



ZigBee Smart Energy

Wireless Glue Networks, Inc.

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Why am I talking to you today?

Wireless Glue Networks, Inc.:

- > ZigBee Smart Energy Logo Certification Test Harness (validated), SE Device Simulator
- > ZigBee Smart Energy RF Module (ZCC-2520-M)
- > ZigBee Gateway/Server middleware GSF
- > Various development kits and modules
- > Java and Javascript for Smart Energy

Myself:

- > Founder of Wireless Glue, CTO
- > Consultant to PG&E on Smart Energy / ZigBee
- > ZigBee Qualification Working Group; specification work
- > ZigBee / HomePlug Certification Working Group Tech Editor

Regulatory Pressures driving Demand Response / Smart Energy

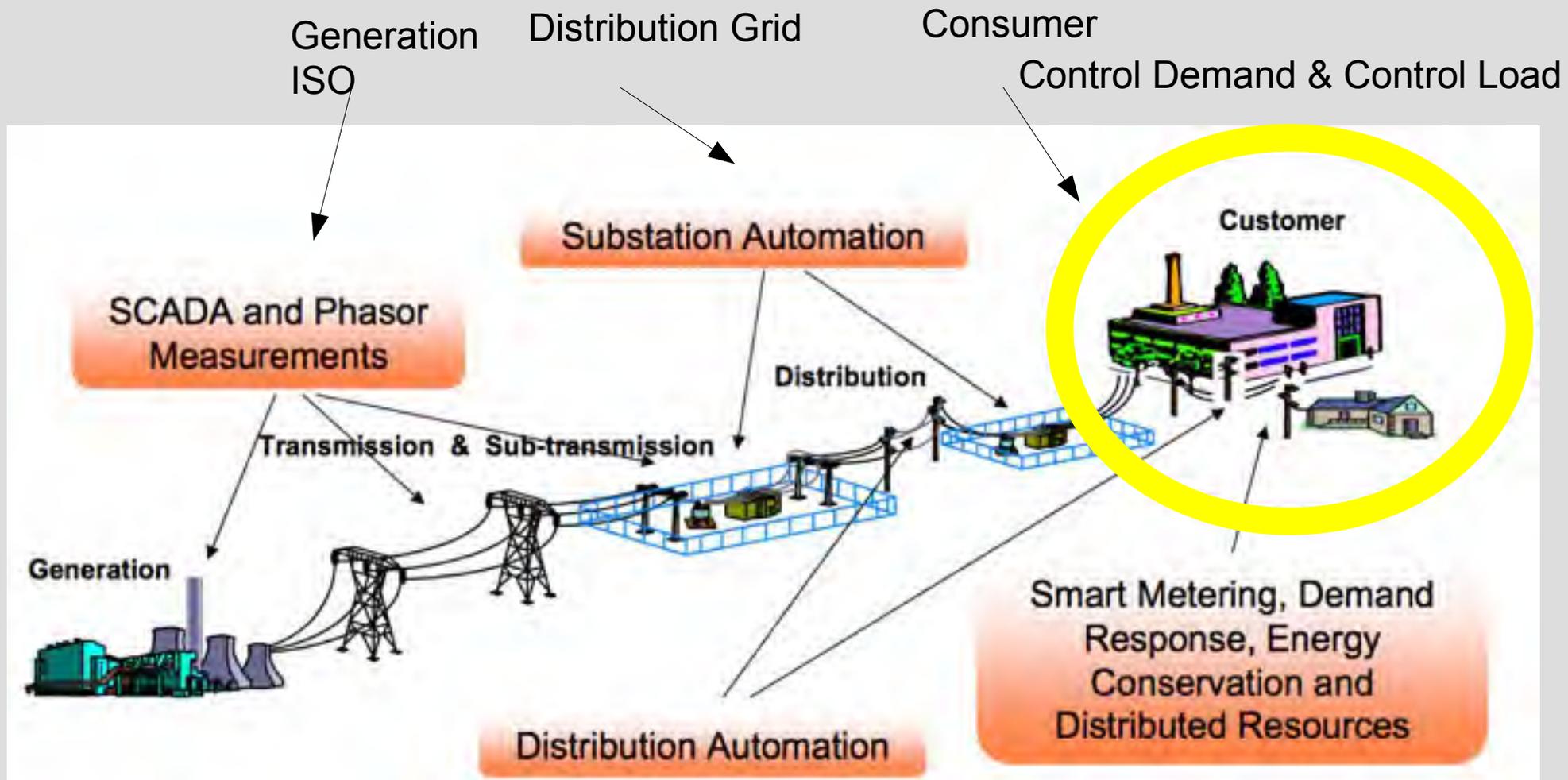
EPACT 2005 -> ENERGY INDEPENDENCE AND
SECURITY ACT 2007 TITLE XIII- SMART GRID

Section 1307 States will implement PURPA:
Public Utilities Regulatory Policy Act
CA PUC requires implementation starting 2010: PG&E, SCE, SDG&E

2009 -> Obama Administration
“Initial Implementating Guideline for the American Recovery and
Reinvestment Act of 2009

Ongoing -> NIST Interim Smart Grid Standards Interoperability Roadmap
Workshop 4/28-4/29 in Washington DC
NIST Interim Smart Grid Standards Interoperabiltiy Roadmap
Summit 5/19- 5/20 in Washington DC

