

GE  
Energy

# ZESEF: ZigBee Smart Energy Overview

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Why?



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# What does the industry want for HAN?

- Retail products
  - No vendor lock-in / competitive market
  - Large talent pool
  - Low cost
  - No market fragmentation globally
- > Led us to look at global open standards  
(industry groups and SDOs)**

# ZigBee?



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# What is ZigBee?

- IEEE 802.15.4
- ZigBee Stack
- Application Layer “Profile”

# ZigBee Smart Energy?

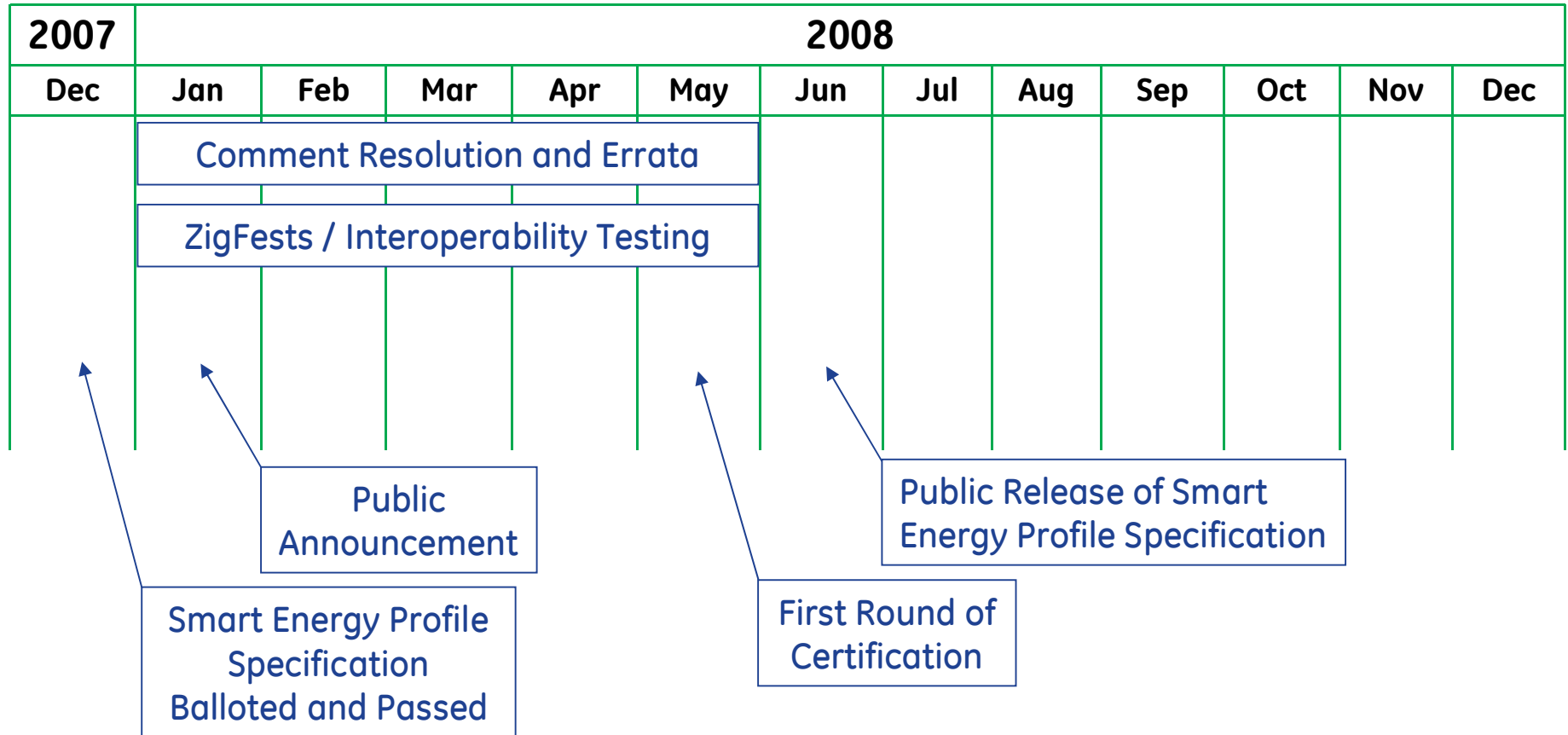


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# ZigBee Smart Energy Profile

- Application-layer standard
- Focus on communications related to efficiency, usage, price, and messaging
- Designed not to specify behavior, but to specify communications to support behavior
- Did not want to recreate existing standards for home automation, etc.
- Range of backhaul bandwidths and cost kept in mind during development

