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ZigBee® Application Profiles



Making machines talk.®

Why Do We Need Profiles?

- Need a common language for exchanging data
- Need a well defined set of processing actions
- Device interoperability across different manufacturers
- Simplicity and reliability for the end users
- Consumer flexibility for products
- Allows solid conformance test programmes to be created
- Realistic application specifications developed through OEM experience

- **Part 1: profile specification**
 - A set of devices required in the application area
 - A set of clusters to implement the functionality
 - A set of attributes to represent device state
 - A set of commands to enable the communication
 - Specification of which clusters are required by which devices
 - Specific functional description for each device

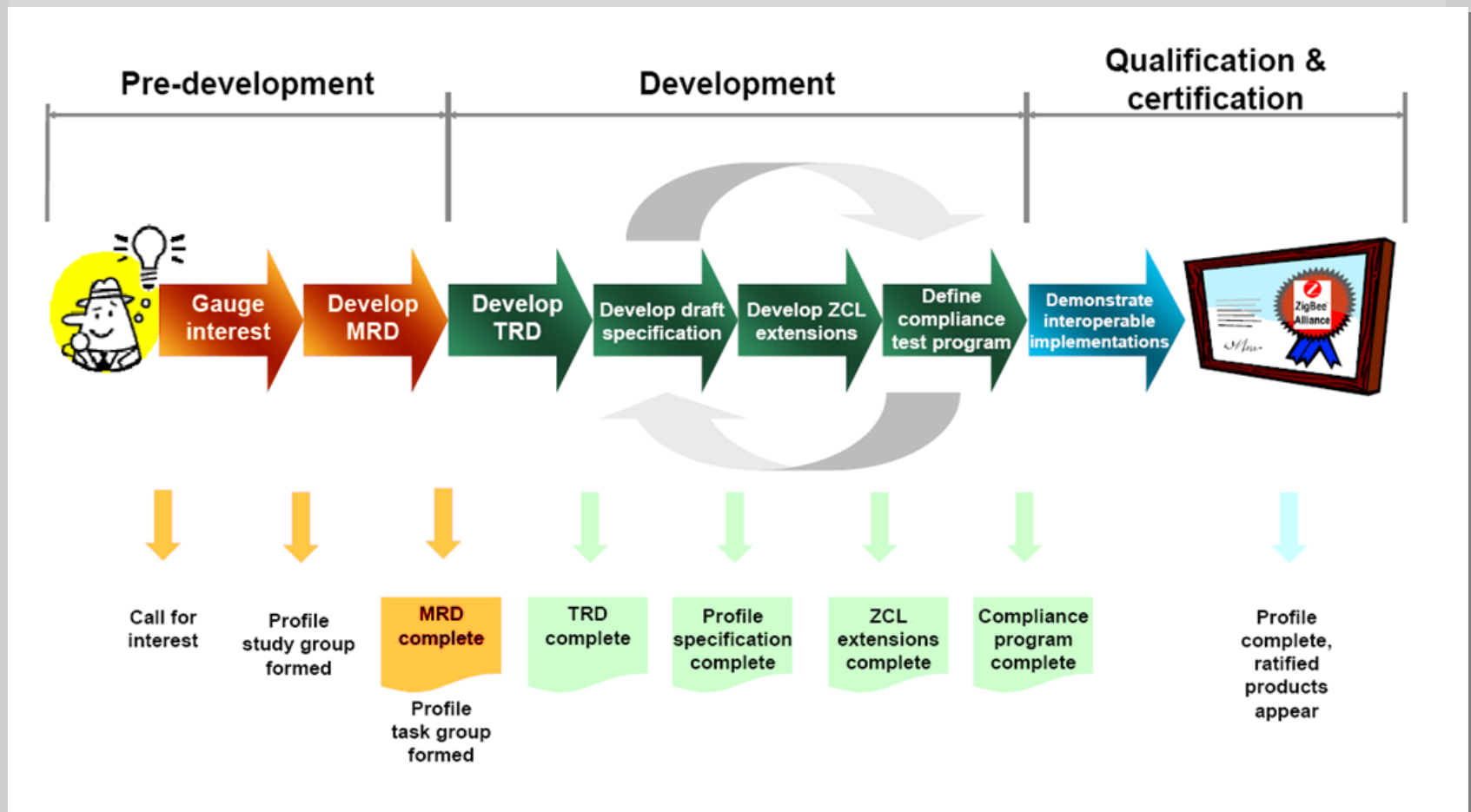
- **Part 2: profile test specification**
 - Set of PICS* for device conformance specification
 - Set of test cases for conformance testing

