



PG&E
SmartMeter 

Home Area Network (HAN)

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PRIVILEGED AND CONFIDENTIAL
Prepared at request of Counsel
Attorney Work Product

About Pacific Gas and Electric Company



- ▶ Energy Services to about 15 M People:
 - ▶ 5.0 M Electric Customer Accounts
 - ▶ 4.1 M Natural Gas Customer Accts
- ▶ 70,000 square miles with diverse topography
- ▶ ~20,000 Employees
- ▶ Regulated by the California Public Utilities Commission (CPUC)

The PG&E SmartMeter Program

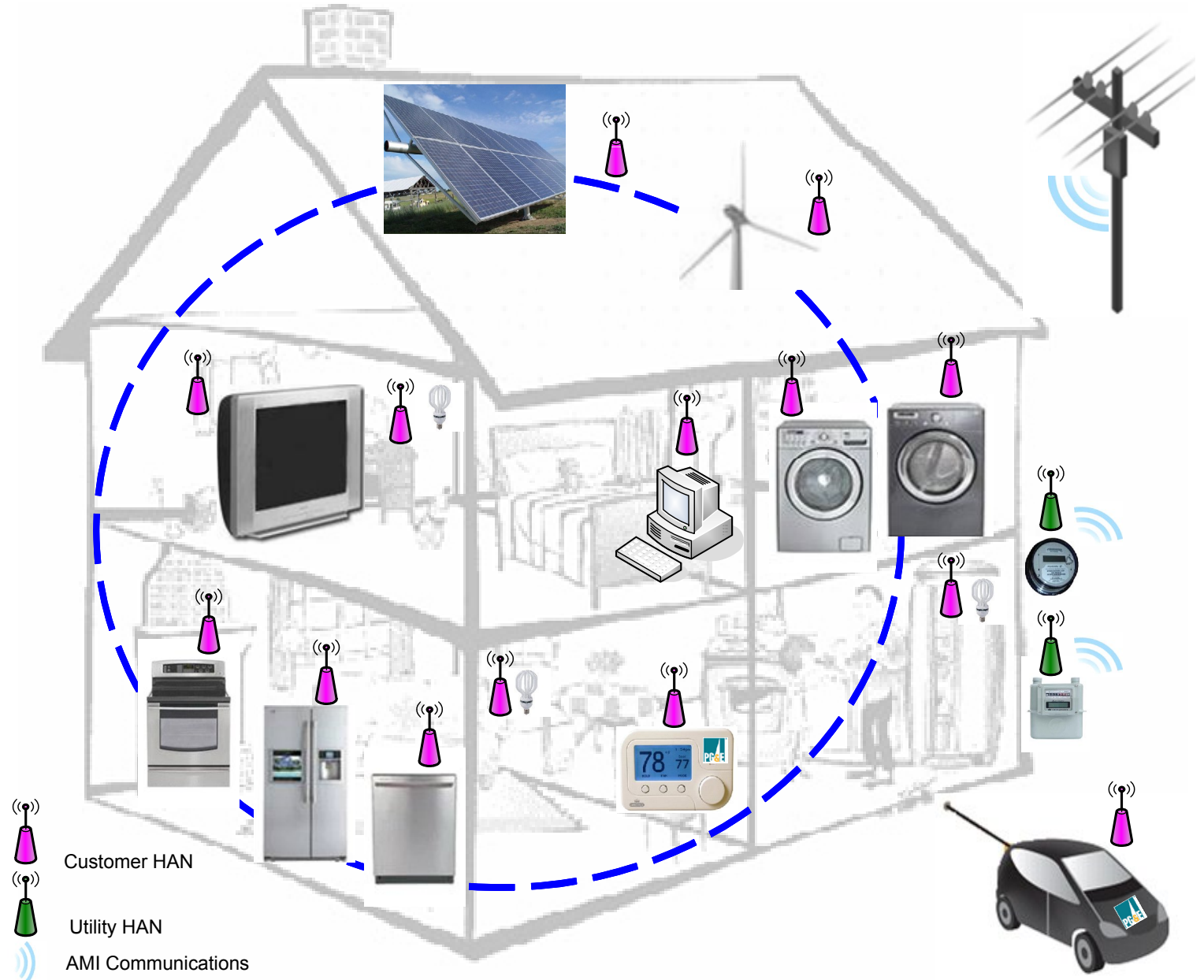
- ▶ Automated meter reading for all customers
- ▶ 10 Million meter upgrades
- ▶ A network to collect meter reads remotely and communicate with the meters
- ▶ IT systems to manage and store the reads, and make them available to PG&E business applications
- ▶ Frequent meter reads - daily for gas, hourly or 15 minute interval for electric
- ▶ Enables demand response rates
- ▶ Enhanced capabilities over time