# Key Milestones



# Ecosystem

- Utilities & Retail Energy Providers
- Government and Regulators
- Outreach to other standards bodies such as OpenHAN
- Security Experts
- AMI and Meter Vendors
- Demand Response and Load Control Vendors
- White Goods Vendors
  - Thermostats
  - Displays
  - Smart Appliances
- System Integrators
- Semiconductor Manufacturers

# Requirements Considered

- Attention paid to several standards bodies, requirements documents, and studies including:
  - OpenHAN
  - Title24
  - Texas
  - Victoria, Australia
  - ...
- Utilities and Retail Energy Providers
- International considerations
- Regulated environments and deregulated environments

# Device Types

- ESP (Energy Services Portal) – can be integrated into meter or standalone
- In-Home Display
- PCT (Programmable Communicating Thermostat)
- Load Control Devices (Pool Pumps, Water Heaters, Appliances, Lighting, etc.)
- Some support for Plug-In Vehicles
- “Dumb” devices (Refrigerator Magnet, Glowing Orb, etc.)

# Clusters

## What is a cluster?

- Standard clusters (Basic, Identify, Alarms, Time, Commissioning, Power Configuration)
- Price
- Demand Response and Load Control
- Simple Metering
- Message
- Key Establishment

# Price

- Multiple commodities (Electric, Gas, Water, Thermal, Pressure, etc.)
- Multiple units of measure for international support (lbs vs. kg)
- Multiple currencies for international support (ISO 4217)
- Scheduling and canceling
- Multiple providers (de-regulated) and rates
- Price ratios and price tiers (and labels)
- Tie to meter register tier
- Net metering
- Alternative cost (greenhouse gas emissions)
- Inter-PAN communication

# Demand Response and Load Control

- Scheduling and canceling
- Digital signature for non-repudiation of event participation (Completed, Opt-Out, Opt-In, etc.) and “what” happened
- Can simultaneously or individually target groups of devices
- Enrollment groups
- Criticality levels, temperature offsets, temperature set points, average load adjustment percentage, duty cycle
- Randomization of start and stop times to avoid spiking

# Messaging

- Scheduling and canceling
- International character sets (UTF-8)
- Multiple urgency levels
- Optional duration
- Optional message confirmation
- Inter-PAN communication

# Metering

- Multiple commodities (Electric, Gas, Water, Thermal, Pressure, etc.)
- Multiple units of measure for international support (lbs vs. kg)
- Summation, demand, tiers, load profile, power factor, demand limit, etc.
- Instantaneous demand
- Historical information (previous day, today, etc.)
- Net metering

# Security

Primitives (Evolution from CIA triad and Parkerian hexad)

- **Authentication / Identification**
  - ECC Digital Certificates
- **Confidentiality / Encryption / Privacy**
  - AES-128 (CCM\*)
  - ECMQV Key Agreement
- **Integrity / Replay Prevention**
  - CCM\*
  - Counters
  - ECDSA Digital Signatures
- **Non-Repudiation**
  - ECDSA Digital Signatures
- **Authorization / Access Control / Permissions / Privilege**
  - Brokered Link Keys
  - ECC Digital Certificates
- **Availability / Accessibility**
  - Frequency Agility
- **Auditing / Accountability / Traceability**
  - Report Event Status



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# Other

- Strives to be OpenHAN compliant
- Time synchronization via ESP
- Benefits from ZigBee!
  - Active community (HA, CBA, TA, PHHC, etc.)
  - Rock-Solid stack
    - ZigBee stack vetted over many years
    - Meshing, routing, security, and other details well defined, tested, and certified
  - IEEE 802.15.4 (global 2.4 GHz spectrum)

# How does Smart Energy evolve?

- Bugs, clarifications, etc. -> CCB
  - Participants can enter, vetted by Change Control Board through a transparent process
- New features
  - MRD -> TRD -> Specification
  - Transparent with multiple layers of approval (WG, ZARC, MSC, BoD)
- Once tested, certified, and approved -> public release
- Attendance-based voting rights to encourage participation and informed voters -> benefit to being a member
- **Backwards compatibility of utmost importance**

# Future Enhancements

- Prepayment
- Tunneling of ANSI / DLMS protocols
- Improvements based on continuing feedback
- Ongoing documentation, marketing
- ZigBee+HomePlug joint efforts

# ZigBee+HomePlug Smart Energy 2.0

- Led by a Joint Steering Committee composed of utilities, ZigBee BoD members, and HomePlug BoD members
- Designed to exploit the benefits of wireless **and** wired
- Continuing trend of reaching out to market (IEC, EPRI, AHAM, SAE, ...)
- Continuing to add new features