- *PICS – Protocol Implementation Conformance Statement

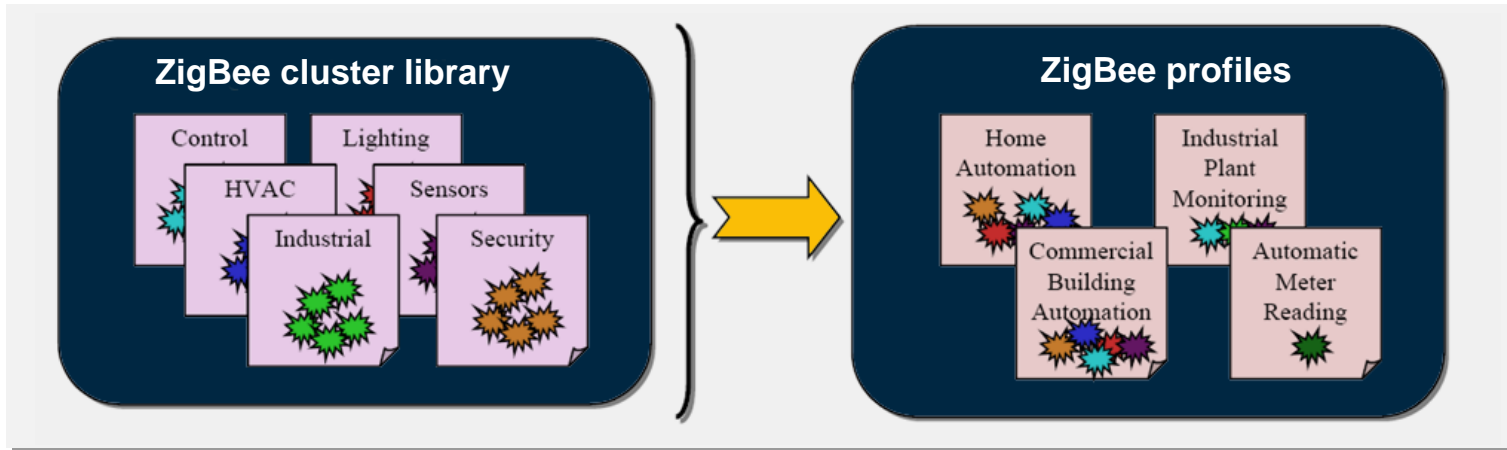
- **Public profiles**
 - For generically useful applications
 - Developed publicly by members of the ZigBee Alliance
 - Managed within the Application Framework Working Group
 - Development follows the profile lifecycle
 - Enables products to undergo logo certification so that the ZigBee logo can be used

- **Manufacturer specific profiles**
 - For manufacturer specific proprietary applications
 - Developed privately by individual manufacturers
 - Manufacturer specific profiles must use a ZigBee allocated profile identifier
 - Commercial products built using manufacturer specific profiles must undergo network capable testing

Profile Development Lifecycle.



The ZigBee Cluster Library (ZCL).



- ZigBee[®] cluster library specifies functional domains
- Each specification specifies the cluster sets for that functional domain
- Each specification defines mandatory & optional clusters, attributes, commands and functional descriptions
- Explicit device descriptions are not defined

- ZigBee[®] profiles specifies application domains
- Each profile collects related elements from the cluster library into application domains
- Each profile defines device descriptions for each required device
- Each profile specifies the cluster identifiers for each cluster used from the cluster library

▪ General

- Basic
- Power configuration
- Device temperature configuration
- Identify
- Groups
- Scenes
- On/off
- On/off switch configuration
- Level control
- Alarms
- Time
- RSSI location

▪ HVAC

- Pump configuration and control
- Thermostat
- Fan control
- Dehumidification control
- Thermostat user interface configuration