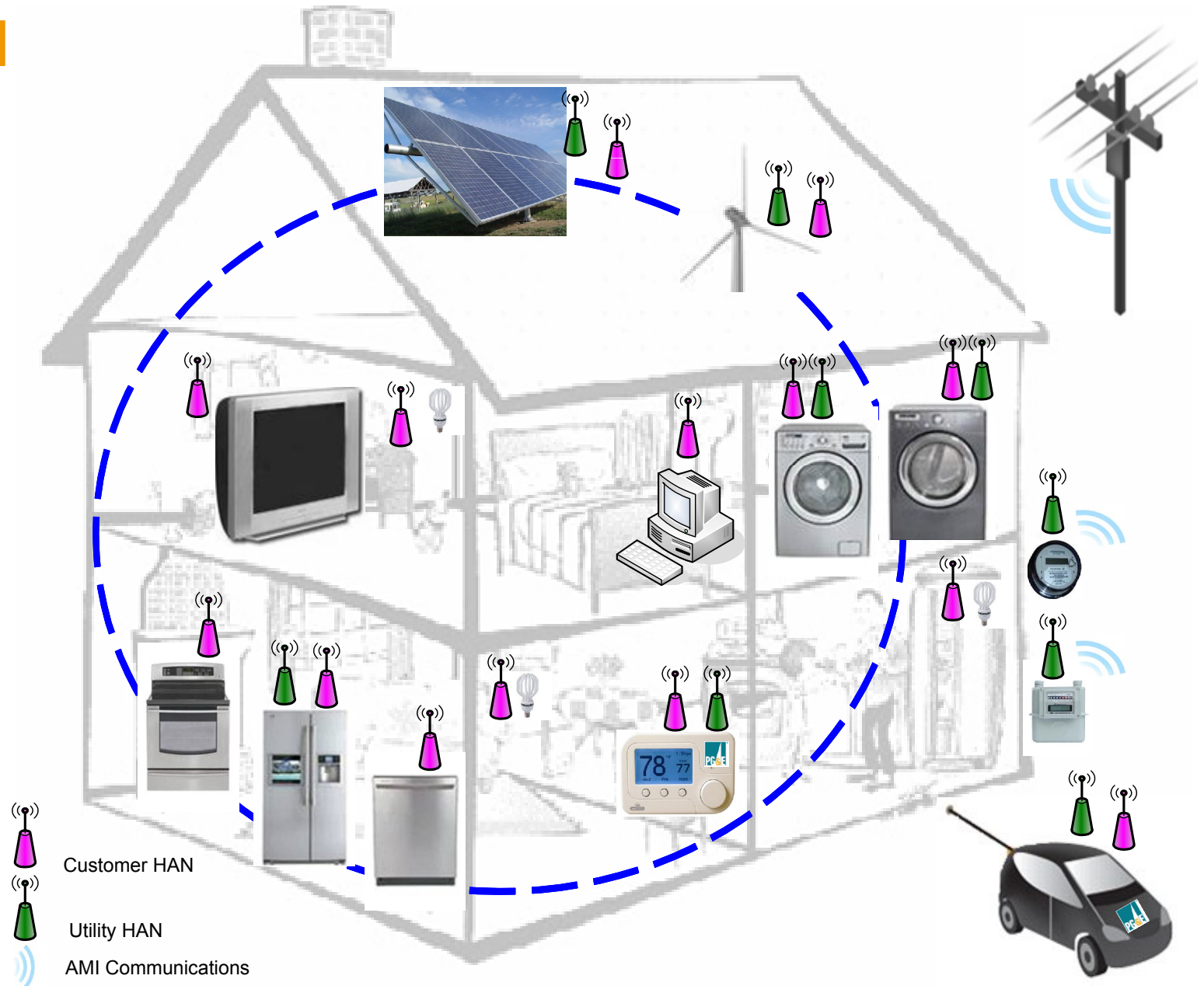
Latest Solid State Meters



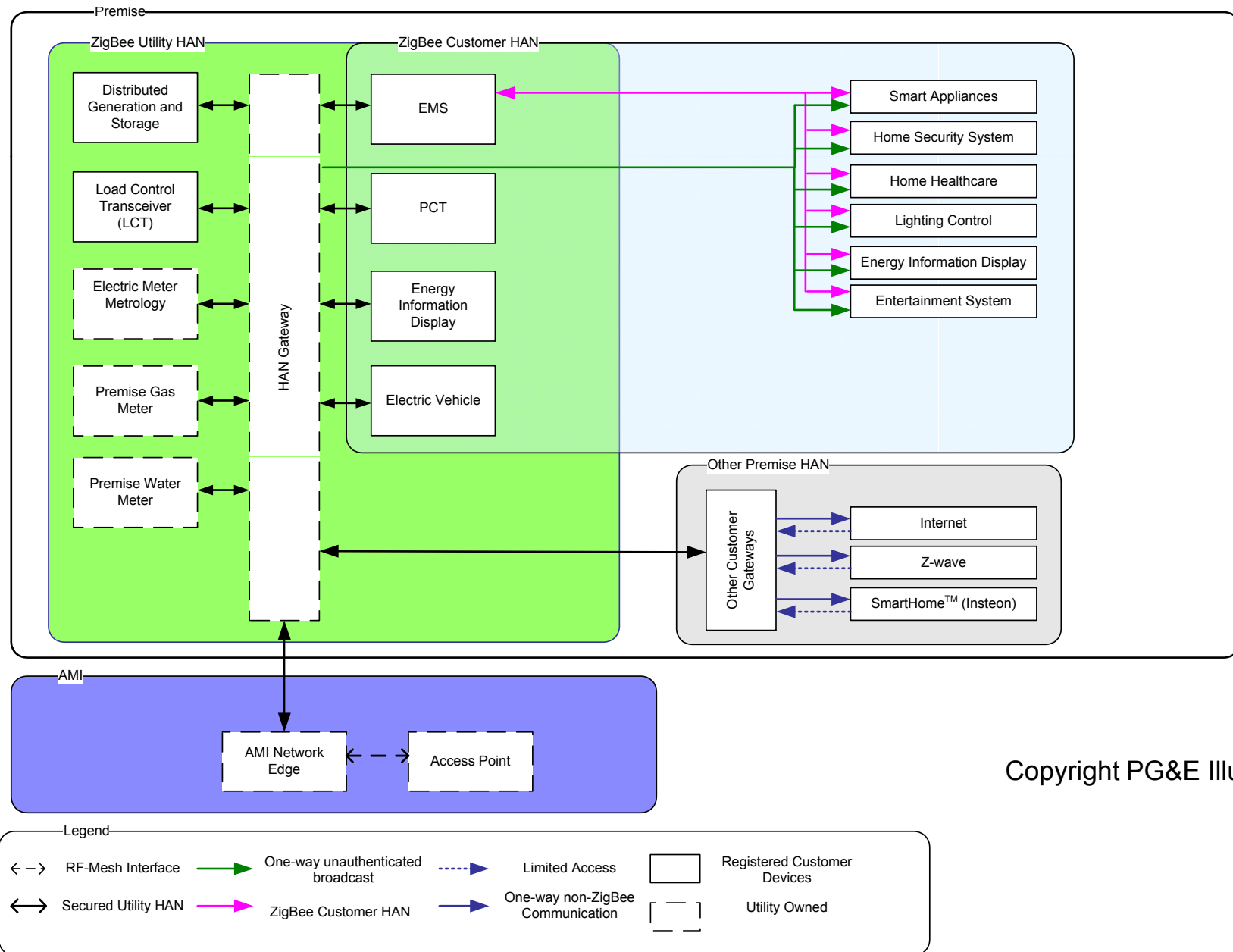
Customer Home Area Network (HAN)



