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# Smart, Secure Charging and Discharging of Electric Vehicles

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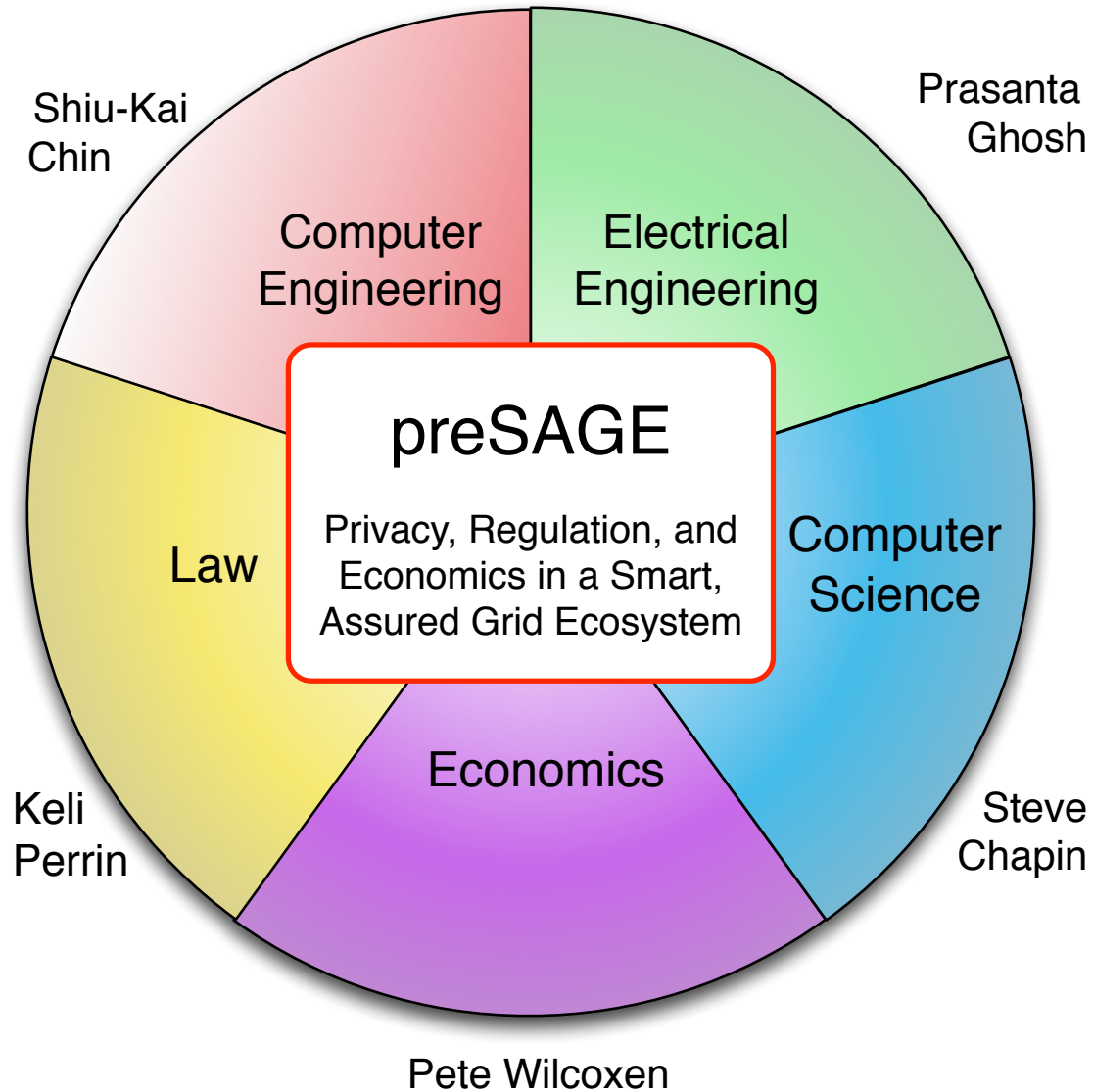
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**EPRI Smart Distribution and Power Quality  
Conference and Exhibition  
June 17-19, 2013**

# Overview of Project

- Short run:
  - To enable EV participation in advanced grid markets
    - Demand response, V2G, storage, etc.
    - Better information for grid operators
  - Consumer acceptance crucial:
    - No smart meter blowback
    - Not just early adopters
    - Overcome fear of BSOD
  - Security: avoid openings for malicious behavior
- Long run:
  - Extend to other components of the grid