▪ Lighting

- Color control
- Ballast configuration

▪ Security

- IAS Zone
- IAS ACE
- IAS WD





▪ Measurement & sensing

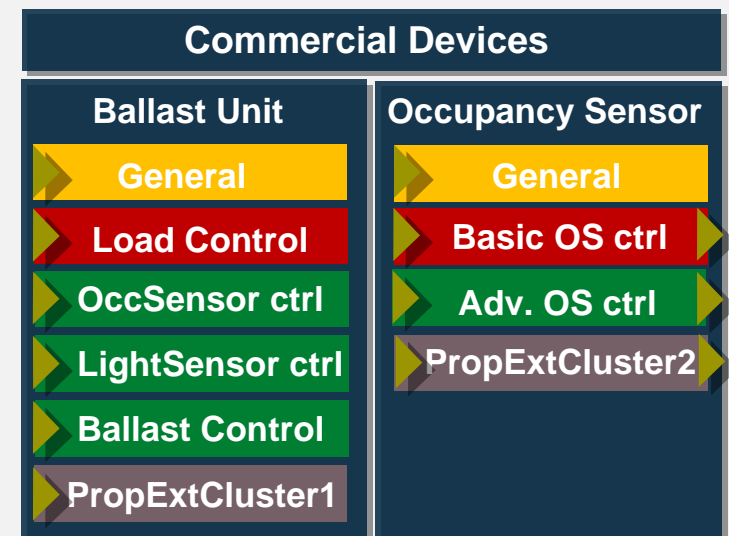
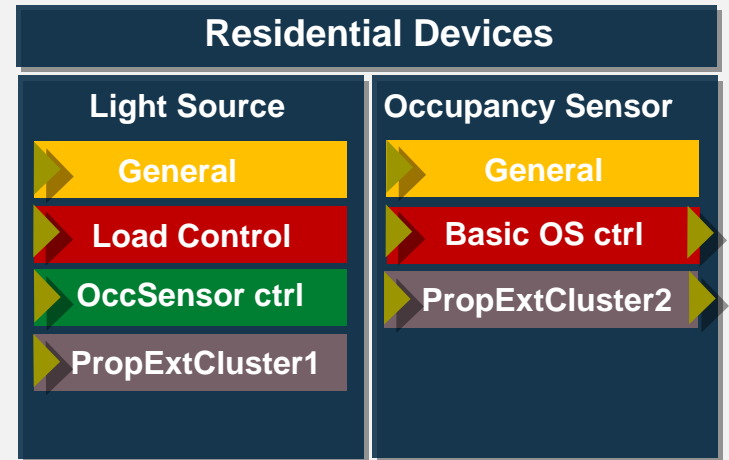
- Illuminance measurement
- Illuminance level sensing
- Temperature measurement
- Pressure measurement
- Flow measurement
- Relative humidity measurement
- Occupancy sensing

▪ Closures

- Shade configuration

ZCL: Incremental Specification.

-  General cluster for basic manipulation and common tasks
-  Mandatory clusters for fundamental functionality
-  Optional clusters for enhanced functionality
 - E.g. Turning a residential sensor into a commercial sensor
-  Proprietary extensions can be added by individual manufactures



Profiles in Progress.

- Commercial Building Automation (CBA)
- Home Automation (HA)
- Personal, Home and Hospital Care (PHHC)
- Smart Energies (SE)
- Telecom Applications (TA)

- Future profiles proposed by member companies...



▪ **Scope & Purpose**

- Applications targeted at a commercial building environment. Such an environment may:
 - have a coverage area of up to 100,000 square feet or more;
 - be typically professionally managed;
 - buildings may have unrestricted access, with attendant security implications;
 - inter-working with an installed base of existing products on other networks (e.g. BACnet) need to be considered.

▪ **Status**

- | | |
|--------------------------------|-------------|
| ○ Market Requirements Document | Complete |
| ○ Profile Specification | Complete |
| ○ Test Program | In Progress |



- **Ballast Unit**

- Allows the control of a light source within a lighting fixture. Basic control functionality is on/off, dim up/down, set light level. Control can be via sensors, from a switch or a remote control.

- **Commissioning Tool**

- Allows the lighting system functionality to be built into a system of installed lighting devices, i.e. which switch controls which ballast.

- **Sensors**

- Allows automatic feedback to ballast units to control the light level. Typical sensors could be occupancy or light level.

- **Thermostat**

- The Thermostat device can have either built-in or separate sensors for temperature, humidity or occupancy. It allows the desired temperature to be set either remotely or locally. The thermostat may send heating and/or cooling requirement notifications to a heating/cooling unit (e.g. an indoor air handler) or may include a mechanism to control a heating or cooling unit directly.

CBA: Professional Lighting Systems.

Lighting Ballast



Occupancy Sensor



Wall Switch



System Commissioning



Lighting Management System



PDA Controller

▪ **Scope & Purpose**

- Applications for the residential automation market to allow OEMs to produce products that will meet the needs of customers ranging from DIY homeowners to professional installers.

▪ **Status**

- Market Requirements Document
- Profile Specification
- Test Program

Complete

Complete

Complete



▪ Generic

- On/off switch
- Level control switch
- On/off output
- Level controllable output
- Scene selector
- Configuration tool
- Remote control
- Combined interface
- Range extender
- Mains power outlet

▪ Closures

- Shade
- Shade controller

▪ HVAC

- Heating/cooling unit
- Thermostat
- Temperature sensor
- Pump
- Pump controller
- Pressure sensor
- Flow sensor