Customer HAN and Utility HAN



An Example: Wireless ZigBee HAN



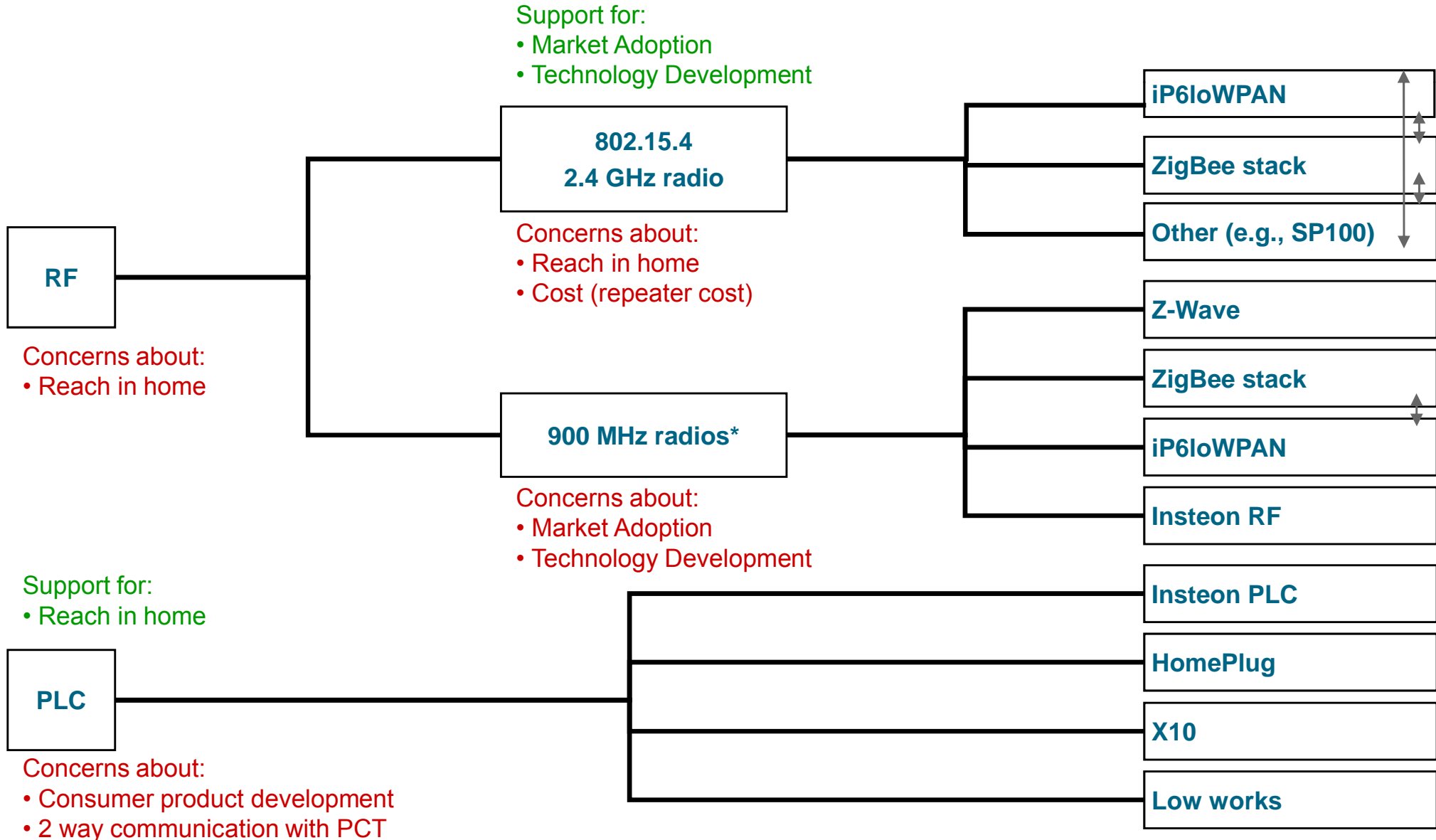
Copyright PG&E Illustration

Can A Single Technology Be The Answer?