System Overview



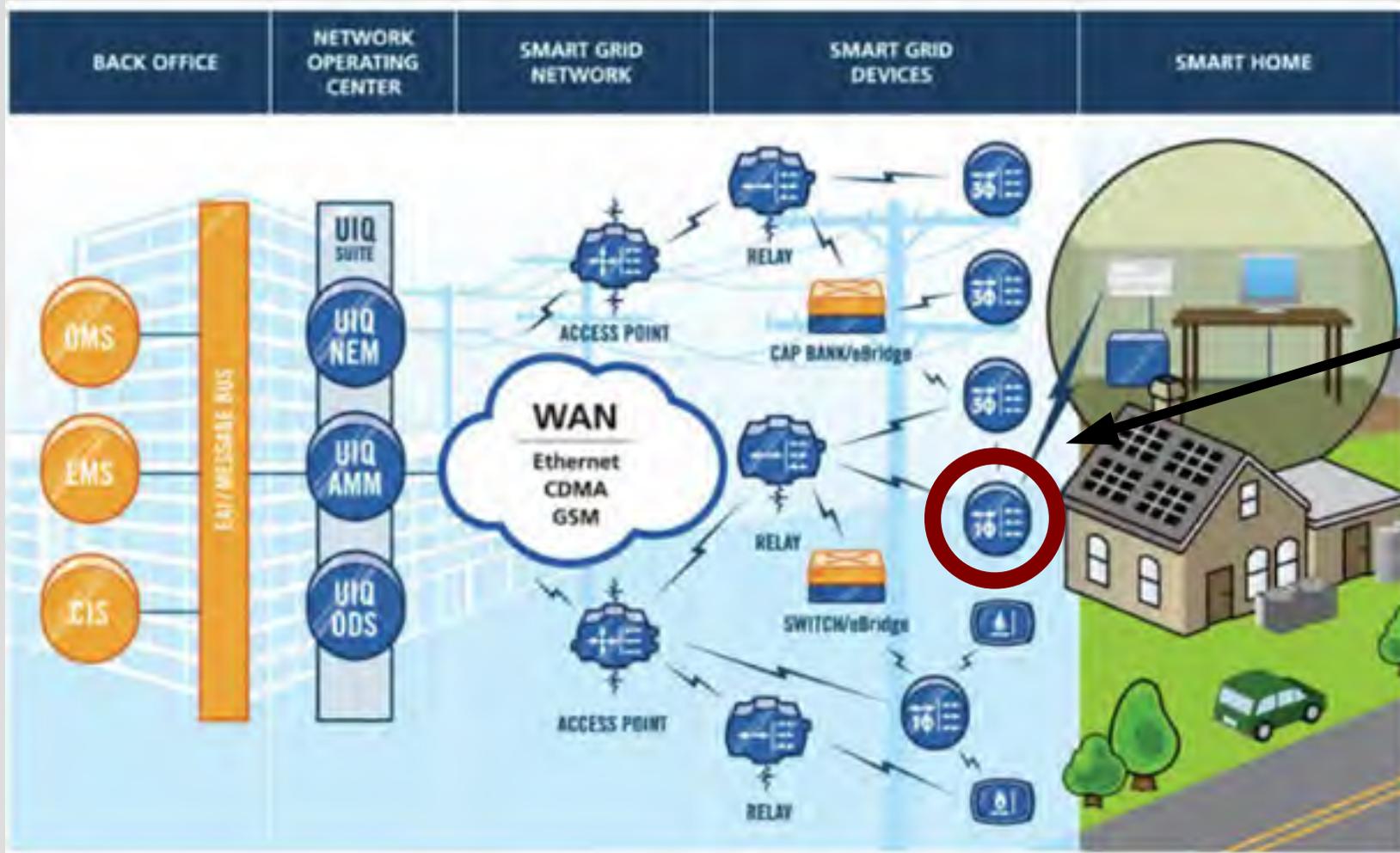
What PG&E is doing



SmartMeter Program Highlights

- ▶ Largest planned implementation of AMI technology in the U.S. to date – 10.3 million meters
 - ▶ \$1.7 B in funding (CPUC, July 2006); additional funding request pending before the CPUC
 - ▶ 5 year deployment: 2006 – 2011
- ▶ The program will pay for itself through operational savings, demand response, and energy efficiency
 - ▶ Among the first critical peak pricing programs for residential customers in the nation
- ▶ The **SmartMeter** project continues to take advantage of evolving technologies
 - ▶ We are moving toward our vision of the Smart Electric Grid
- ▶ Technologies deployed through the **SmartMeter** program establish a platform for future innovations that will benefit our customers, our operations, and the State of California

Silverspring Networks system being deployed by PG&E



5.3 m
ZigBee
radios

Focus on household devices: utility owned HAN network

**IOU: Investor Owned Utility-- UtilityAMI
openHAN requirements published in 2007**

(2009 – OpenHAN, OpenSG - UCA)

openHAN requirements became basis of ZigBee “Smart Energy” (SE)
Application Profile



ZigBee Alliance completes
the Smart Energy certification program
May 19, 2008

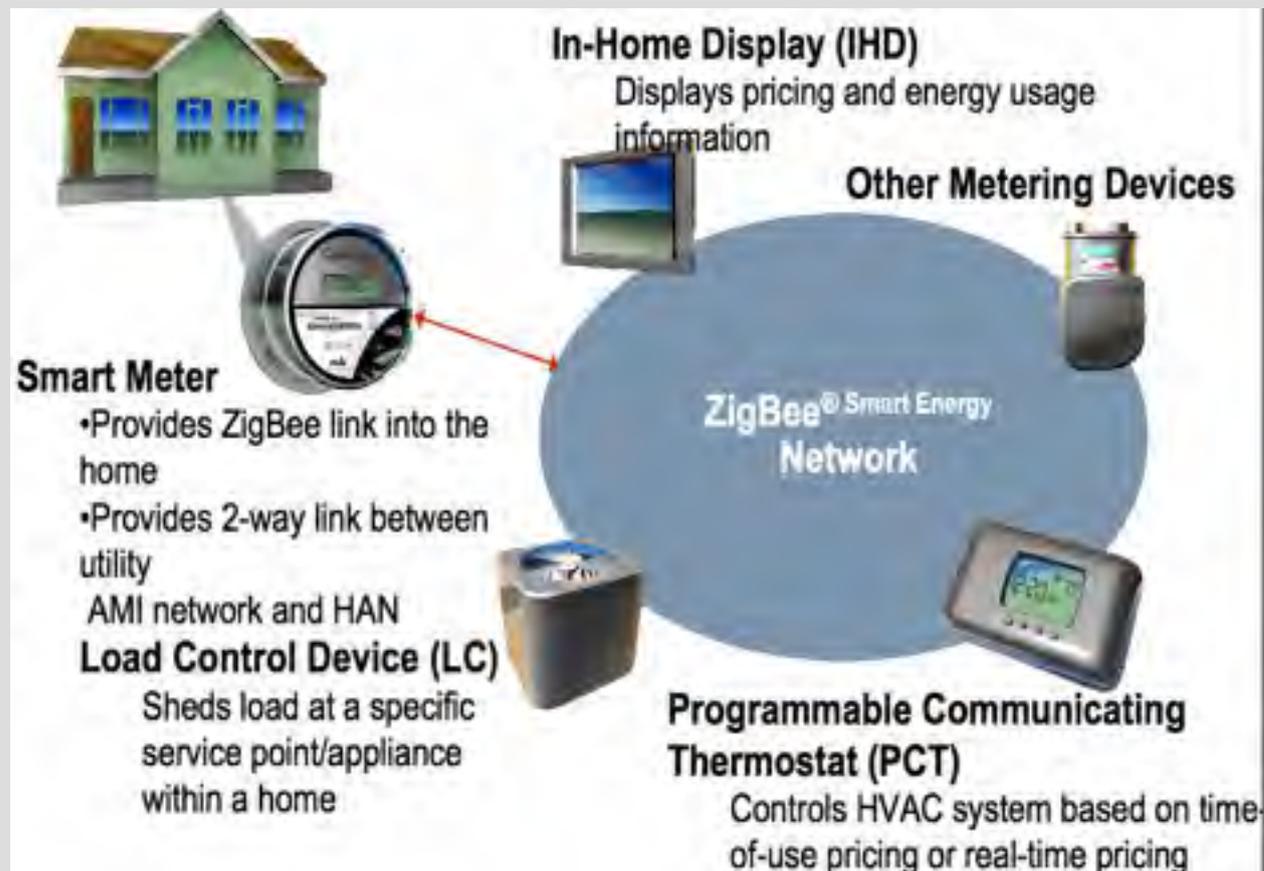
Energy Service Portals, Meters, PCT, In Home Display

Itron, Landis-Gyr, Trilliant, Comverge, PRI, LSR, WGN, Tendril,
Computime, etc. receive first Smart Energy Logo Certification