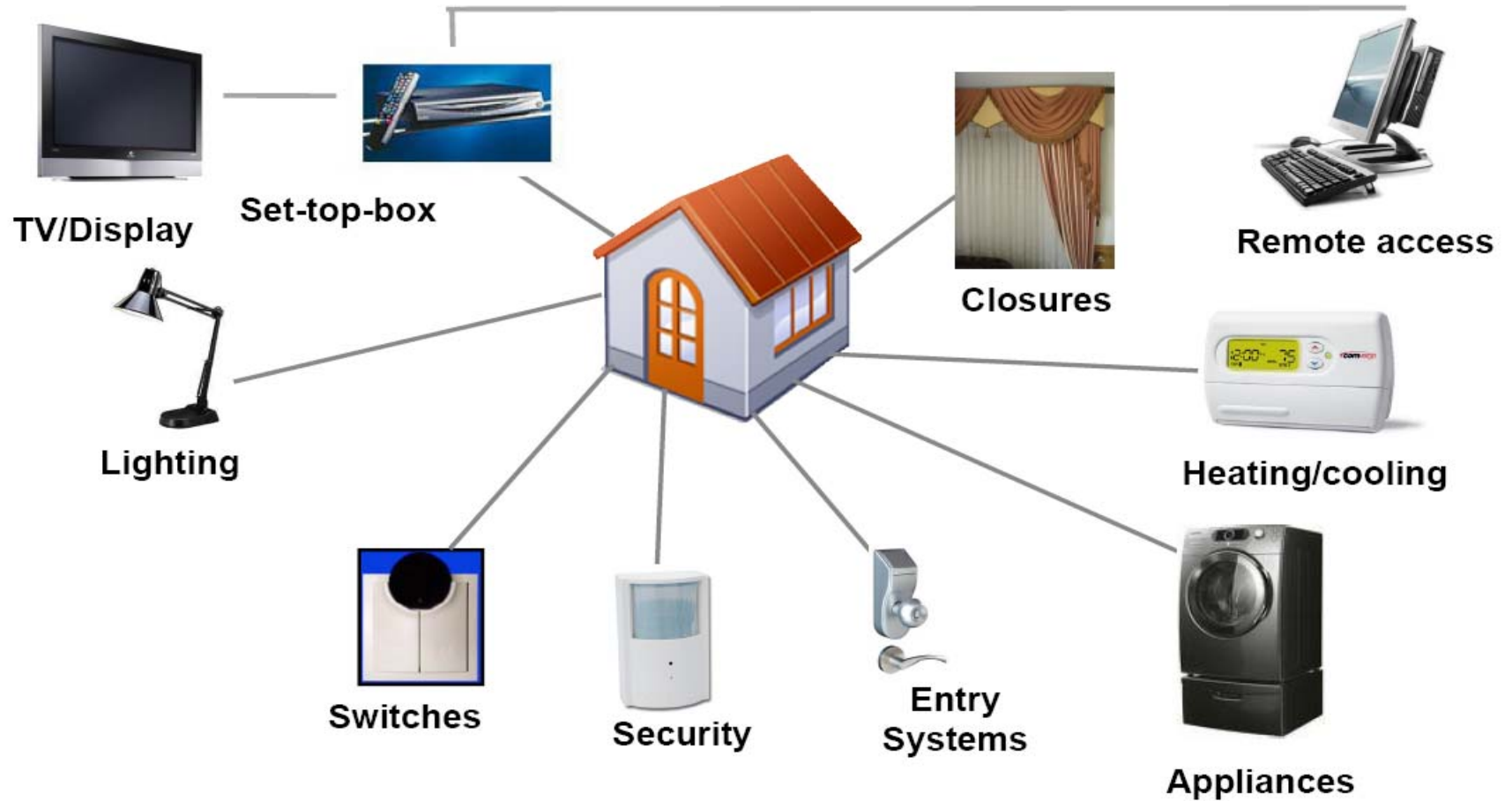
▪ Intruder alarm systems

- IAS control and indicating equipment
- IAS ancillary control equipment
- IAS zone
- IAS warning device

▪ Lighting

- On/off light
- Dimmable light
- Color dimmable light
- On/off light switch
- Dimmer switch
- Color dimmer switch
- Light sensor
- Occupancy sensor

HA: Home Control.



▪ **Scope & Purpose**

- The PHHC profile will be used by all the devices which jointly cooperate to fulfill the requirements of a non-invasive health care application.
The devices involved in a health care application could be separated in medical devices (blood pressure monitor, oxygen saturation monitor, EEG, etc.) and non-medical devices (gateway, cell phone, light system, etc.).
The health care application use cases presented in this document can be logically separated into the following categories:
 - Chronic disease monitoring
 - Personal wellness monitoring (ensuring an individual's wellness and safety)
 - Physical fitness
 - Elderly care – assisted living

▪ **Status**

- Market Requirements Document
- Profile Specification
- Test Program

Complete
In Progress
/



▪ **Data Collection Unit**

- The Data Collection Unit (DCU) gathers the data from the different on-body medical and non-medical devices and delivers it to a gateway. The DCU might perform some local aggregation and/or compression before sending the data to a gateway. Typically, a DCU is a portable device that is more capable than the on-body devices (medical or non-medical). Its functionality could be integrated into a mobile device such as a PDA or phone.

▪ **Electrocardiograph**

- This is a device that records and measures the electrical activity of the heart over time. The frequency of measurement is a few times a day, or continuously for periods of a few hours in some use cases.

