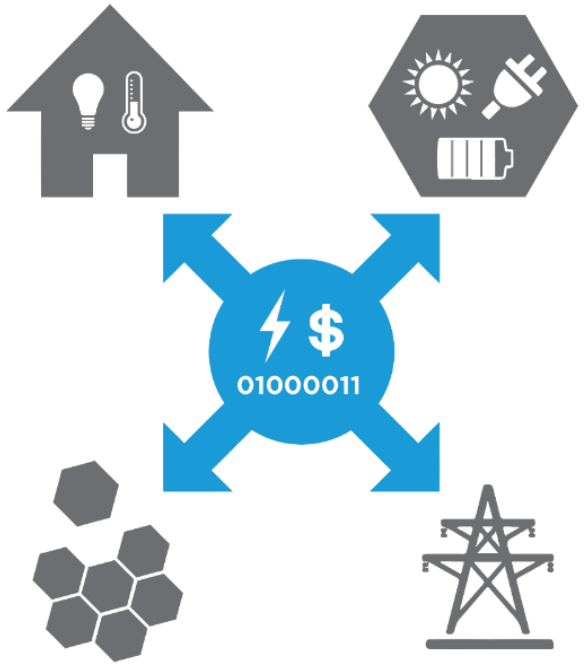
Recipe for a Transactive Energy Implementation for Microgrids



A NIST Transactive Energy Challenge Project

"Transactive Energy for Energy Management in Microgrid Systems"

Presented By:

Jennifer Worrall

Businovation
Breakthrough Thinking by Design℠

EML
The Energy Mashup Lab

TeMix™
Transactive Energy Services

TATA
TATA CONSULTANCY SERVICES

ITEROS

Recipe

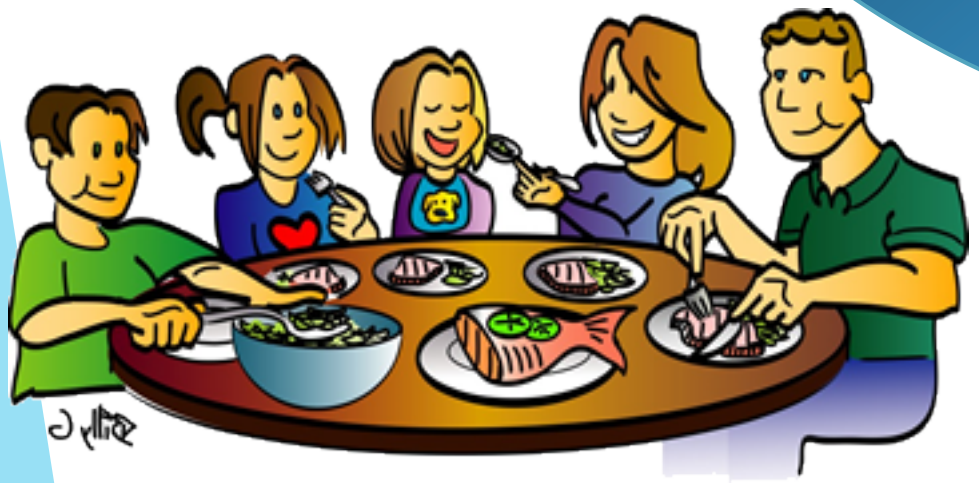
- Style of Cooking
- Utensils
- Ingredients
- Instructions
- Cook Time

T.E. Microgrids ★★★★★

The new T.E. Microgrids in GridEdge Heights serves up the ***tastiest*** energy transactions! We arrived just in time with no reservation and were seated right away at a sun lit window table!

The ***Daily Tender*** menu presented by our Market Maker Ed was chock full of highly liquid, energy-rich offers at reasonable prices. Market Facilitator "Chef" Jennifer sources only the most reliable Energy and Transport ingredients from highly qualified suppliers, several of whom were seated at adjacent tables to us, and delivers her fresh offers with a clearly identified shelf life – never a "stale tender" here at TE Microgrids.

