WF 311: Introduction to ZigBee Public Application Profiles

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Agenda

- ZigBee Primer
- ZigBee "Feature Sets"
- ZigBee "Profiles"
- Current Public Application Profiles
- Technology Partnerships

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ZIGBEE PRIMER

The ZigBee Alliance

"The ZigBee Alliance is a global ecosystem of companies creating wireless solutions for use in residential, commercial and industrial applications. The ZigBee Alliance companies work together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard. The ZigBee Alliance membership comprises technology providers and original equipment manufacturers worldwide. Membership is open to all."

More than 300 members,

including Digi International

Origins of the ZigBee Name

Honey Bee Biology/Sociology:

Using a communication system, whereby a bee dances in a zig-zag pattern, worker bees are able to share information such as the distance and direction of a newly discovered food source to fellow colony members.

ZigBee & IEEE 802.15.4

- ZigBee uses the PHY and MAC defined by 802.15.4

- Accordingly, ZigBee is a WPAN network, but with added networking intelligence

- ZigBee inherits the RF characteristics of its 802.15.4 platform:
  - RF Link Budget
 - Current Draw

Simplified ZigBee Stack
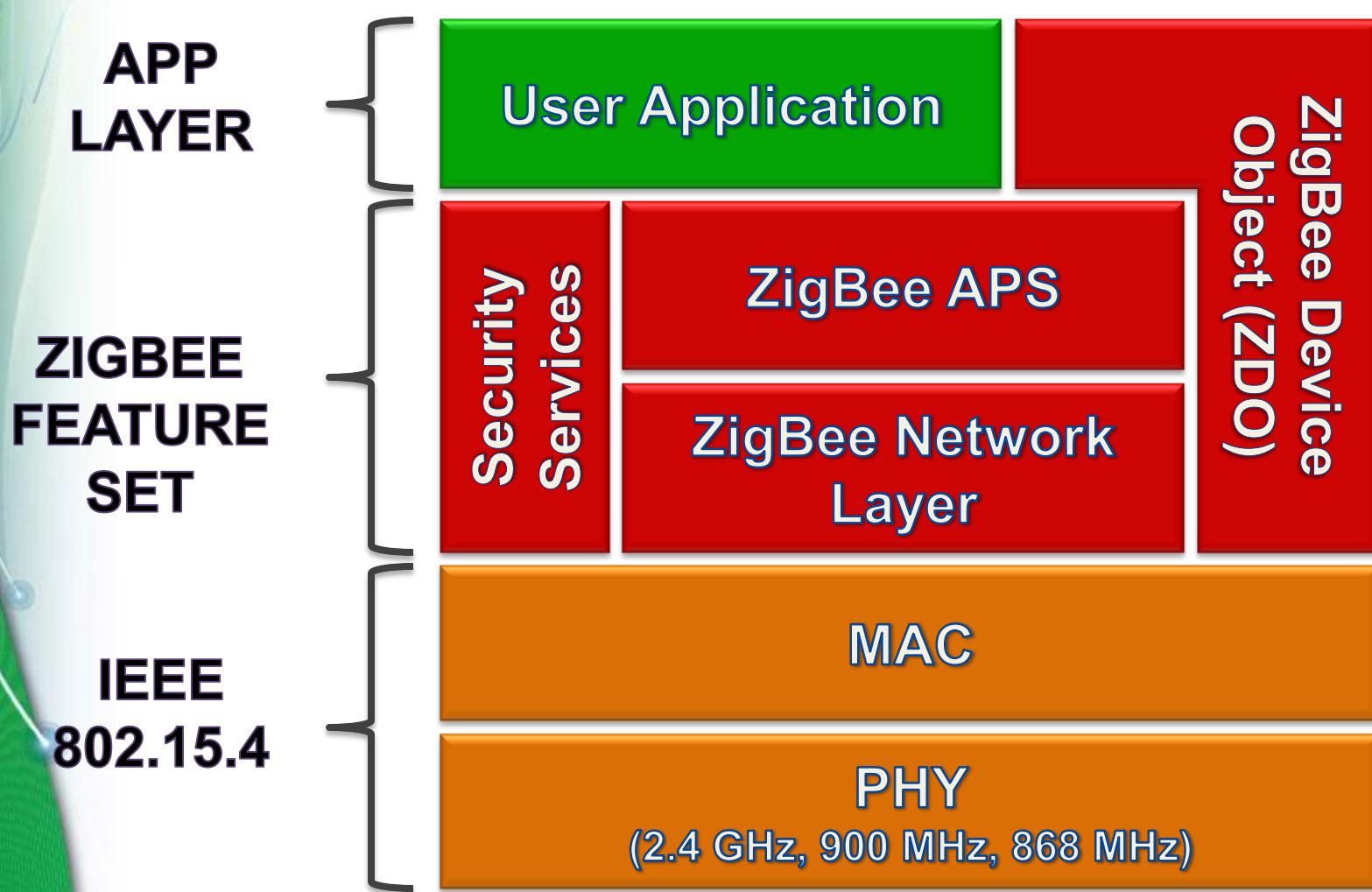
FEATURE SETS

Simplified ZigBee Stack

APP LAYER
- User Application

ZIGBEE FEATURE SET
- Security Services
- ZigBee APS
- ZigBee Network Layer
- ZigBee Device Object (ZDO)