# Our Team



# Relevant Properties of Smart Grids



Diagram source: NIST

EPRI Smart Distribution and Power Quality 2013 Conference and Exhibition

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# Guiding Principles

- Joint Control
  - Historical: top-down, hierarchical control
  - Won't play in the V2G space
  - Recognize all entities as first-class peers
- Security and Privacy
  - Minimal information exchanged (privacy)
  - Encryption to restrict access (privacy and security)
  - Strong access control (security)
  - Auditing (reliability)
  - Token-based authentication/authorization (privacy)

**Need to know: everything, only, and when**

# Why EVs?

Mobile

Demand

Joint  
Control



Key smart grid roles

- Storage
- Demand response
- Auxiliary services
- Reduced emissions
- Bidirectional power flow

Distributed

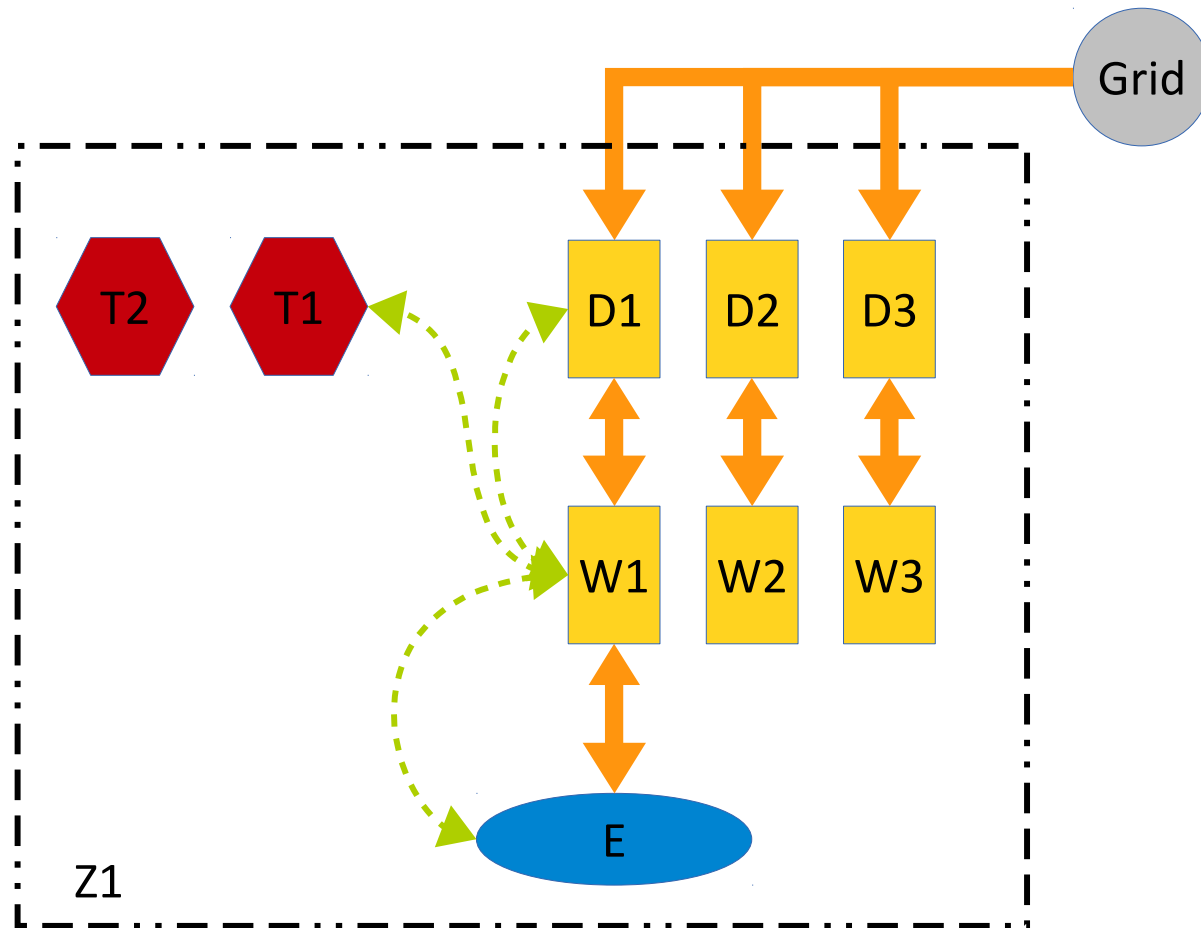
Complex Authentication

Generation

Across Multiple Domains

**Everything else is a special case!**

# Design Architecture Abstraction: Three Classes of Entities



# Principles in action: A Day (24 hours) in the Life of Jackie Bauer

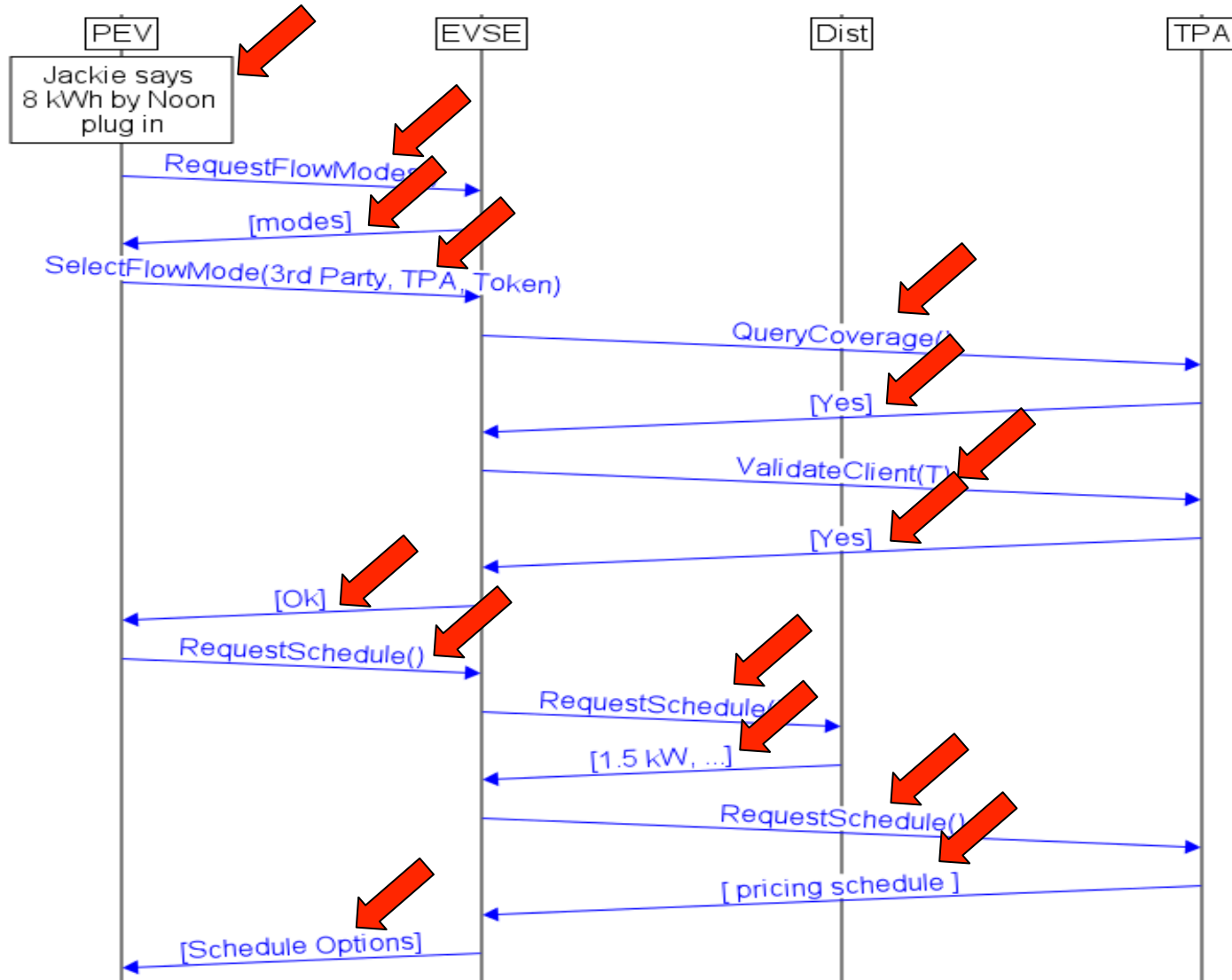
Players:

- Jackie, an EV owner
- Eve, her PEV
- Walter, her work-based public EVSE
- Dan, the Distribution Authority
- Tom, the Third Party Aggregator