Basic System centered on Demand Response/ Load Control

SMART ENERGY 1.0: ZigBee Technology

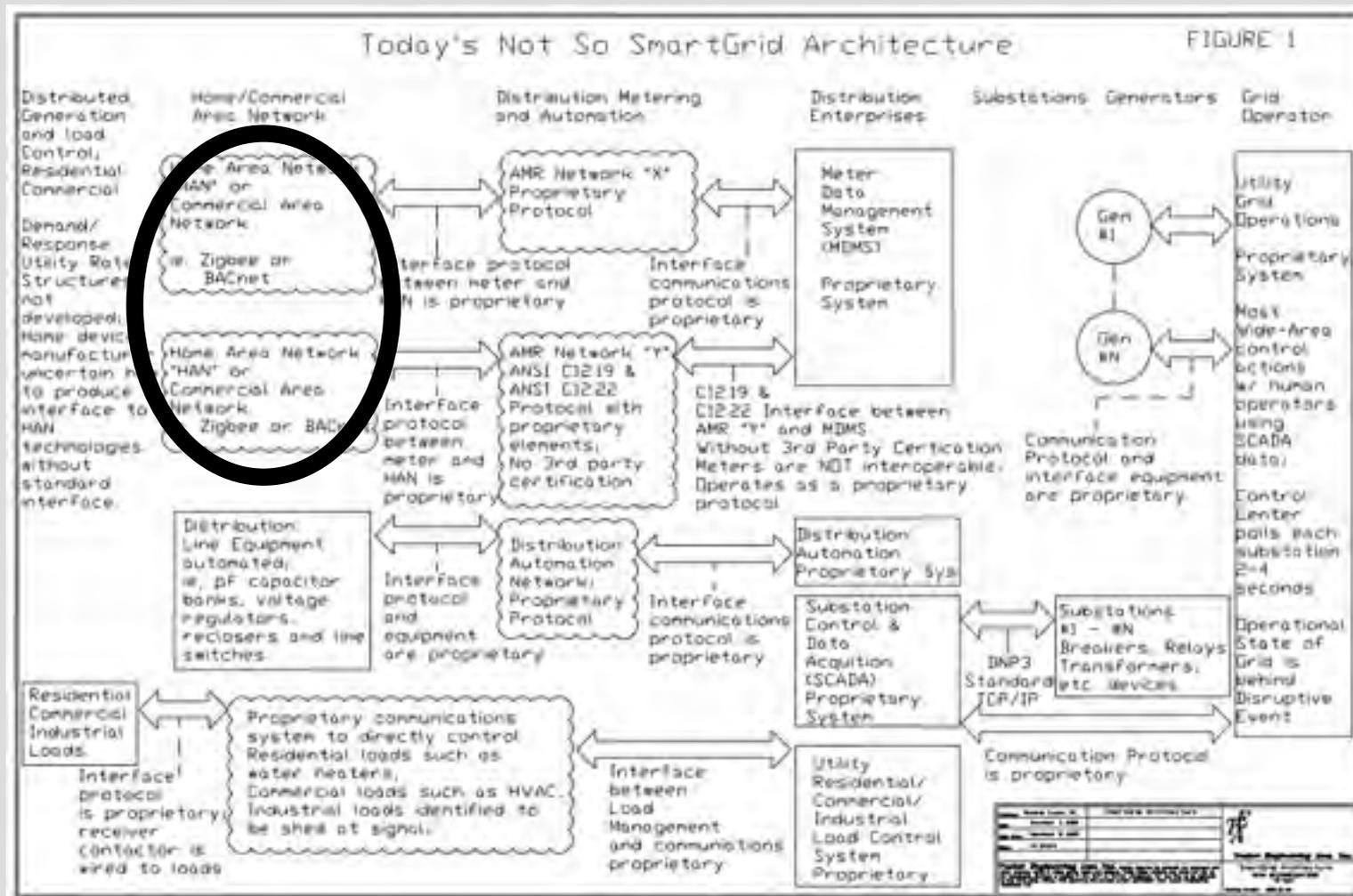
It's a start; implementation is still fragmented across the US



Basic System centered on Demand Response/ Load Control

SMART ENERGY 1.0: ZigBee Technology

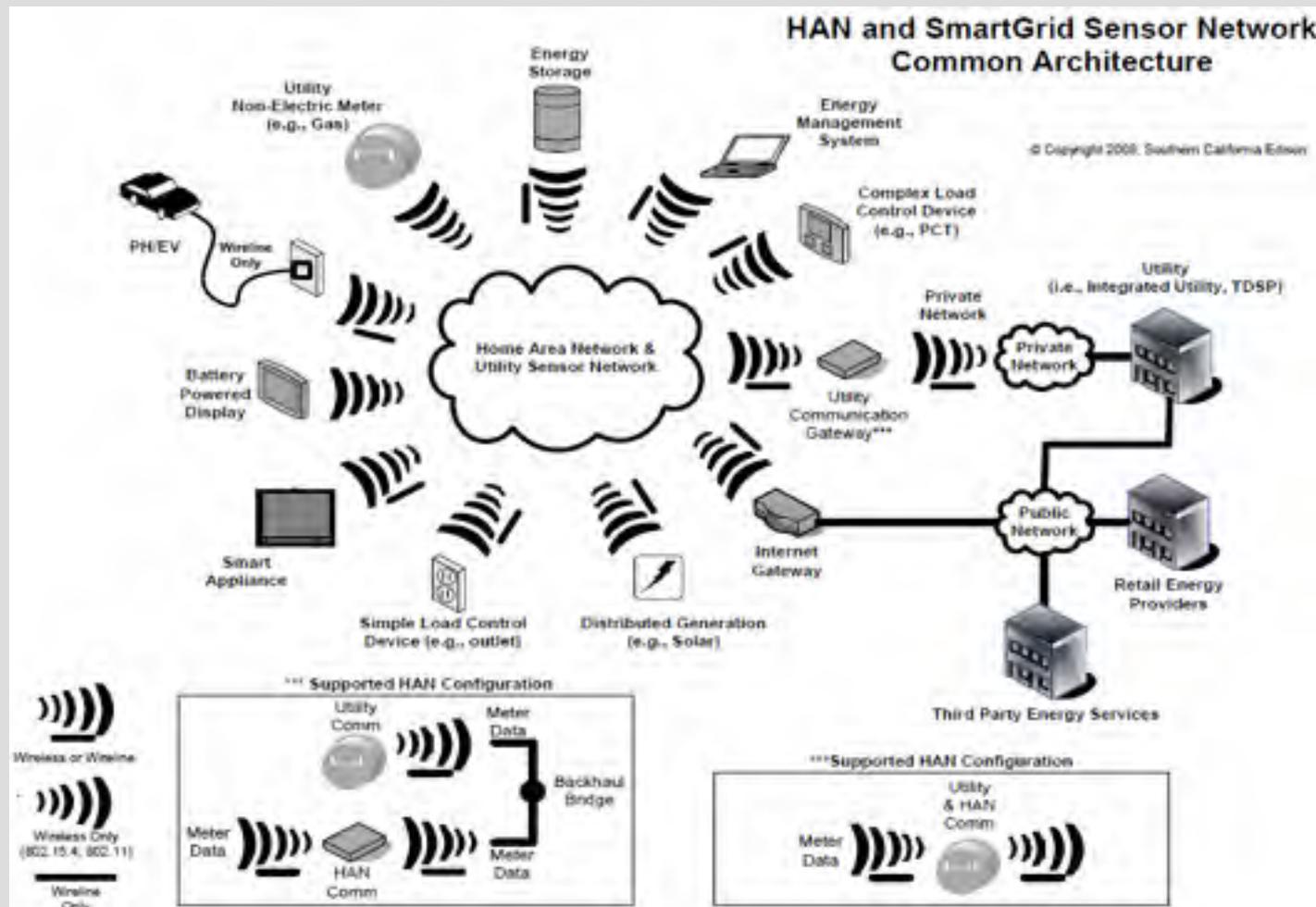
It's a start; implementation is still fragmented across the US



