

The Semantics of Price and Price-Responsive Nodes

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Goals

- Understand the semantics of price
- Decouple to divide and conquer
 - Any price stream to any relevant device
 - Transport price streams
 - Loose coupling allows independent evolution
- Enable independent development and deployment of price-responsive devices and facilities
- Support economic interactions



Driving to Grid 2020

Outline

- Semantics of Price
- Price-response architecture
- Price streams and delivery
- Divide and Conquer for fast evolution
- Apply foundational standards
- From Price-Takers to Transactive Energy

Semantics of Price

- Actionable information—make business decisions
- Need to know price and product definition
 - NIST/SGIP PAP03 – EMIX and PAP04 – WS-Calendar
- Price as control
 - Mechanism Design Theory
- Price as price
 - Goal: use “real” prices
- Many dimensions for price semantics

Semantic Dimensions

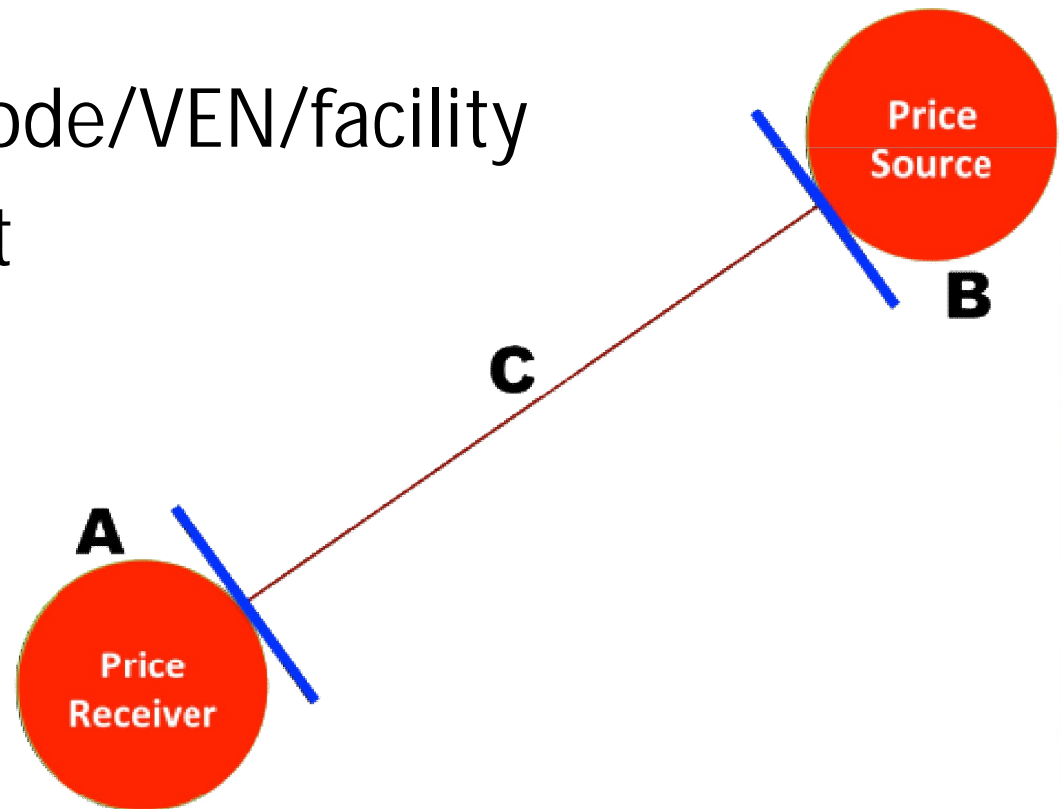
Dimension	Question
Transactable prices	Can I buy or sell?
Actual prices	What do I pay?
Fiat prices	Who made the prices up and why?
Actionable	Is action appropriate using the price?
Time	Historic/Present/Future?
Indicative	Is the abstracted information on direction only?
Certainty	How certain is the price?
Real?	Can I compute economic value with this price or is it abstracted?

Price-Response Architecture

- Support economic interactions (1- and 2-way)
 - Price Distribution and Transactive Operation
- Support independent evolution
- Support Price Streams
- Use standard interoperation
- Build responsive end nodes to take advantage of price-taking and of evolving market mechanisms

Price Streams and Delivery

- Time series of prices = Price Stream
- Separate price stream sources and recipients
 - Independent evolution of Price sources and users
- A: device/node/end node/VEN/facility
- B: price source/market
- C: communication link



Sources and Users of Price

- A: device/node/end node/VEN/facility
 - A receiver for the price stream
 - Can be a price-taker or market participant
- B: price source/market
 - A computed/fiat price (e.g. PNL Transactive Control)
 - A market price
 - A scheduled/tariff/contracted price
- C: communication link
 - Means to communicate price streams
 - Semantics of OASIS Energy Interoperation/OpenADR2

Divide and Conquer

- Decouple
- Which price source?
 - Configuration
 - Discovery
 - Installation/encompassing microgrid
- Which price receivers?
 - Configuration
 - Discovery
 - Broadcast with metadata
- Configuration not code

Independent Evolution

- Independent evolution of the (abstract) ends
 - Apply innovation rapidly
- As more effective price streams are available can use them
- As more effective VEN algorithms are developed use them (see Price-Responsive Devices paper)
- Use standard interoperation and Service-Oriented Architecture approaches

Apply Foundational Standards

- OASIS Energy Interoperation applies SOA to exchanges related to energy
 - OpenADR2 and TEMIX are profiles
 - Uses WS-Calendar and its Streams extension
 - Concepts map directly
 - Easy to implement over any transport
 - EMIX artifacts including price quotes are use in Energy interoperation service payloads
- Standard is free to read, free to use, and in the process of broad deployment
- Connects unlike endpoints with minimal effort

- Processing of a price stream depends on semantics
- Price-taker
 - Communication is by EiQuote service
- Market participant
 - Communication is by EiQuote or EiTransaction
- Transactable prices delivered by EiTransaction
- See TEMIX papers here and in other conferences

Summary and Conclusions

- We have defined semantic dimensions for price
- Demonstrated configuration-based integration
 - In effect, supporting Energy Interoperation “pre-integrates” all of the actors
- Creators of markets and indicia can innovate rapidly unconstrained by the existence and evolutionary state of price-responsive nodes
 - Independent of each other
 - Maximum flexibility by standards-based decouplingt