Medium

Physical (radio)

Protocol (stack)



Few of Many Possibilities

Single Dwelling Unit

Multi Dwelling Unit

Option 1

- ▶ In the meter: ZigBee 2.4GHz, Home Plug CC
- ▶ Other: None

- ▶ In the meter: ZigBee 2.4GHz, Home Plug CC
- ▶ Other: None

Option 2

- ▶ In the meter: ZigBee 2.4GHz
- ▶ Other: None

- ▶ In the meter: ZigBee 2.4GHz
- ▶ Other: Bridge or collar to HomePlug in meter bank

Option 3

- ▶ In the meter: ZigBee 2.4GHz
- ▶ Other: None

- ▶ In the meter: HomePlug
- ▶ Other: None

Pros and Cons of Deployment Options

Advantages

Risks/Disadvantages

Option 1:

ZigBee (2.4GHz) and HPCC in the meter

- ▶ Signal reaches 100% of territory*
- ▶ Uniform meter supply chain
- ▶ Connects to majority of devices

- ▶ Cost of 2 chipsets in the meter
- ▶ Complications to back office systems and to customers due to integrating two technologies (could provide HP to ZigBee bridge or introduce ZHPCC)

Option 2:

ZigBee (2.4GHz), HomePlug Bridge for MDUs

- ▶ Signal reaches 74% of territory*
- ▶ Uniform meter supply chain
- ▶ Connects to majority of devices

- ▶ Deployment complications of bridge installations in various building types
- ▶ HP two way communication to the PCT in MDU (could provide HP to ZigBee bridge)
- ▶ Complications to back office systems and to customers due to integrating two technologies (could provide HP to ZigBee bridge or introduce ZHPCC)

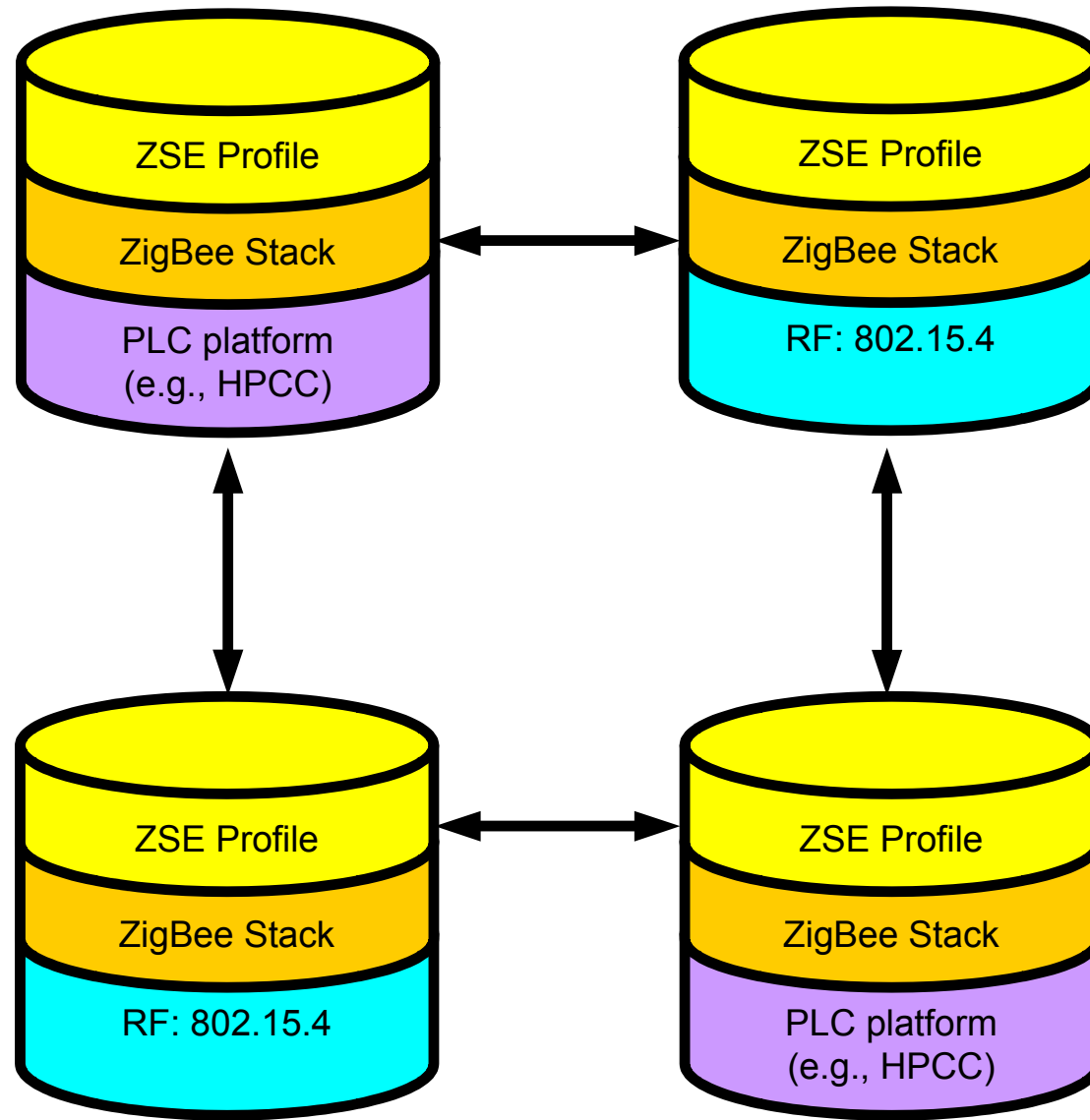
Option 3:

ZigBee (2.4GHz) under glass for SDUs, HomePlug underglass for MDUs

- ▶ Signal reaches 74% of territory*
- ▶ Connects to majority of devices

- ▶ Meter supply chain complexity
- ▶ HP two way communication to the PCT in MDU (could provide HP to ZigBee bridge)
- ▶ Complications to back office systems and to customers due to integrating two technologies (could provide HP to ZigBee bridge or introduce ZHPCC)

ZHPCC Vision

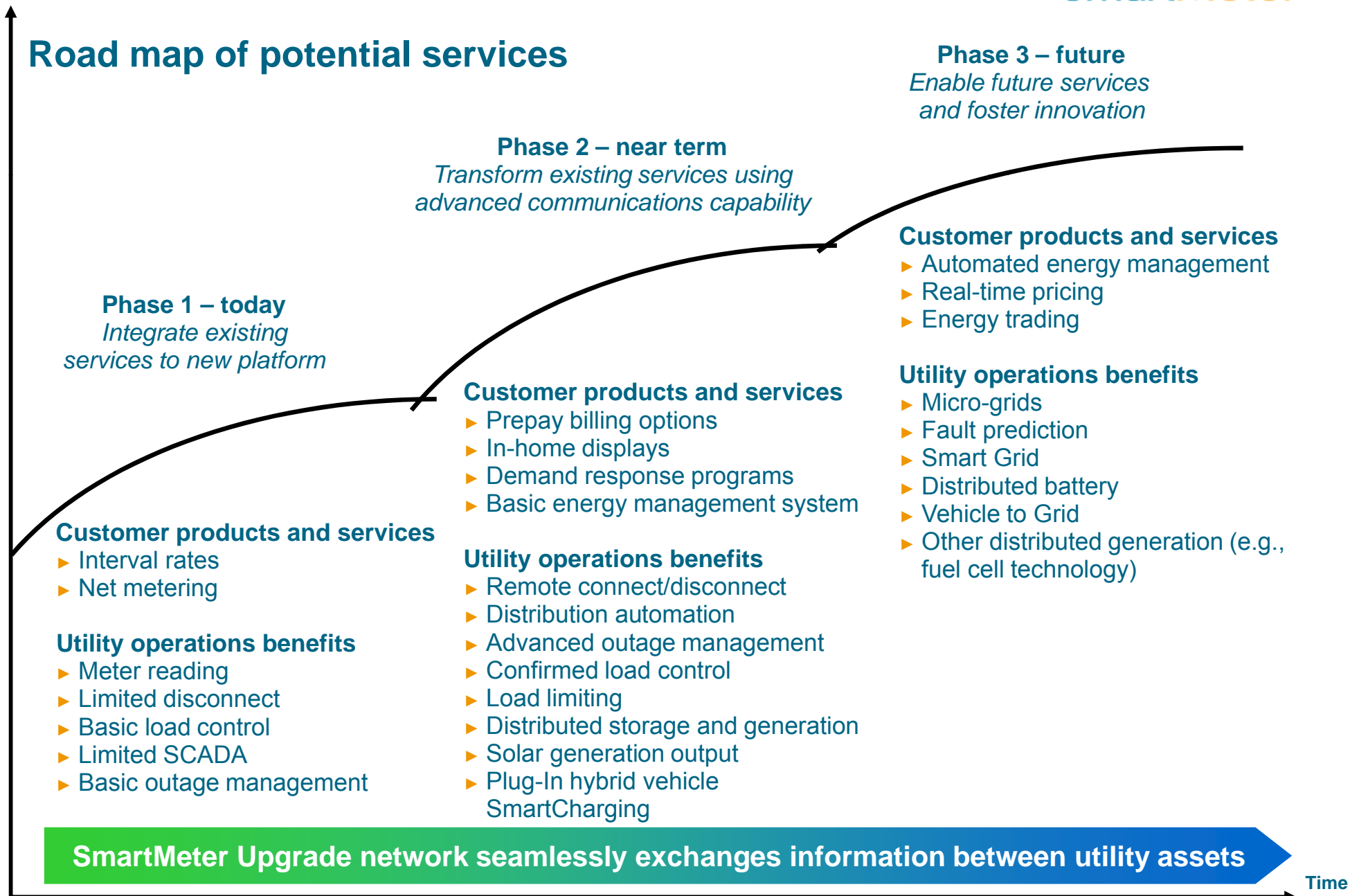


SmartMeter to Smart Grid Vision



Road map of potential services

Cumulative Benefits



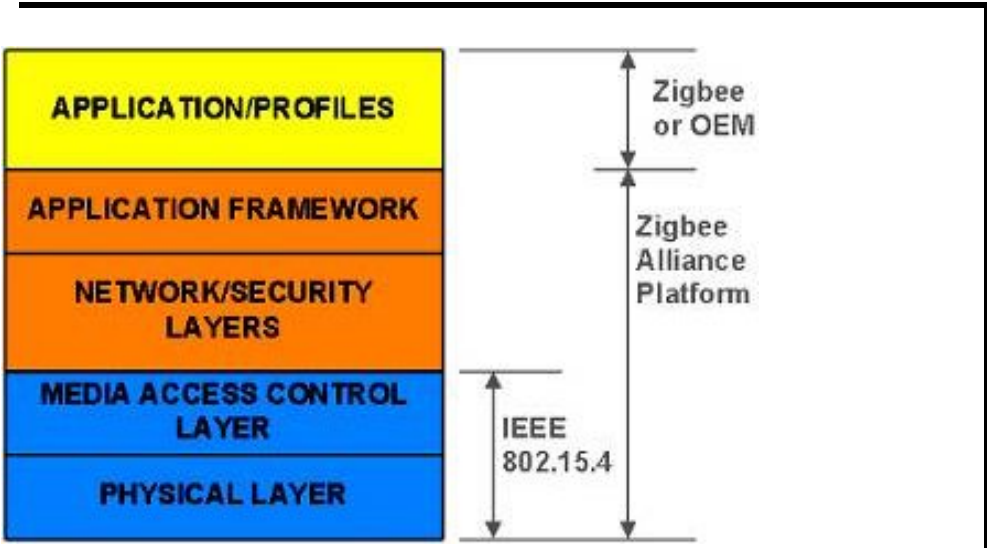
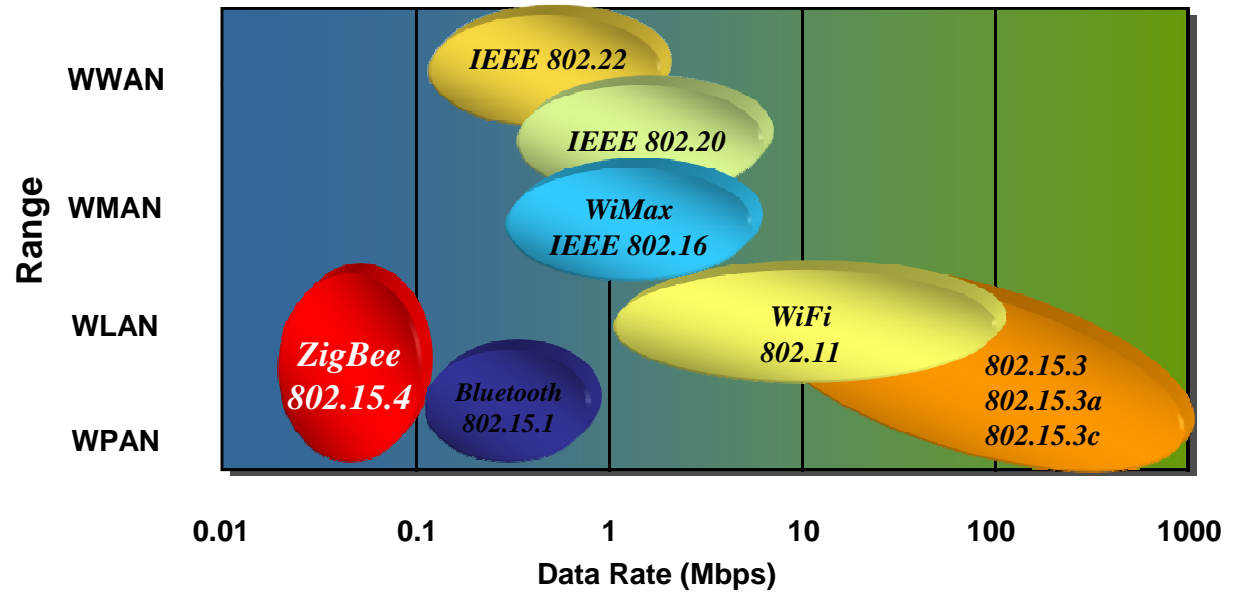
Technical Overview of ZigBee