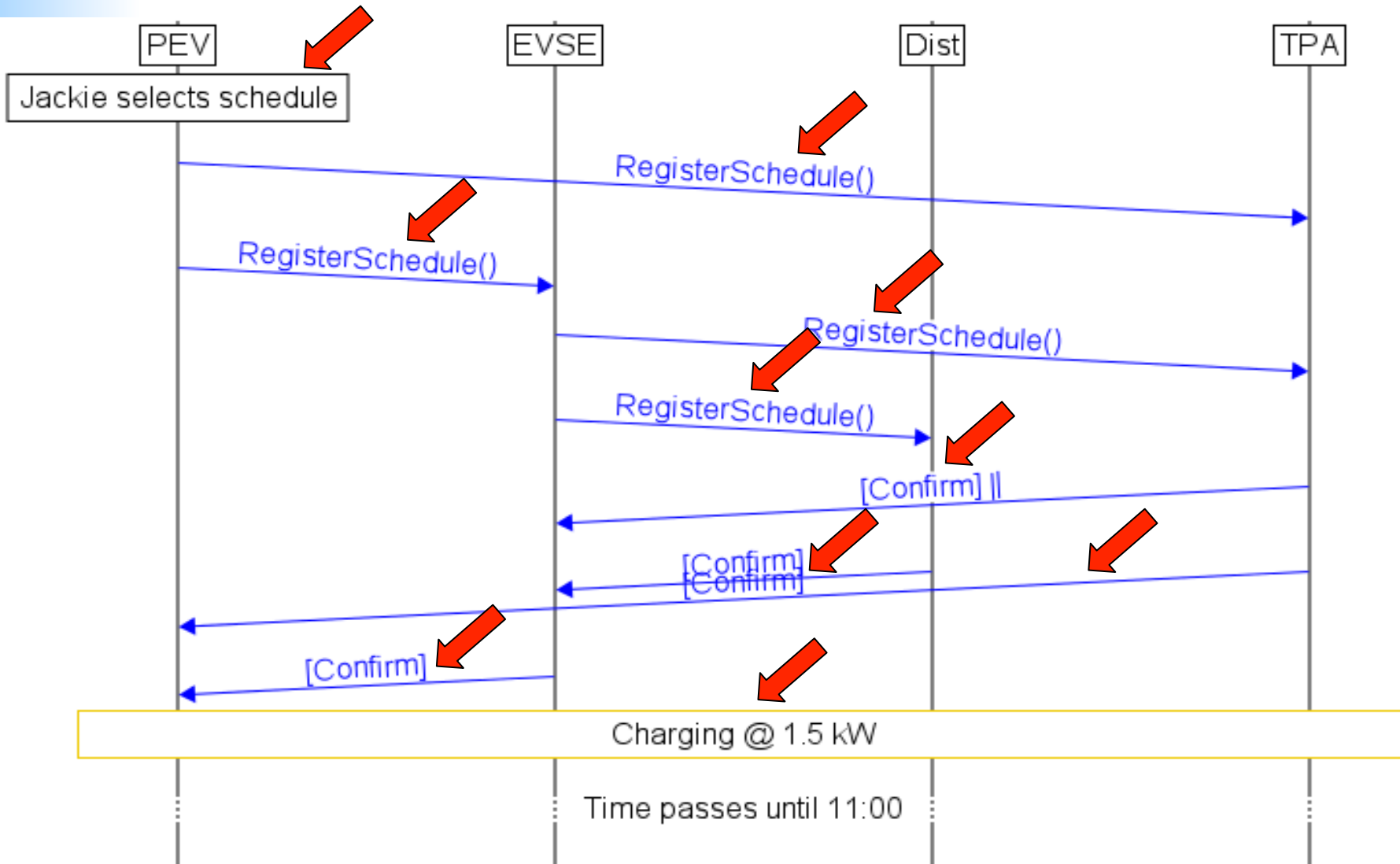




# Step-by-step Example, part 1



# Step-by-step Example, part 2



<http://msc-generator.sourceforge.net> v3.5.4

# Conclusions

- Focus on EVs provides the richest problem space
- Multidisciplinary project team
  - Economics, EE, CE, CS, Law
- Distinguishing contributions
  - Joint control
  - Privacy & security
- Next step:
  - Lab scale demonstration
  - Knowledge transfer & workforce development
- We are seeking feedback and interaction with industry and practitioners (chapin@syr.edu)