IoT is the concept of everyday physical objects being connected to the internet and being able to identify themselves to other devices.
Cheerios floating in a bowl of milk!
CA Electrification Goals

- **SB100**: Renewable energy and zero-carbon resources shall supply 100% of all retail sales of electricity by 12/31/2045

- **SB350**: Increased energy efficiency and electrification of buildings and transport to reduce carbon emissions
Or Electrocution?

- Rapidly increasing *variable* generation with *decentralized* ownership and location and increased electrical demand
  - Millions of *things* that can be both suppliers and consumers
  - Demand is as important as supply

- Grid reliability and stability concerns
  - Traditional DR (shed peak demand) is of limited value
  - Balancing the grid between supply and demand will be really complex
  - How to address reactive power
The Smart Grid

- The digital technology that allows for two-way communication between the utility and its customers.
- Consists of controls, computers, automation, and new technologies and equipment working together.
- Responds quickly to changing electric demand (& supply).
The Union

What is the Smart Grid?

- The Smart Grid
- The Smart Home
- Renewable Energy
- Consumer Engagement

Operation Centers
Distribution Intelligence
Plug-in Electric Vehicles

Home / What is the Smart Grid?
But Wait …

- What exactly are we talking about?
  - Direct control of things?
- If so, what controls what, when, and how?
- If not – and since traditional DR is of limited value – what’s the most optimal information exchange model?
The Shimmy!

- **Shape**: advance notice to things to reshape their load
  - OpenADR event with *price* signals (day ahead or more)

- **Shift**: let things know the best times to use more or less energy (save money)
  - OpenADR event with *price* or *mode* signals

- **Shed**: reduce peak demand for emergency – traditional DR
  - OpenADR event with *mode* signals

- **Shimmy**: requests fast response from the things
  - OpenADR event with *mode* signals
But Wait …

- What about the supply side?
  - What information should be communicated to the suppliers?
  - How do they do settlement?
  - How do they do forecasting?
  - Maybe it’s *Transactive Energy*!
RATES
Retail Automated Transactive Energy System

GFO 15-311 - Advancing Solutions That Allow Customers To Manage Their Energy Demand
Group 2
— Load Management Systems that Facilitate Participation as Demand-side Resources
— Evaluate customer response to Transactive Signals
What is Transactive Energy?

- It’s Block Chain!
  - No, it’s really not

- Most widely used definition comes from PNNL/GWAC
  - “A system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using **value** as a key operational parameter”
Transactive Signals = Price Signals?

- How do we
  - Recoup transportation charges?
  - Represent Reactive Power?

- Since there’s no binding delivery and payment commitment/records
  - Settlement is complicated: for future signals, what’s the actual cost?

- Forecasting is not optimal: relationship between quantity and price is implicit

If there are no “Transactions” anywhere so why even call it Transactive?
The Authentic Transactive Energy

- **Transactions** at specific *locations* on time *intervals*
  - Energy related products such as Real and Reactive Power
  - Transport related products such as two-way energy transport

- **Full lifecycle**
  - Tender (or offer), transaction, and delivery
  - Bidirectional to buy/sell (DER)
  - Settlement does not require baselines and measurement/verification

- **Tariff independent** (Dr. Cazalet)
What’s It Got to Do with OpenADR?

- OpenADR is a known and mature brand
  - The standard for communications between the utilities and customers

- They share many concepts
  - TeMIX and OpenADR are both based on OASIS | eMIX and share many constructs

- Complements OpenADR
  - OpenADR 2.0a/2.0b address Informational and Directive signals
  - Transactive Energy addresses Transactional signals
    - Very important for microgrids/DER

- Regulatory, utility, manufacturer, and ultimately more customer friendly
  - Dealing with multiple standards is costly and confusing for everyone
It's Complex But It's Already Solved!

- ADSI for DO
- TeMix Platform™
- TeMix Agent™
- ISY Portal ™
- EPRI VTN / Group 3
- ISY994 ™
- Smart Meter
- Zigbee™ SEP
- Virtual Assistants
- DER: EV, PV Storage
- NMM, CPUC 21/3, Sunspec, Modbus
- Z-Wave™, INSTEON™ or Other
- HVAC, Lighting, Pool Pumps, Sensors, Things
- Occupancy Geo-Fenced
- Remote Access from anywhere
- Simple Mobile App
- Local Access Tablets/Computers/Touch Panels