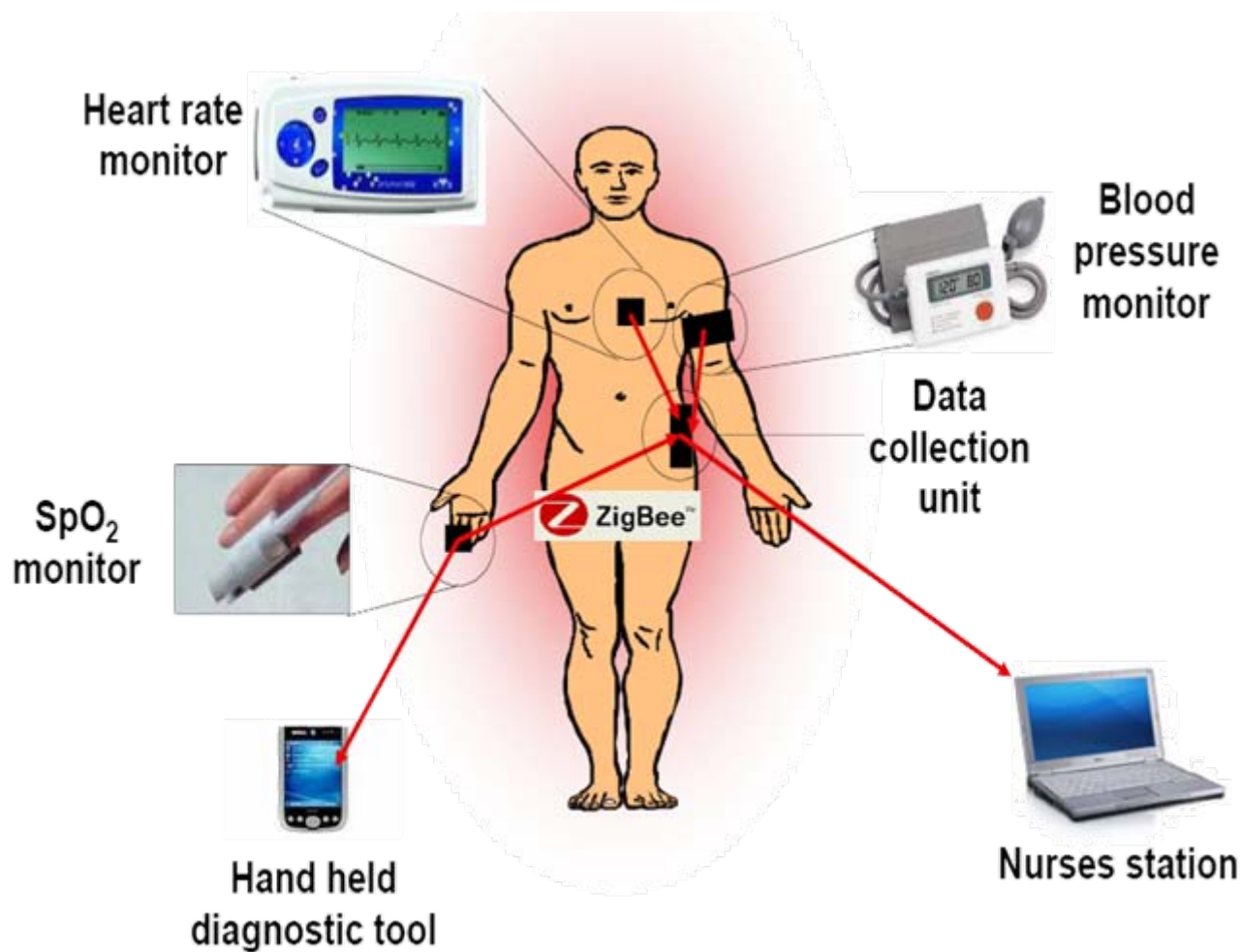
▪ **Pulse Monitor**

- A pulse monitor measures a *proxy* value for the heart rate. For healthy persons, the value of this measure is an accurate measure for the heart rate. The frequency of measurement varies from a few times per second to a small number of times per day.

▪ **Sphygmomanometer**

- A sphygmomanometer (blood pressure meter) is a device that measures the blood pressure. Typically, the frequency of measurement is several times a day.

PHHC: Patient Monitoring.



PHHC: Assisted Living.

Facility



Smoke Detector



Residents



Positioning Strap



Panic Button Fall Detector



Staff



Central Monitoring Station



▪ **Scope & Purpose**

- Applications for two-way communications of metering data and energy management to provide more efficient and reliable energy usage. Goes beyond automated meter reading to demand-response systems for real-time pricing and voluntary load shedding.

