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Interoperability for Demand Flexibility (mainly Pricing)

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General Principles

- Interoperability is how the modern world works
  - IT, plugs/outlets, money exchange, …
  - Electricity management is anomalous in poor interop
  - The best things in life are **Simple** and **Universal**
  - This is an essential principal
- California needs to develop the best technology it can - then seek global harmonization
  - We (humans) have done this before with IT
- Any system that is interoperable implements a specific *system architecture*
  - System Architecture is: "**Who** talks with **Whom** about **What**"
  - Coming to consensus on that architecture is a needed step

Structural Foundations (1)

The fundamental mechanisms of **electricity coordination**

- **Energy**
  - What meters measure
  - What prices are for
- **Power**
  - What inverters do
  - Power quality, reactive power, …
- **Capacity**
  - “Size of the pipe”
  - Rarely addressed today







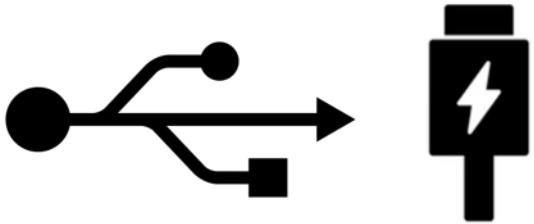
Structural Foundations (2)

- California has identified two architectures - Pricing and VPPs
  - Interoperability needs to assure that both work well
- Customers need to have choice in coordination model
  - Should be able to mix price-optimized and VPP-optimized devices
  - Should be able to change model for any device at any time
- All devices should be able to take in both:
  - Highly Dynamic Prices (HDP)
  - Standard Functional Controls
- Local control (on site) should always be an option

Structural Foundations (3)

- We need to learn appropriate lessons from the success of Internet technology
  - IT delivers massive interoperability at low cost
  - Internet Protocol - foundation - is **one mechanism at all scales and contexts**
- Price is the **only** mechanism that can do this for electricity
  - Any building type, any country, any context, any scale
  - Price must be the foundation
  - Can layer other mechanisms/details on top
- USB today is great example of interoperability
  - Globally harmonized
  - Simple
  - Digitally managed

$/kWh



Highly Dynamic Prices (HDP)

Definition

- Intervals between **hourly** and 5 minutes
- Set no farther in advance than the day before
- **Different every day**

Necessary conditions to be responsive to actual grid conditions

Components

- Electricity **prices** for a forecast period, usually 24 hours
  - May be guaranteed or best-effort
- May include a parallel set of **export** prices

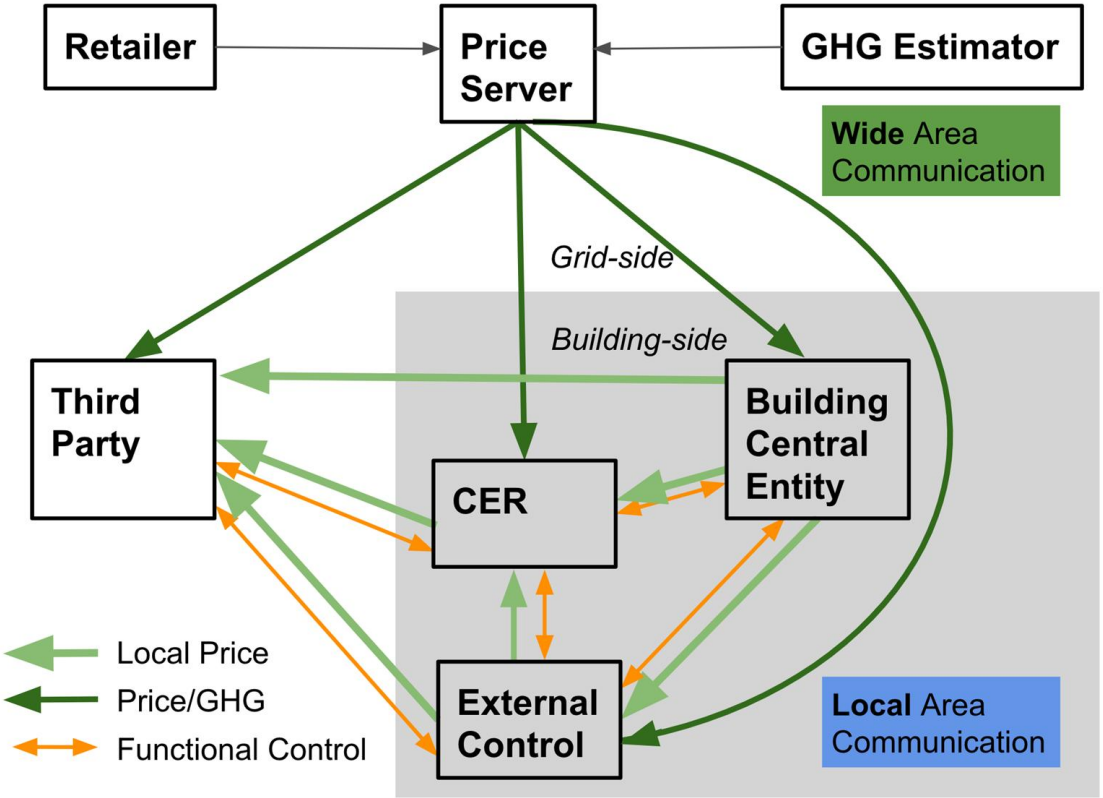
Non-financial

- Marginal **GHG** emissions forecast (also intervals)
- Very occasional **alerts**
  - Grid emergency, PSPS, wildfire, tsunami, air quality, …

Need to constrain Maximum Tariff Complexity

NOT "RTP"

“Price-Based Grid Coordination” (PBGC)