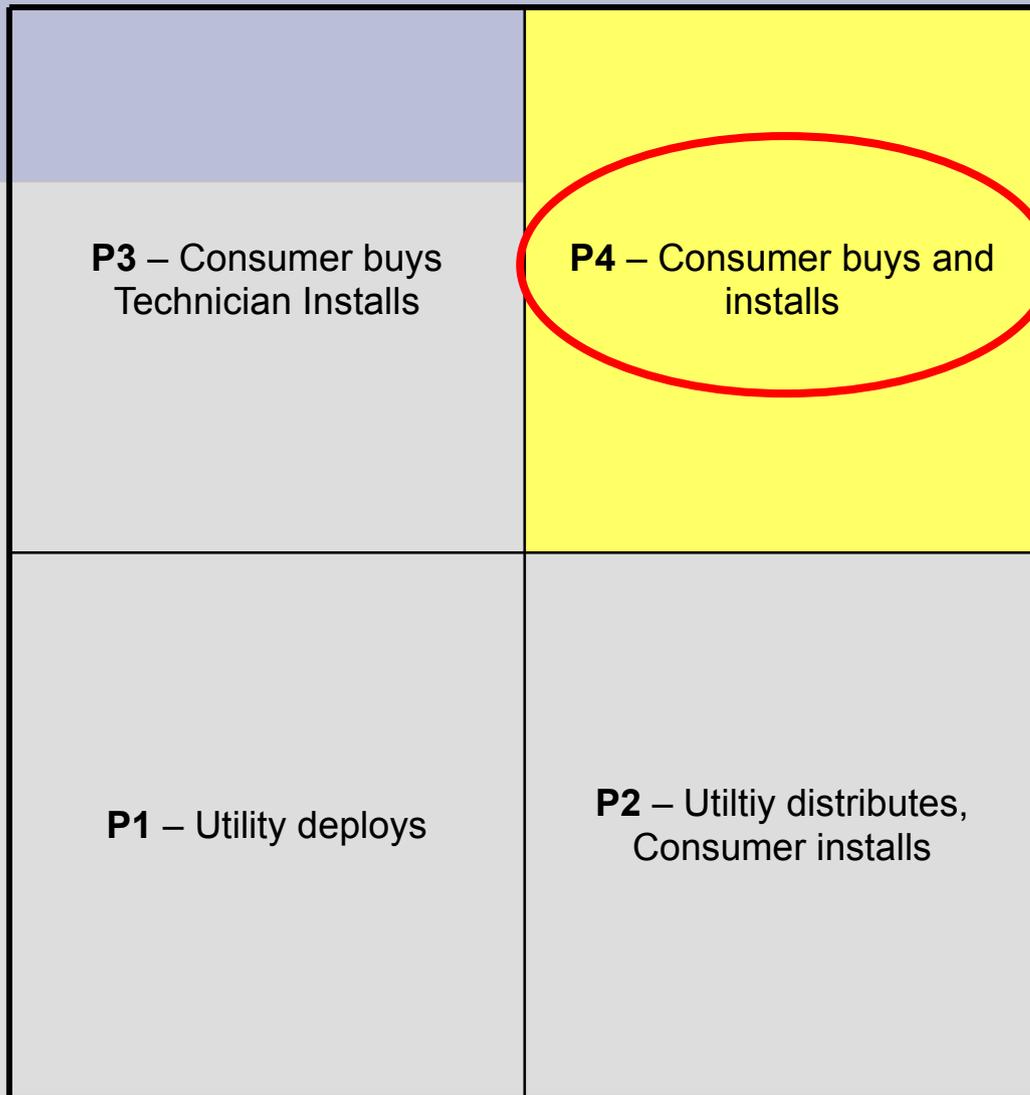
Wider range of devices

SMART ENERGY 2.0: ZigBee + HomePlug

This is the intent: widespread adoption as method for Smart Grid into homes



Smart Energy 2.0



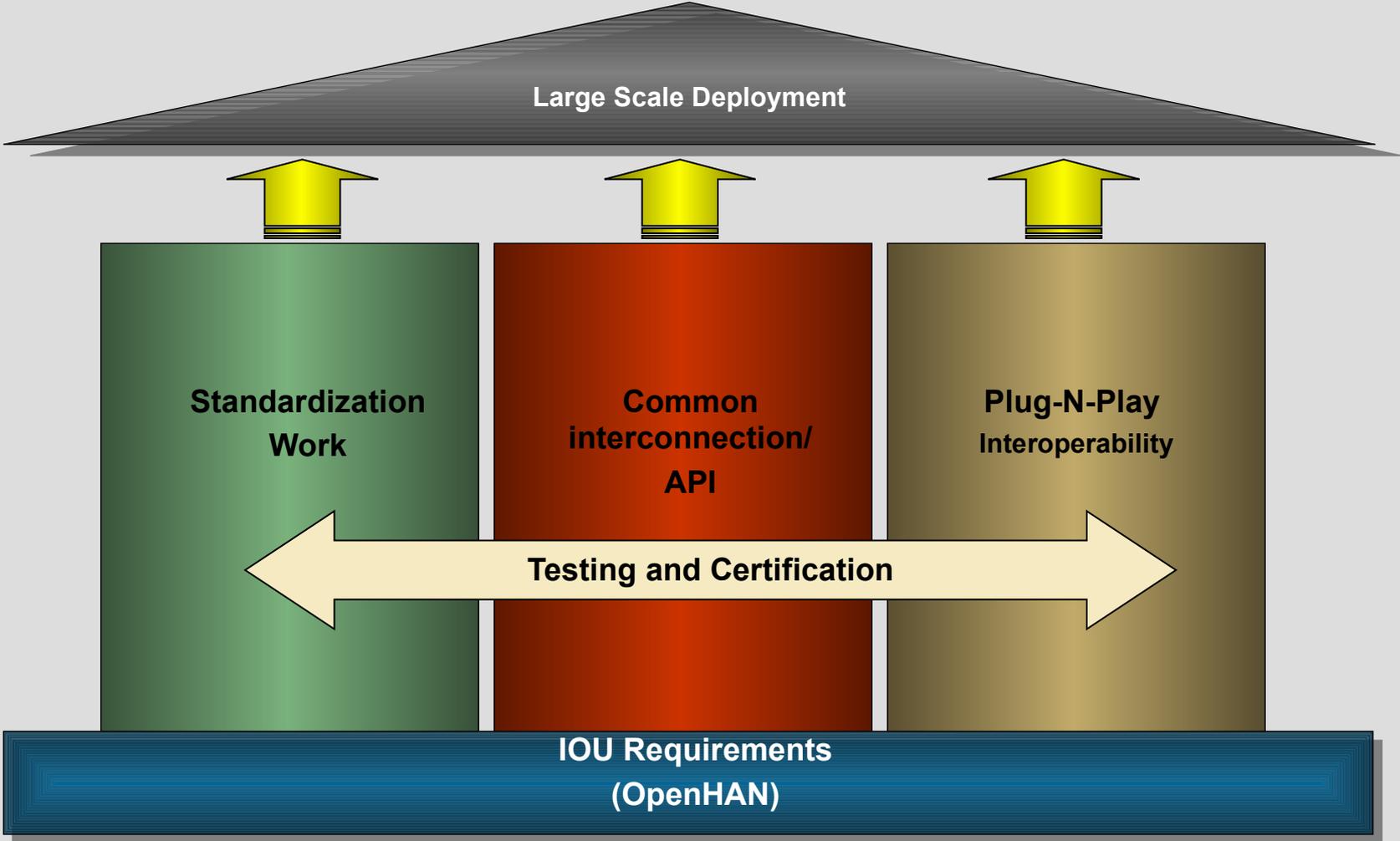
Utility Installation

Consumer Install

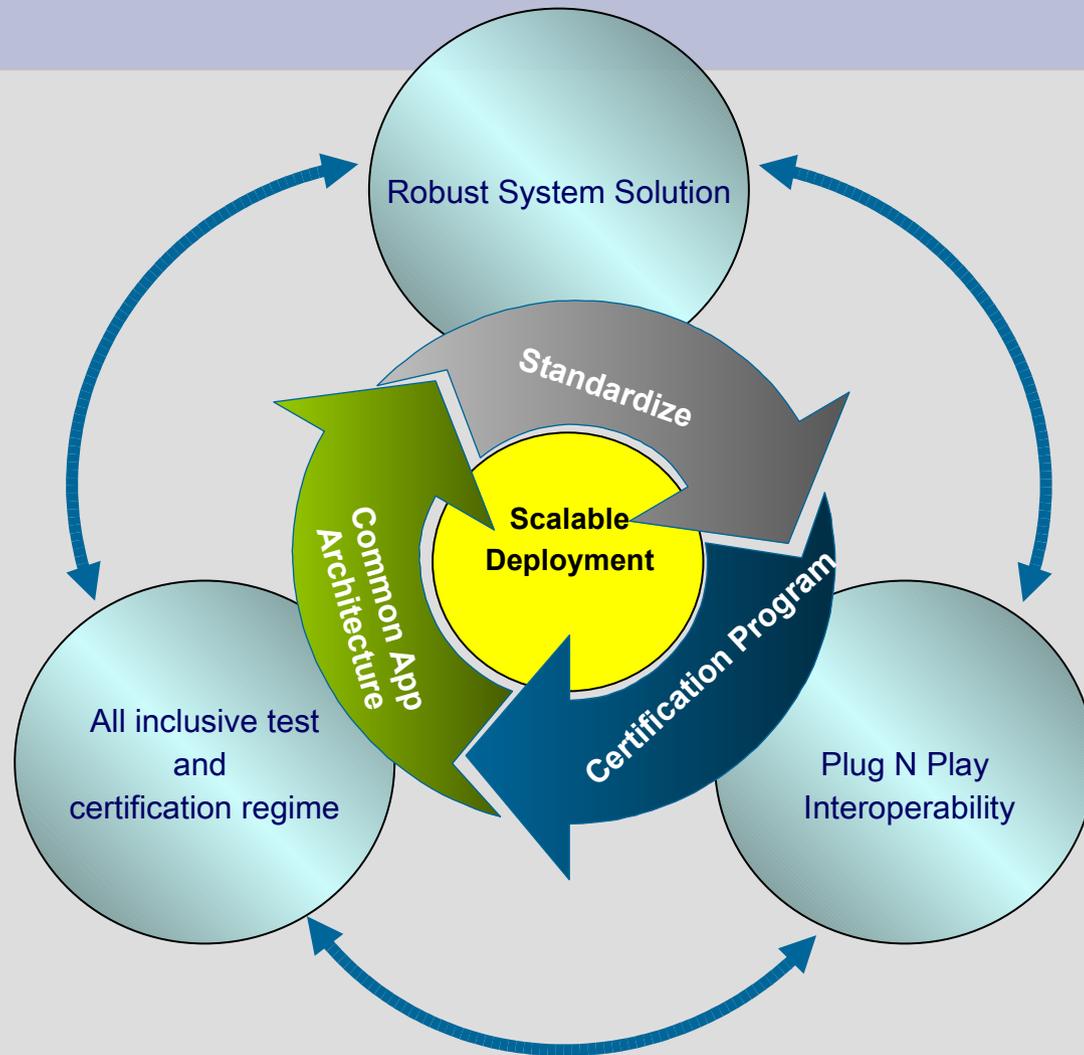
Large scale HAN SE