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- **Features supported by ZSE profile include:**

- Basic metering [measurements, historical information, etc]
- Demand Response (DR) and Load Control
- Pricing [multiple units and currencies, price tiers, etc.]
- Text messages
- Device support for Programmable Communicating Tstats (PCTs), In Home Displays (IHDs), Load Control Devices, Energy Management Systems, etc.
- Security to allow consumer only, utility only or shared networks



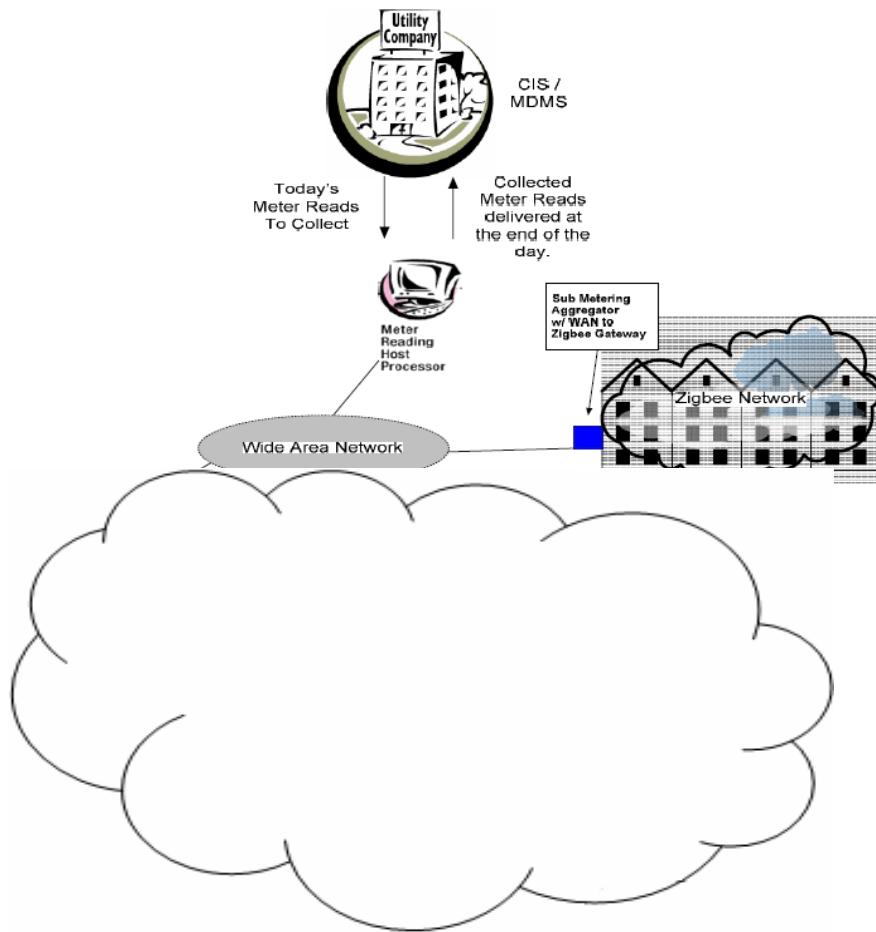
- **Energy Services Portal**
 - The Energy Services Portal connects the energy supply company communication network to the metering and energy management devices within the home. It may be installed within a meter, thermostat, in-premise display, or may be a standalone device, and it will contain another non-ZigBee communication module (e.g. powerline carrier, RF, GPRS).

- **Metering End Device**
 - The Metering End Device is a meter (electricity, gas, water, heat) that is fitted with a ZigBee device. Depending on what is being metered the device may be capable of immediate (requested) reads or it will send autonomously readings periodically. A Metering End Device may also be capable of communicating certain status indicators (e.g. battery low, tamper detected).

- **In-Premise Display**
 - The In-Premise Display will relay energy consumption data to the user by way of a graphical or text display. The display may or may not be an interactive device. At a minimum it will show current energy usage, a history over selectable periods, billing information and efficiency data. The display may also show critical pricing information to advise the customer when peaks are due to occur so that they can take appropriate action.