- Data flow to CER / customers is one-way
  - Return is measurements from feeders, substations, …
- Allows innovation in how to determine prices and how CER use them
- Enables multiple locations of translating prices to functional controls
- Building ‘gateway’ not required
  - But really useful

CER: Customer Energy Resource

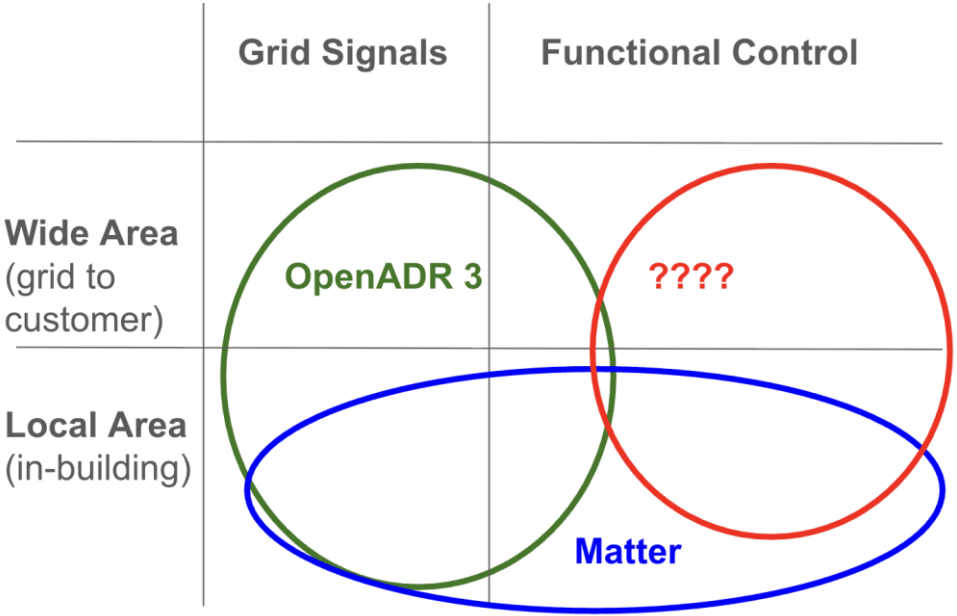
Local Prices

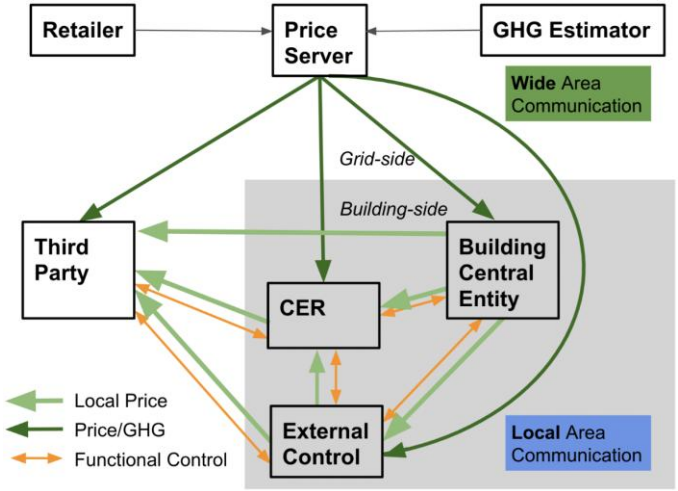
- The *value* of electricity inside the customer site
  — can diverge from the price at the meter
  - Price is a unit of measurement
  - Price can be used in cash exchange - or otherwise; just like meters and kg

- Examples
  - Asymmetric import / export prices
  - Addition of GHG burden
  - Microgrid operation
  - DC power domain
  - Capacity constraint at meter
  - Internal capacity constraint
  - Local generation
  - Peer-to-peer exchange

Protocol Needs

- **Grid Signals** - only about electricity
- **Functional Control** - about device function





- Matter should be encouraged (but not required)
- OpenADR 3 a candidate for wide area functional control

What does OpenADR 3 look like?

- OpenADR 3 designed to be as simple as possible
  - And no simpler
- Simplicity makes it hard to be non-interoperable
  - Complexity facilitates non-interoperability, including unintentional
- Easily extensible

Identification

Timing

Metadata

Content

```
{
   "eventName": "pricingEvent",
   "programID": "44",
   "intervalPeriod": {
      "start": "2023-02-10T00:00:00.000Z",
      "duration": "PT1H"
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         "units": "KWH",
         "currency": "USD"
      }
   ],
   "intervals": [{
      "id": 0,
      "payloads": [{
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         "values": [
            0.17, 0.23, 0.08]
         }
      ]
   },
   ]
}
```

openADR ALLIANCE

California needs (1)

Offer all customers good HDP tariffs ASAP

- No HDP incompatible features
- Sufficient annual dynamic range to be valuable

- Automate devices to existing tariffs (e.g. TOU) ASAP - price servers
  - Existing devices can get routine software update
  - Some will need external control (in-building or cloud)
- Offer only one tariff per customer class — hourly with TOU backstop
  - At least half of all customers would immediately begin to save money and would have incentive to shift more
  - Customers more expensive to serve would continue with TOU

California needs (2)

- No pilots or programs
  - We know how to do price communication / coordination
- Consider reframing FDAS as voluntary / labeling
  - Simpler, faster, easier to get industry cooperation
  - Like Energy Star
  - Mandatory can be considered later
- Begin transition from 2030.5 to OpenADR 3 for inverter management
  - Needed for gateway model for coordination
  - Also use OpenADR 3 for capacity management

Summary

- Keep things simple
- Ensure local connectivity
- Move forward now - no need to wait
- Advance interoperability for both pricing and VPPs

Thank you