must be
P4

just a few percent of
service calls will make
large scale HAN SE
impossible

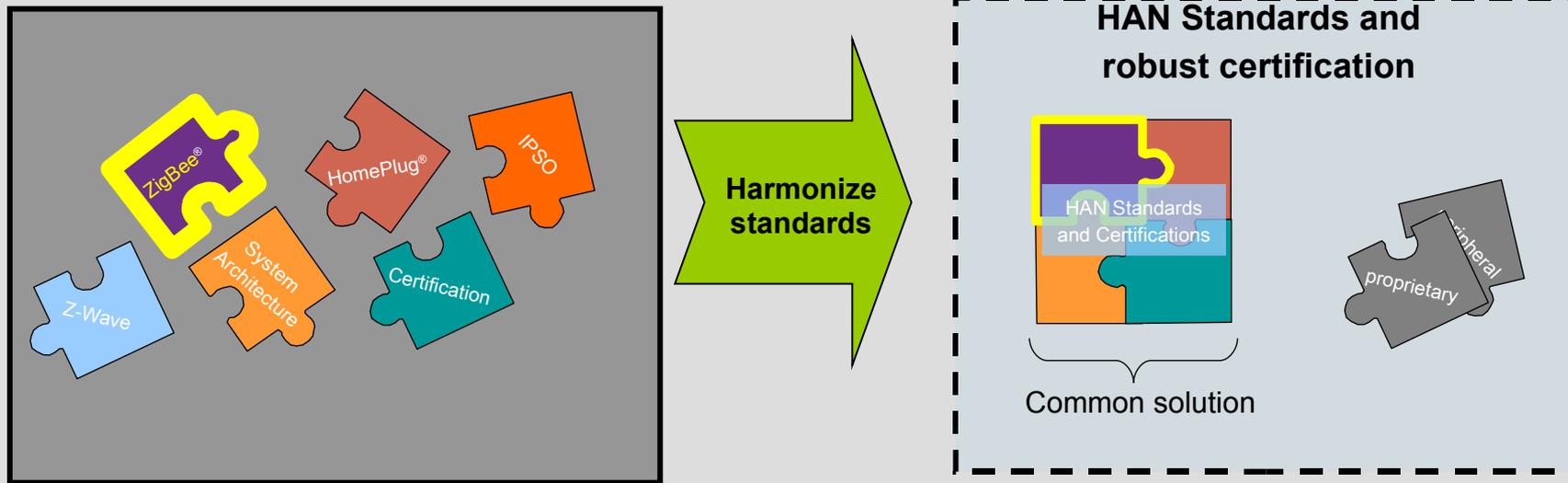
Smart Energy 2.0



To Achieve Smart Energy 2.0: Creation of a device ecosystem enabling end-to-end Smart Grid



To Achieve Smart Energy 2.0: Creation of a device ecosystem enabling end-to-end Smart Grid