ZigBee: An Example

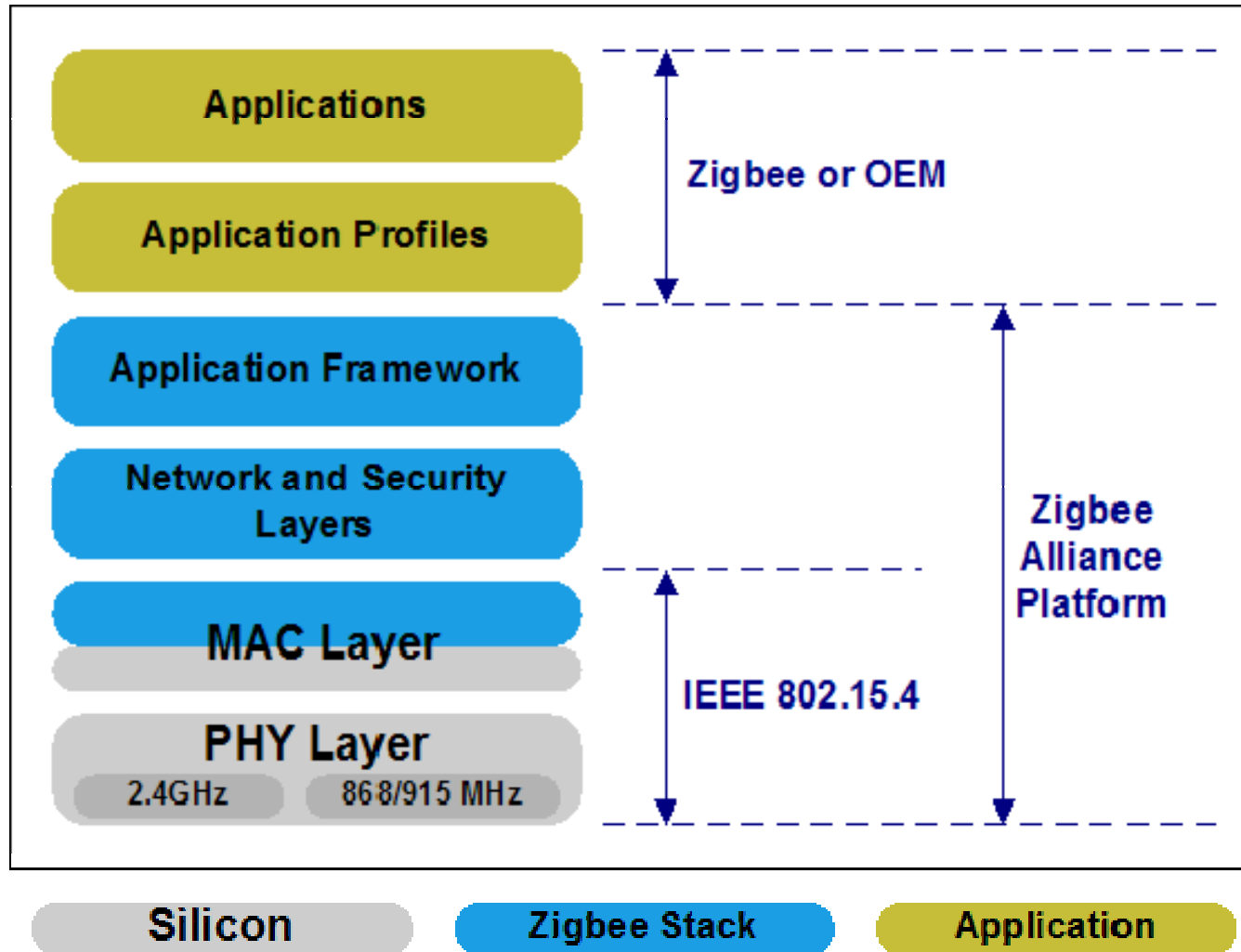
The ZigBee Solution

- Open Standard
- Radio + Protocol
- Mesh Networking



- 65,536 network (client) nodes
 - Full Mesh Networking Support
 - 27 channels over 3 bands [2.4GHz, 915MHz, 868MHz]
 - 250Kbps data rate
-
- The mesh network diagram shows a central purple node (Network coordinator) connected to several yellow nodes (Full Function nodes) and green nodes (Reduced Function nodes). Dotted lines represent communications flow, and orange lines represent virtual links.
- Network coordinator (purple dot)
 - Full Function node (yellow dot)
 - Reduced Function node (green dot)
 - Communications flow (dotted lines)
 - Virtual links (orange lines)

ZigBee Stack



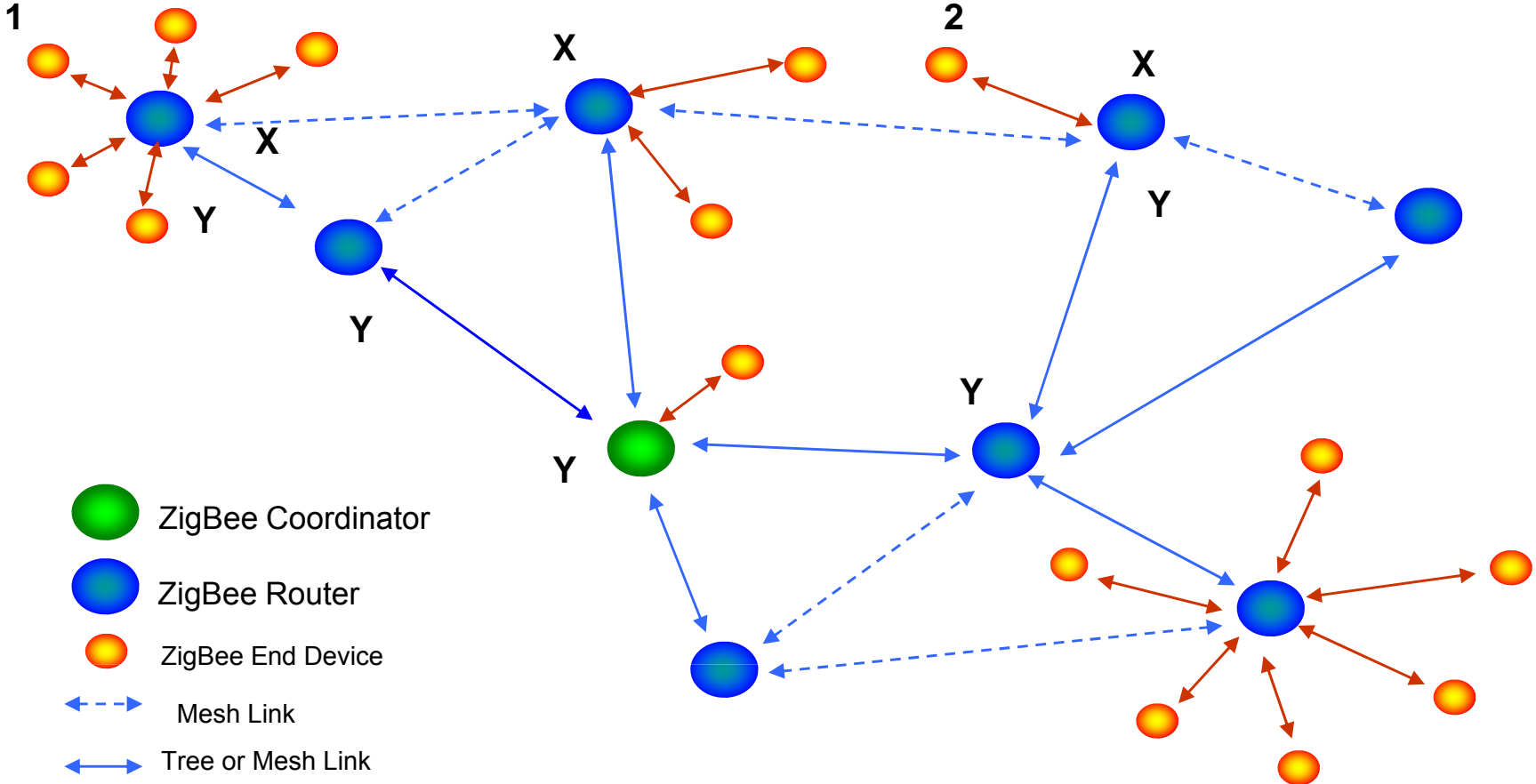
Source: SDG&E Presentation on August 8 by Terry Mohn at EPRI