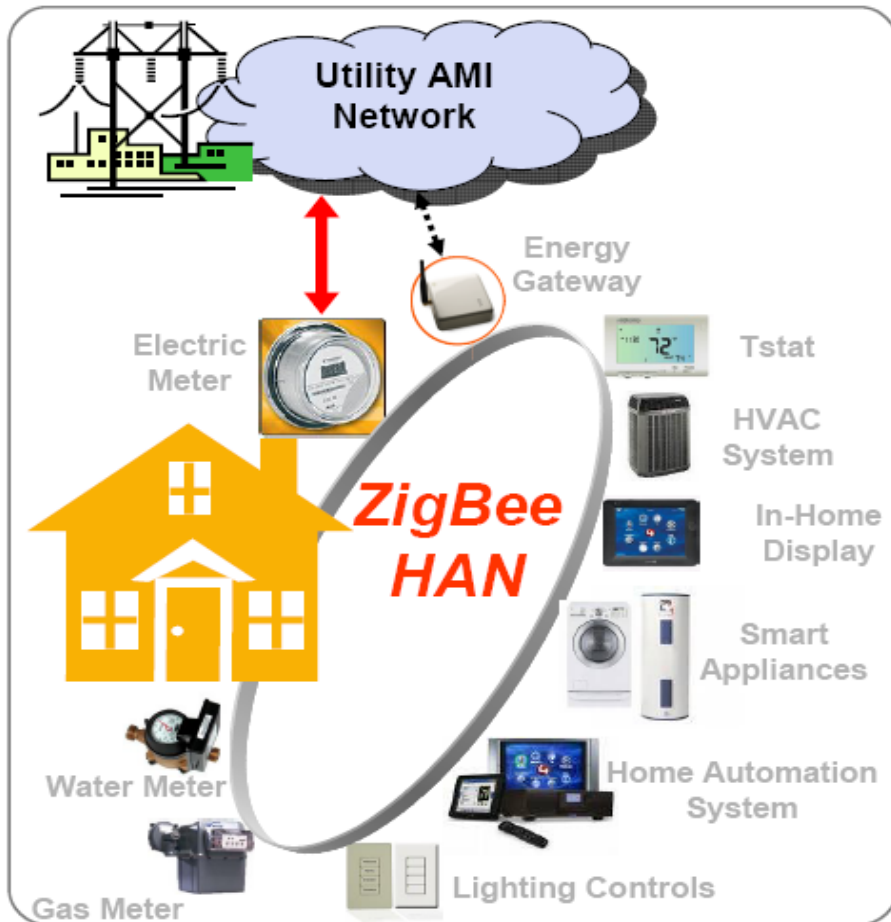
- **Others**
 - Extension of Home and Commercial Building Automation devices for use with Ami services such as load shedding.

SE : Enhanced AMI.



- **ZigBee[®]** helps extend the infrastructure of Advanced Metering beyond meter reading to include two way communications
- **Makes possible:**
 - Improved grid reliability and efficient energy delivery
 - Two-way communication between utility and customer
 - Real-time pricing and true competition in the energy market
 - Enhanced consumer control over balance between lifestyle and budget

Home Area Networks Advanced Energy Management.



- Urgent demand for Smart Energy + Home automation systems compatibility
- Makes possible:
 - Time-of-use pricing
 - Demand-Response / Load control
 - Customer choice
- ZigBee[®] is the Wireless HAN technology of choice :
 - Mature, open standard
 - Proven, robust, secured
 - Selected by leading AMI/HAN deployments



Where to find ZigBee® Smart Energy ?



California	
Southern California Edison	Regulatory approval; large scale pilot 2008; ZigBee specified for HAN
Pacific Gas & Electric (PG&E)	Regulatory approval; large scale pilot 2008; Open Standard specified for HAN, Using ZigBee SE
San Diego Gas and Electric	Regulatory approval; large scale pilot 2008; Open Standard specified for HAN, Using ZigBee SE
Texas	
CenterPoint	Filed plans to pilot 250,000 meters with ZigBee Smart Energy
Oncor	Filed plans to deploy 3.3M smart meters using ZigBee Smart Energy
Reliant Energy	Rolling out ZigBee Smart Energy products to residential customers
TXU	Offering free demand response thermostats using ZigBee Smart Energy
Others in USA	
Detroit Edison	Plan to automate 2.6M electric and 700K gas meters starting in 2009, using ZigBee Smart Energy
Virginia	Dominion putting out 200K unit pilot using ZigBee Smart Energy
Australia	
Victoria	Mandatory rollout beginning Q1 2009; ZigBee Smart Energy required for HAN
New South Wales	Proposal + approval underway
Europe	
Gothenburg, Sweden	ZigBee NAN (Last Mile Communications) in deployment now (300K to Q1 2009) with support for future ZigBee HAN (Local Communications) adoption
Others...	Various European trials not widely publicised yet, mainly for AMR/NAN/Last Mile communications

▪ **Scope & Purpose**

- The profile will be applied in telecom value-added services and supplementary services to enhance and fulfill the telecom network functions, and it also includes some applications integrated with some mobile terminals and plug-in modules.

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- **ZigBee Mobile Terminal**

- ZigBee[®] Mobile Terminal will integrate functions of a general mobile device and functions of a ZigBee[®] device into one single device. Note a general mobile device could be a cellular phone, a PDA, a Wi-Fi phone or a WiMax phone in the future.