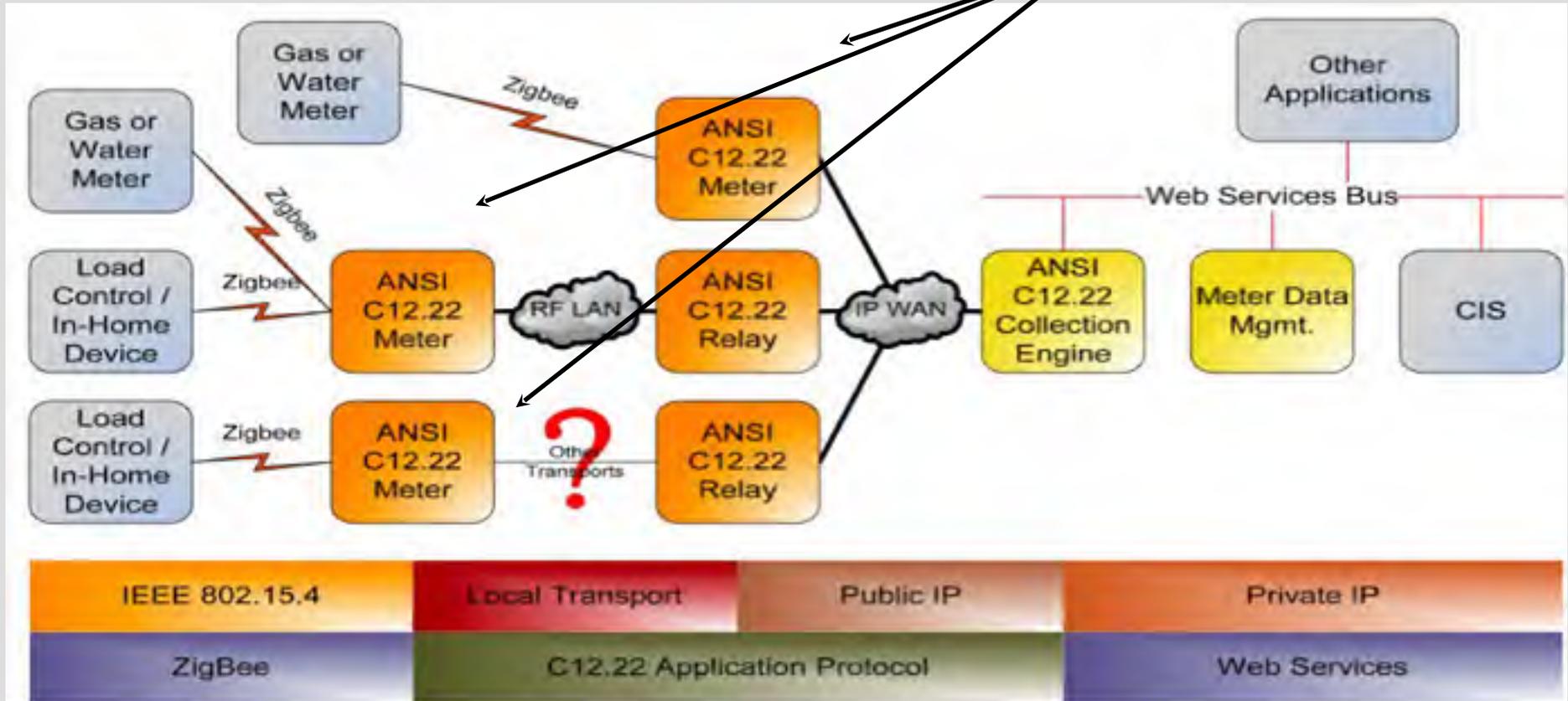


Time is NOW to standardize

ZigBee Smart Energy is the focal point

ZigBee Smart Energy I.x

ESP Device



ZigBee Smart Energy I.x

ZigBee

SE

Clusters



Cluster	Expected Mode	Application Level Security Required
Demand Response	Command	Yes
Price	Informational	No
Simple Metering	Informational	No
Complex Metering	Both	Yes
Prepayment	Both	Yes
Message	Informational	No

ZigBee Smart Energy I.x

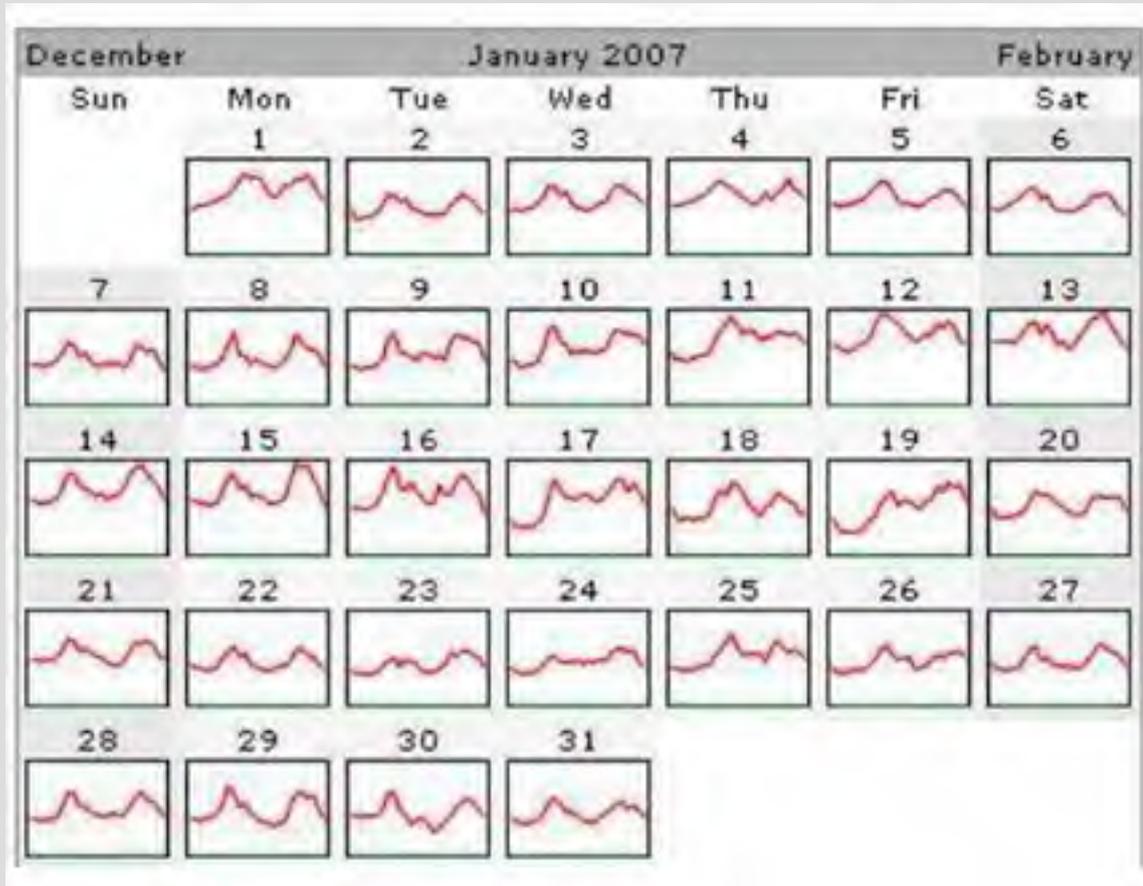
```
<cluster id="0x0701" apsEncryptionRequired="true">
  <description>
    AMI Cluster Library -- Demand Response and Load Control Cluster
  </description>

  <server>

    <command id="0x00" name="LoadControlEvent" mandatory="true">
      <uint32 name="IssuerEventId"/>
      <uint16 name="DeviceClass">
        <bitfield name="HvacOrFurnace" width="1" position="0"/>
        <bitfield name="StripOrBaseboardHeater" width="1" position="1"/>
        <bitfield name="WaterHeater" width="1" position="2"/>
        <bitfield name="PoolPumpOrSpaOrJacuzzi" width="1" position="3"/>
        <bitfield name="SmartAppliance" width="1" position="4"/>
        <bitfield name="IrrigationPump" width="1" position="5"/>
        <bitfield name="ManagedCommercialAndIndustrial" width="1" position="6"/>
        <bitfield name="ResidentialOnOff" width="1" position="7"/>
        <bitfield name="ExteriorLighting" width="1" position="8"/>
        <bitfield name="InteriorLighting" width="1" position="9"/>
        <bitfield name="ElectricVehicle" width="1" position="10"/>
        <bitfield name="GenerationSystem" width="1" position="11"/>
      </uint16>
      <uint8 name="UtilityEnrollmentGroup"/>
      <uint32 name="StartTime"/>
      <uint16 name="Duration"/>
      <uint8 name="CriticalityLevel"/>
      <uint8 name="CoolingTemperatureOffset"/>
      <uint8 name="HeatingTemperatureOffset"/>
      <int16 name="CoolingTemperatureSetPoint"/>
      <int16 name="HeatingTemperatureSetPoint"/>
      <int8 name="AverageLoadAdjustment"/>
      <uint8 name="DutyCycle"/>
      <uint8 name="EventControl">
        <bitfield name="RandomizeStartTime" width="1" position="0"/>
        <bitfield name="RandomizeEndTime" width="1" position="1"/>
      </uint8>
    </command>
```