ZigBee Device Function

- ▶ ZigBee Coordinator (ZC)
 - ▶ One required for each ZB network
 - ▶ Initiates network formation
- ▶ ZigBee Router (ZR)
 - ▶ Participates in multi-hop routing of messages
- ▶ ZigBee End Device (ZED)
 - ▶ Does not associate or route
 - ▶ Enables very low-cost solutions

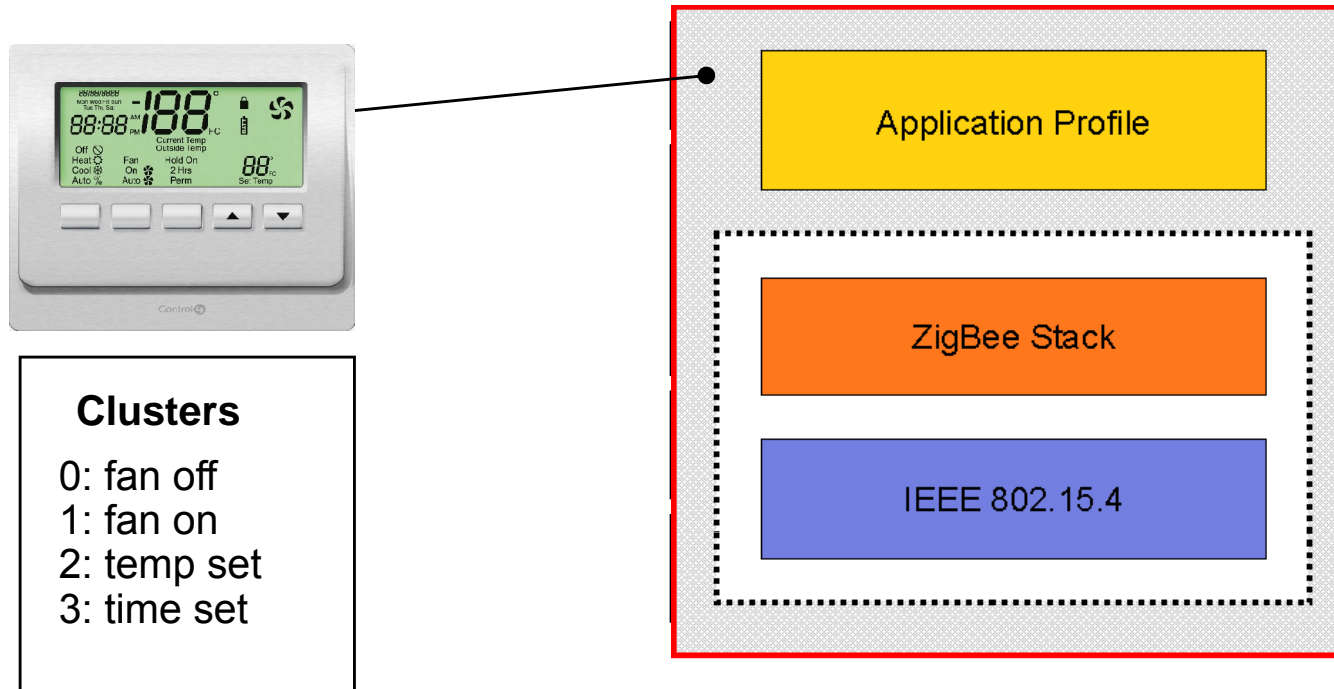
Source: SDG&E Presentation on August 8 by Terry Mohn at EPRI

ZigBee Communication



Source: SDG&E Presentation on August 8 by Terry Mohn at EPRI

Application Profiles



- ▶ Application profiles define what messages are sent over the air for a given application
- ▶ Devices with the same application profiles interoperate end to end
- ▶ ZigBee publishes a set of public profiles, but vendors may create manufacturer specific ones as well

Source: ZigBee Alliance

ZigBee Smart Energy Profile

- ▶ Features supported by ZSE profile include:
 - ▶ Basic metering [measurements, historical information, etc]
 - ▶ Demand Response and Load Control
 - ▶ Pricing [multiple units and currencies, price tiers, etc]
 - ▶ Text messages
 - ▶ Device support for PCTs, IHDs, load control devices, Energy Mgmt Systems, etc.
 - ▶ Security to allow consumer only, utility only or shared networks

- ▶ Timeline of ZSE
 - ▶ Mid-2007 – work started by Alliance members to define requirements for ZSE
 - ▶ Nov 2007 – ZSE profile was letter balloted and approved by Alliance members
 - ▶ Jan 2008 – completed feature development
 - ▶ Mar 2008 – 3rd interoperability test event with over 20 companies
 - ▶ May 2008 – [planned] certification test event and publication of ZSE profile

Source: ZigBee Alliance

Industry

- ▶ IEEE 802.15.4
- ▶ ZigBee Alliance
- ▶ OpenAMI
- ▶ OpenHAN