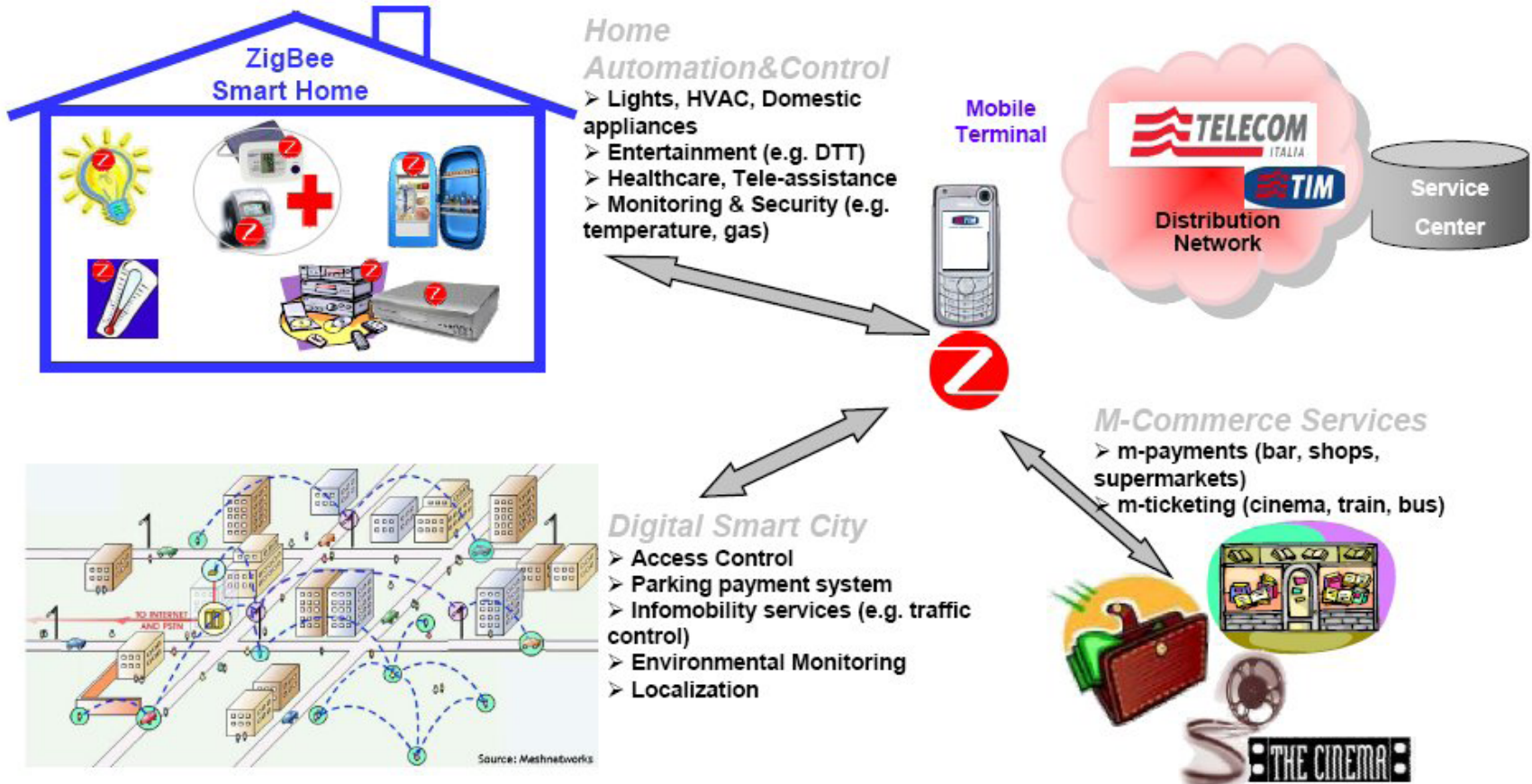
- **ZigBee SIM Card**

- ZigBee[®] SIM Card is a Subscriber Identity Module (SIM) card providing ZigBee functionalities such as wireless short-range connection, secure data transfer and profile functions (deriving from TA Profile or other ZigBee[®] profiles).

- **ZigBee Point-of-Sales**

- ZigBee[®] Point of Sales (ZigBee[®] POS) is a device that can be used for payments services (e.g. mobile payments). It can communicate to ZigBee[®] TA profile devices like ZigBee[®] Mobile Terminal and ZigBee[®] SIM card in order to operate payment transactions or deliver an electronic product code to complete required payment operations.

Handset is the hub of the interaction between user and objects



▪ **Scope & Purpose**

- This profile is designed to enable wireless sensor network (WSN) applications. Three distinct applications are defined that can be categorized as WSN applications:
 - *Environmental Monitoring* of either indoor or outdoor areas
 - *Asset Tracking* of mobile tagged-things or persons
 - *Structural or Machine Monitoring*
- Installation scenarios may include areas with little or no infrastructure such as networks that are deployed outdoors, or as temporary installations. In such situations, the assumption of a powered backbone is no longer tenable. The nodes themselves should be capable of *battery powered routing* or forwarding of their neighbors' data to one or more centralized *collection points*. Note that with sensor data, the key assumption is that the data must be collected and pulled out of the network.

▪ **Status**

- | | |
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| ○ Profile Specification | In Progress |

▪ Profiles Organisation

- Can be public or manufacturer specific
- Public profile development follows a well defined procedure
- The ZigBee Cluster Library provides a repository of functionality
- Profiles are built incrementally
- Manufacturer specific extensions can be added

▪ Profiles in Development

- Advanced Metering Infrastructure
- Commercial Building Automation
- Home Automation
- Personal, Home & Hospital Care
- Telecom Applications
- Wireless Sensor Applications

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