ZigBee Smart Energy I.x

ESP can collect energy usage info



effective in energy management and conservation

ZigBee Smart Energy I.x

LCE: Load Control Event
Issued by ESP

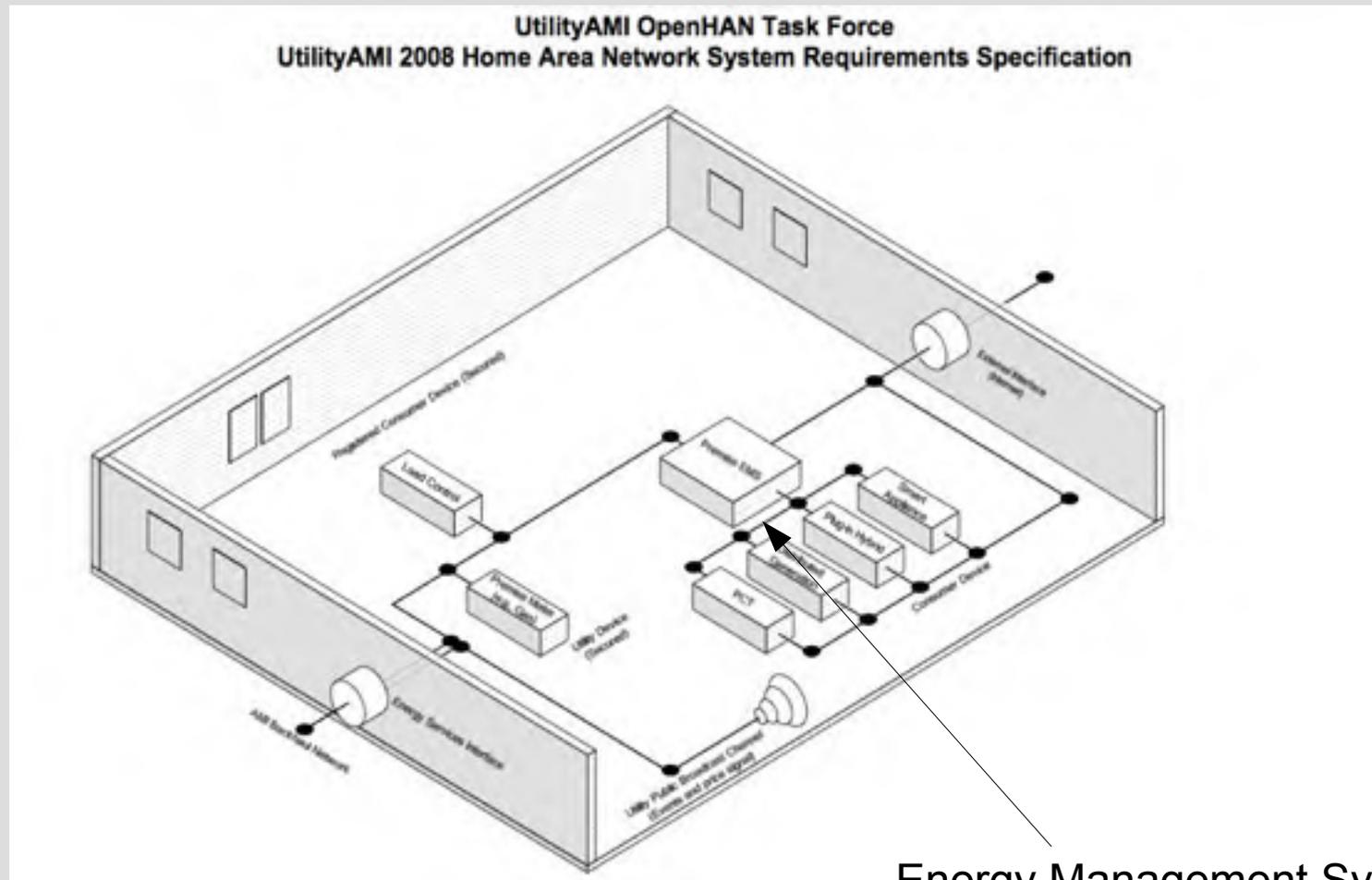
```
sequenceDiagram
    participant ESP
    participant HAN
    ESP->>HAN: LCE: Load Control Event Issued by ESP
    HAN-->>ESP: RES: Report Event Status: Received HAN device side
    HAN-->>ESP: RES: Report Event Status: Started HAN device side
    HAN-->>ESP: RES: Report Event Status: Complete HAN device side
```

RES: Report Event Status: Received
HAN device side

RES: Report Event Status: Started
HAN device side

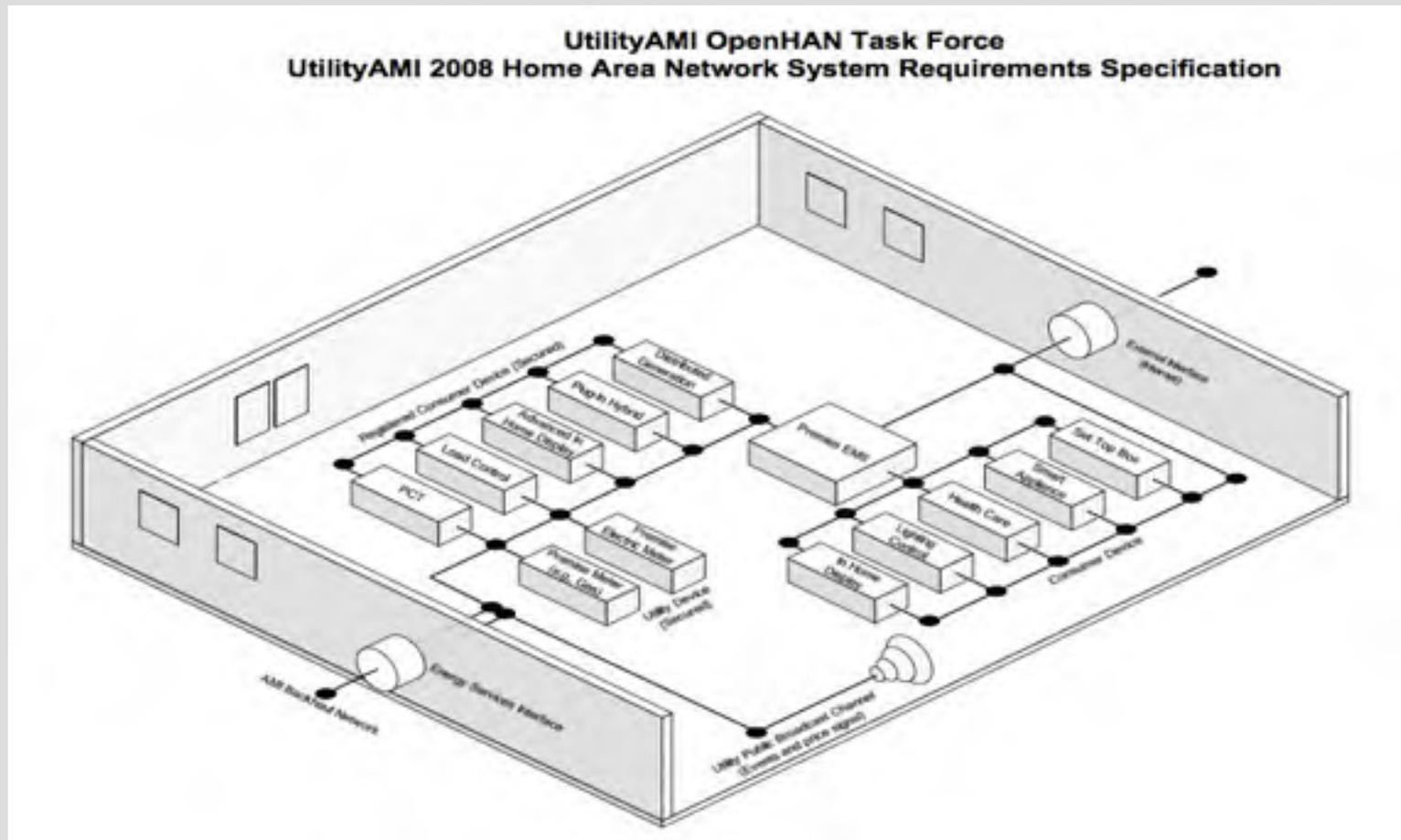
RES: Report Event Status: Complete
HAN device side