Several offers actually expired *while* we perused the menu and were immediately removed from lack of demand at their initial price point. We eventually went with the plain vanilla 10kWh plate with Carbon REC side, and left fully satisfied after two hours of replenishment.



Style of Cooking

- Common Transactive Services group considered multiple standards-based approaches[1]
  - Similar ***types*** of messages required for each approach (Quote, Tender, Transaction, Delivery)
  - All transactive systems will ***require*** certain components and functionality
  - All transactive systems will have design decisions when creating their market
- Focusing on a TeMIX-style implementation for today's discussion

[1]NIST Transactive Energy Challenge CTS Team. (2016, May) Common Transactive Services Report. [Online]. https://github.com/EnergyMashupLab/TransactiveEnergyChallenge/tree/master/CommonTransactiveServices

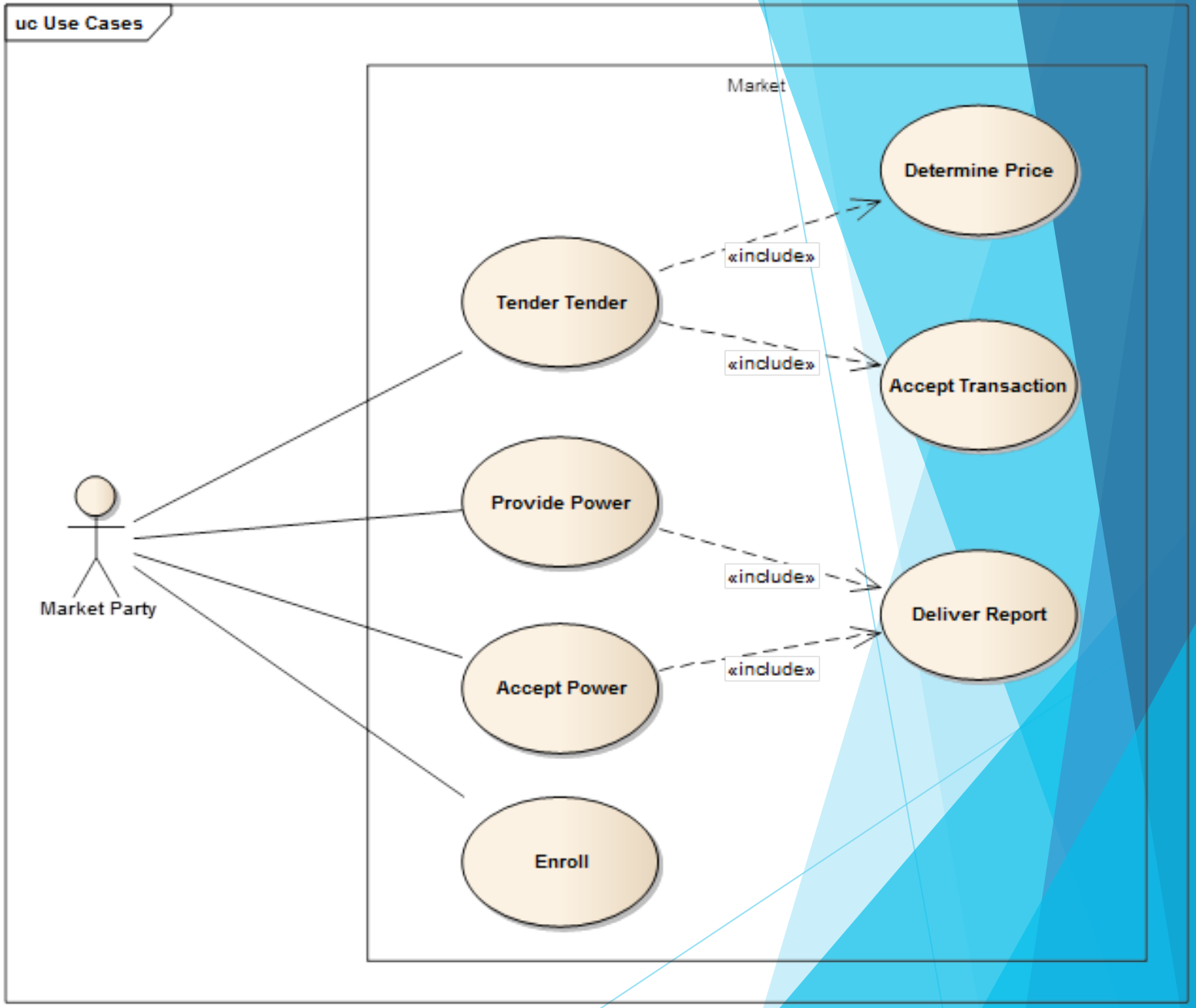
Utensils

Formal software engineering approach used:

- Use Cases
- Requirements
- High Level Design

Future:

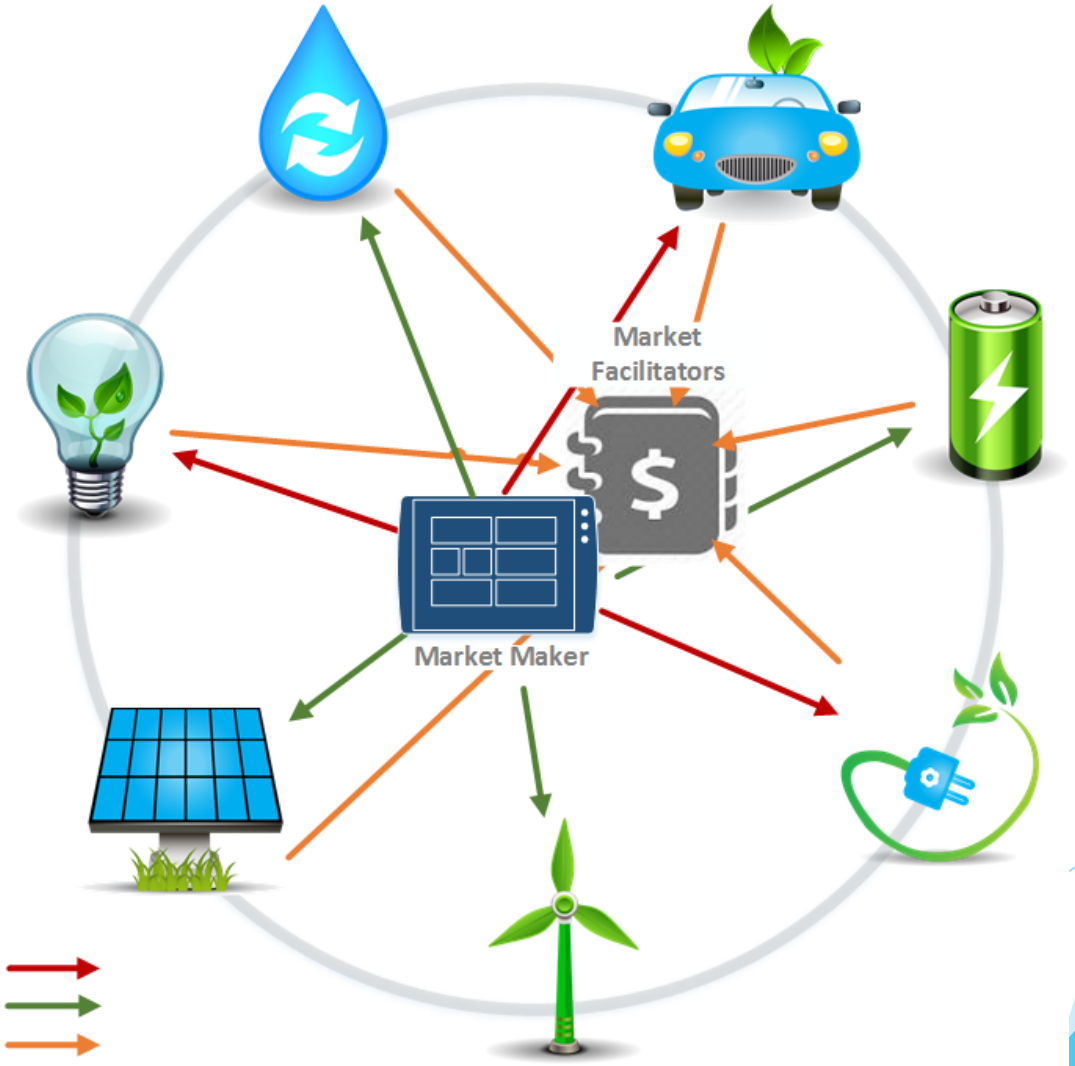
- Implementation
- Test Procedures
- Requirements traceability



