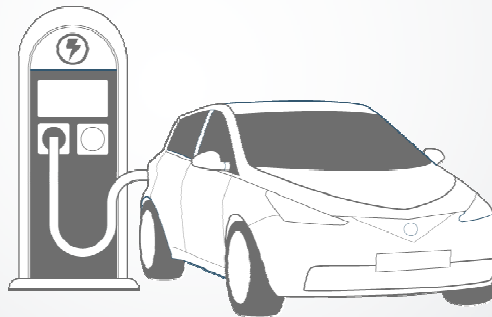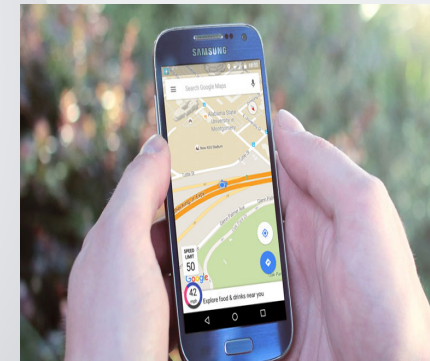
Blockchain for Supply Chain Security

Blockchain for sustainable food supply chain

Blockchain for Multi-cloud, Social Cloud

Blockchain for Electric Vehicles

Blockchain for Crowd-sourcing, crowd-sensing

DR. SUBHASIS THAKUR, INSIGHT CENTRE FOR DATA ANALYTICS

THANK YOU

QUESTIONS ?

DR. SUBHASIS THAKUR, INSIGHT CENTRE FOR DATA ANALYTICS