Implementation of various devices via owner controlled network and utility owned network



Energy Management System:
Bridges SE to other networks

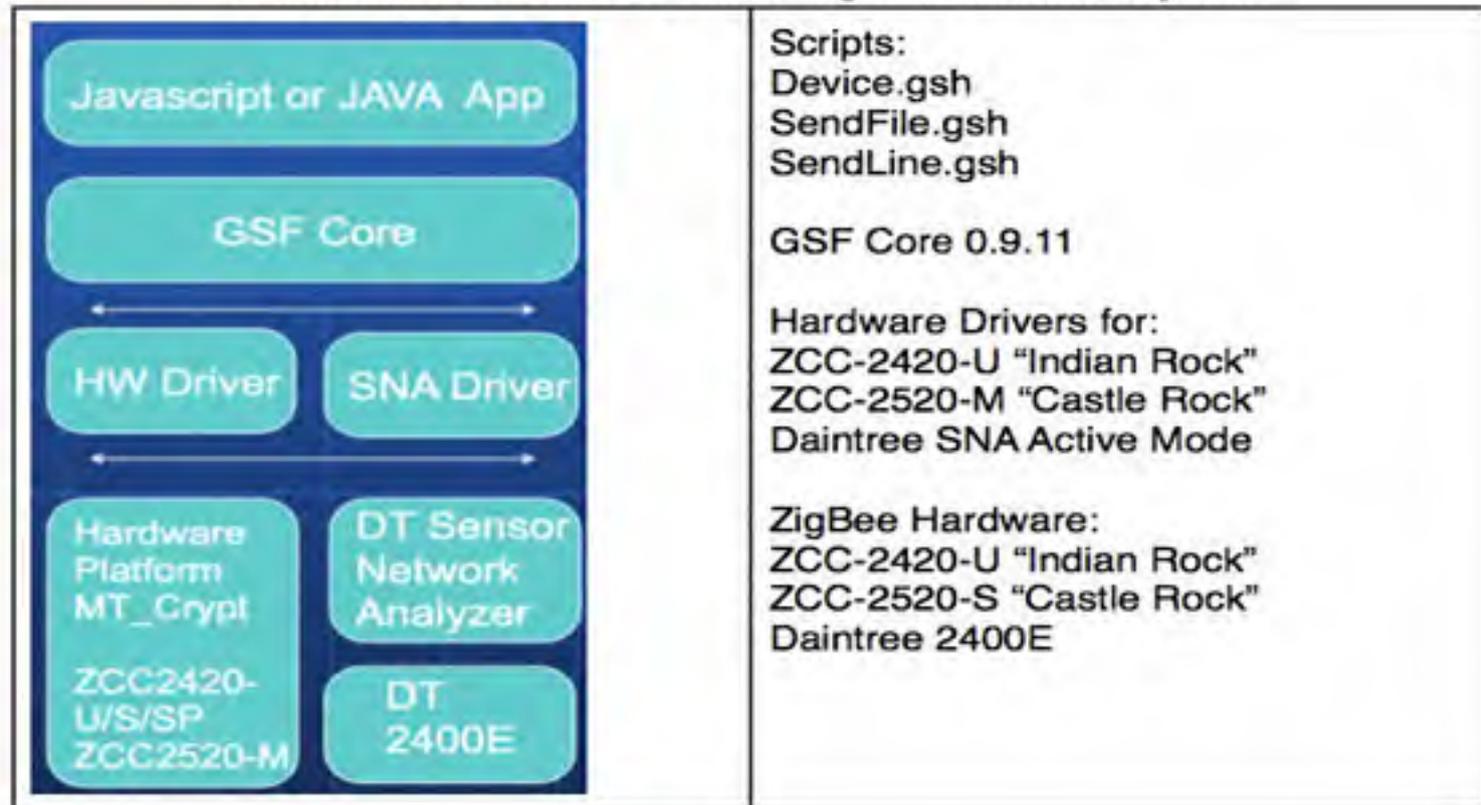
Final Form of SE and HAN



PCT, IHD, EMS, Smart Appliance, LCD, Submetering
PHEV/PEV, PHHC, Energy Storage/Generators, Home Automation

Serverside Javascript and Java Framework for ZigBee and Internet Smart Objects

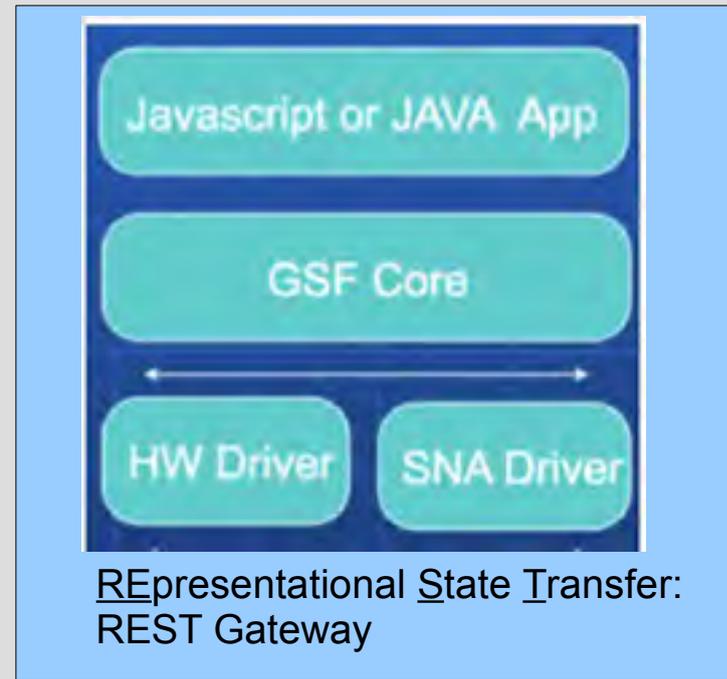
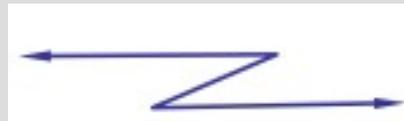
Architecture of Wireless Glues' ZigBee Glueware System



GSF Server System Diagram



Rich Internet Application (RIA)
Ajax Client



Q&A