Documents available at https://github.com/TransactiveEnergy/microgrids

Ingredients
Elements of a Transactive System

- Market Participants
  - Microgrids
  - Storage Devices
  - Electric Vehicles
  - Internet of Things
  - Utility
  - Etc.
- Market Facilitator(s)
- Market Maker(s)



Ingredients
Market Participants

- Participants must be able to:
  - Forecast usage requirements
  - Determine response to tenders
  - Control usage based on transactions
  - Measure usage
- Technical requirements:
  - Internet/intranet connectivity
  - Create and respond to transactive messages (e.g., CTS, TeMIX, PowerMatcher)
  - Respond to messages in a way that meets the market context

Ingredients
Market Facilitator

- The facilitator must be able to:
  - Authenticate market participants
  - Determine if tenders are valid
  - Records tenders and transactions
  - Determine transaction settlement
- Technical requirements
  - Internet/intranet connectivity
  - Ability to retain transaction records
  - Rule processing for compliance to market context
  - Ledger functionality

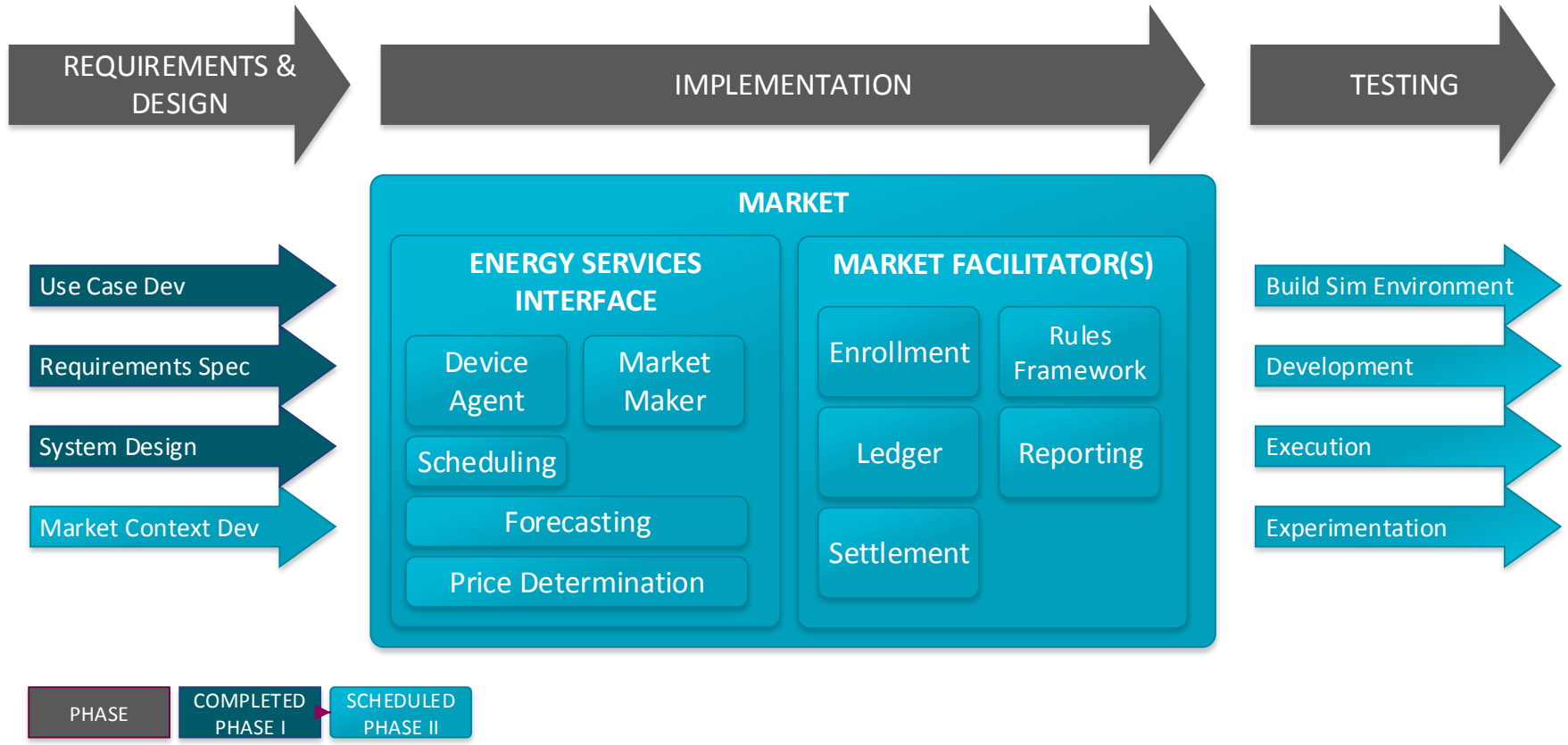
Ingredients
Market Makers

- Specialized type of market participant
- Help with liquidity and stability
- In a TeMIX implementation, market makers frequently send out small buy/sell forward tenders
- Market participants can adjust their position by accepting these small tenders

Instructions
Building the Market Context

- What products can be transacted?
- What is the transaction interval?
- How often are tenders created?

Cook Time



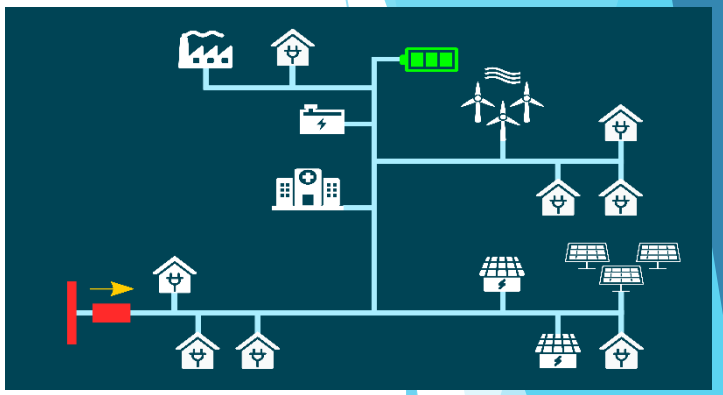
- Finish reference implementation for ESI and Facilitator
- Build simulations
- Implement within a microgrid
- Implement in a grid-connected setting

Case Study #1: Flexible Honeycombed Microgrids using Dynamic Microgrid Configurator

Load, DER Schedules Contingency Scenarios from historical data

Real Time Network Events

Network Constraints Private Microgrid Boundaries



Distribution Network Model

Configuration Repository For Scenarios

Dynamic Microgrid Configurator

Honeycombed Microgrids Configuration

Interfaces to TE Framework
Event and Report Interfaces

Implementation is in progress. A demonstrator of DMC with Event & Report Interfaces has been developed

Case Study #2: Brooklyn Microgrid

- Participants include 130 buildings—including iconic brownstone houses, public housing towers and schools, along with a grocery store, gas station and fire station
- Completely decentralized platform using Ethereum block chain implementation
- Goal is to balance the power and loads among the participants of the grid
- Live on April 11th, 2016

SCIENTIFIC AMERICAN™

ENERGY

A Microgrid Grows in Brooklyn

One New York City neighborhood's efforts to pool local renewable energy sources reflects a larger push toward decentralized power production and consumption

By Morgen E. Peck on April 22, 2016


TeMix™
Transactive Energy Services


EML
The Energy Mashup Lab


TATA
TATA CONSULTANCY SERVICES


Businovation
Breakthrough Thinking by Design℠


ITEROS