IEEE 802.15.4
- MAC
- PHY (2.4 GHz, 900 MHz, 868 MHz)
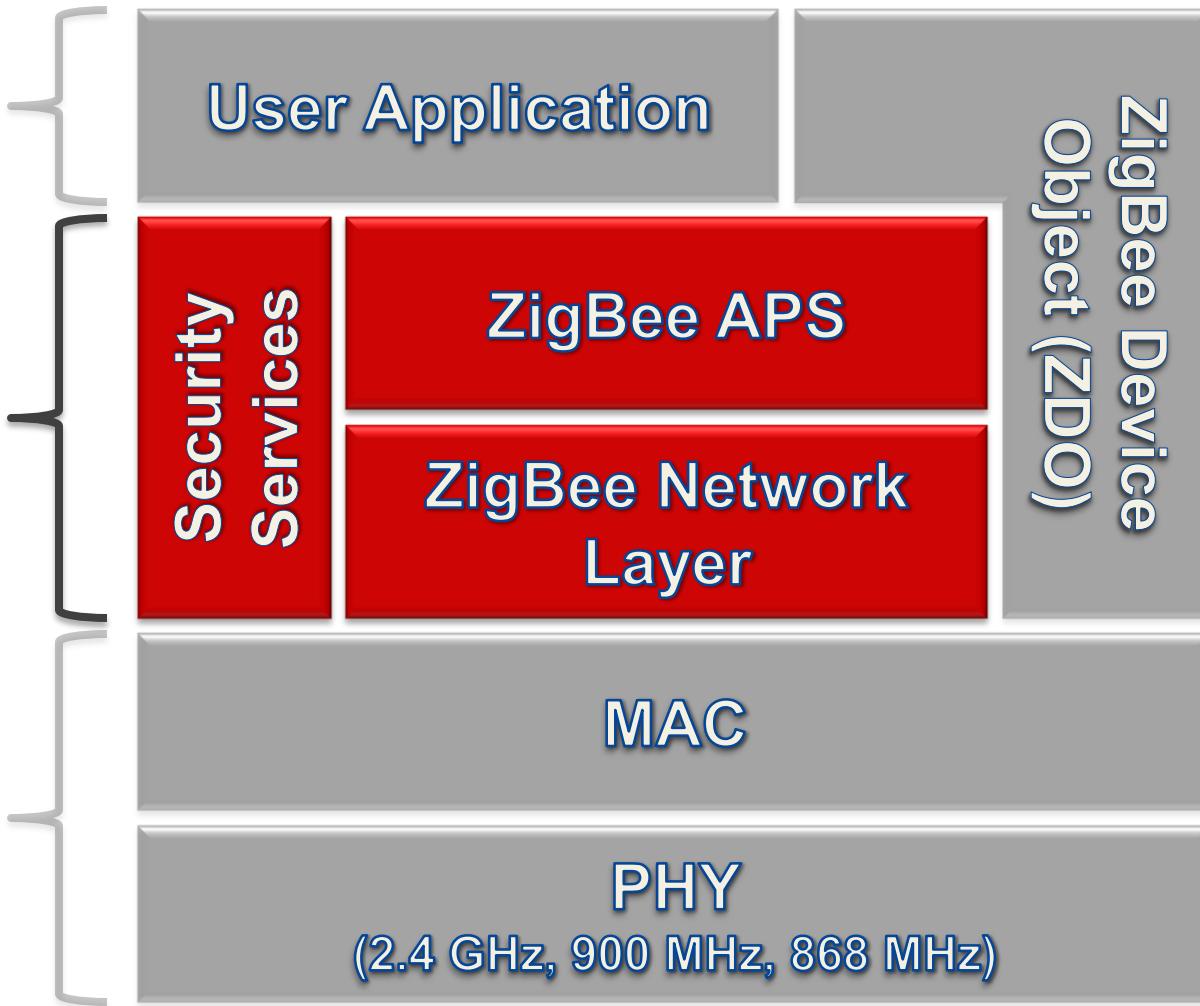
"A Feature Set refers to a group, or set, of features."

-- ZigBee Alliance Definition

www.digi.com

ZigBee Feature Sets

- Focused on the wireless networking:
  - Commissioning
  - Joining
  - How data flows through the network
- What we really mean is what features are supported in a version of the ZigBee specification, similar to a protocol revision.
- When you hear "Feature Set" in the context of ZigBee, think about it in terms of how the network itself behaves.

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Features At-A-Glance

Feature	ZigBee Feature Set	ZigBee PRO Feature Set
Network Scalability	Easily supports networks of hundreds of devices	Advanced support for networks of thousands of devices
Fragmentation	O	X
Frequency Agility	O	X
Channel Selection	X	X
Automated Device Address Management	X	X+
Group Addressing	X	X+
Wireless Commissioning	X	X+
Centralized Data Collection	X	X+
Device Maintenance & Network Recovery	X	X
Group Broadcasts	X	X
Compatibility	Devices can participate in ZigBee and ZigBee PRO networks	Devices can participate in ZigBee and ZigBee PRO networks
AES128 Encryption/ Authentication/ Trust Centers	X	X
IEEE 802.15.4 Physical Radio	X	X
Global Operation in 2.4 GHz plus 915MHz Americas / 868 MHz Europe	X	X
Single-hop Extended Range - up to Hundreds of Meters	X	X
Reliable Self-Healing Mesh Network	X	X
Ultra Low-Power, Long Battery Life	X	X
Low Cost	X	X
Network Traffic Load	Average	Increased

Legend:
X – Standard
+ – Optimized
O – Optional

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PROFILES

Simplified ZigBee Stack

APP. LAYER

ZIGBEE FEATURE SET

IEEE 802.15.4

PAP/MSP

ZigBee Device Object (ZDO)

Security Services

ZigBee APS

ZigBee Network Layer

MAC

PHY
(2.4 GHz, 900 MHz, 868 MHz)

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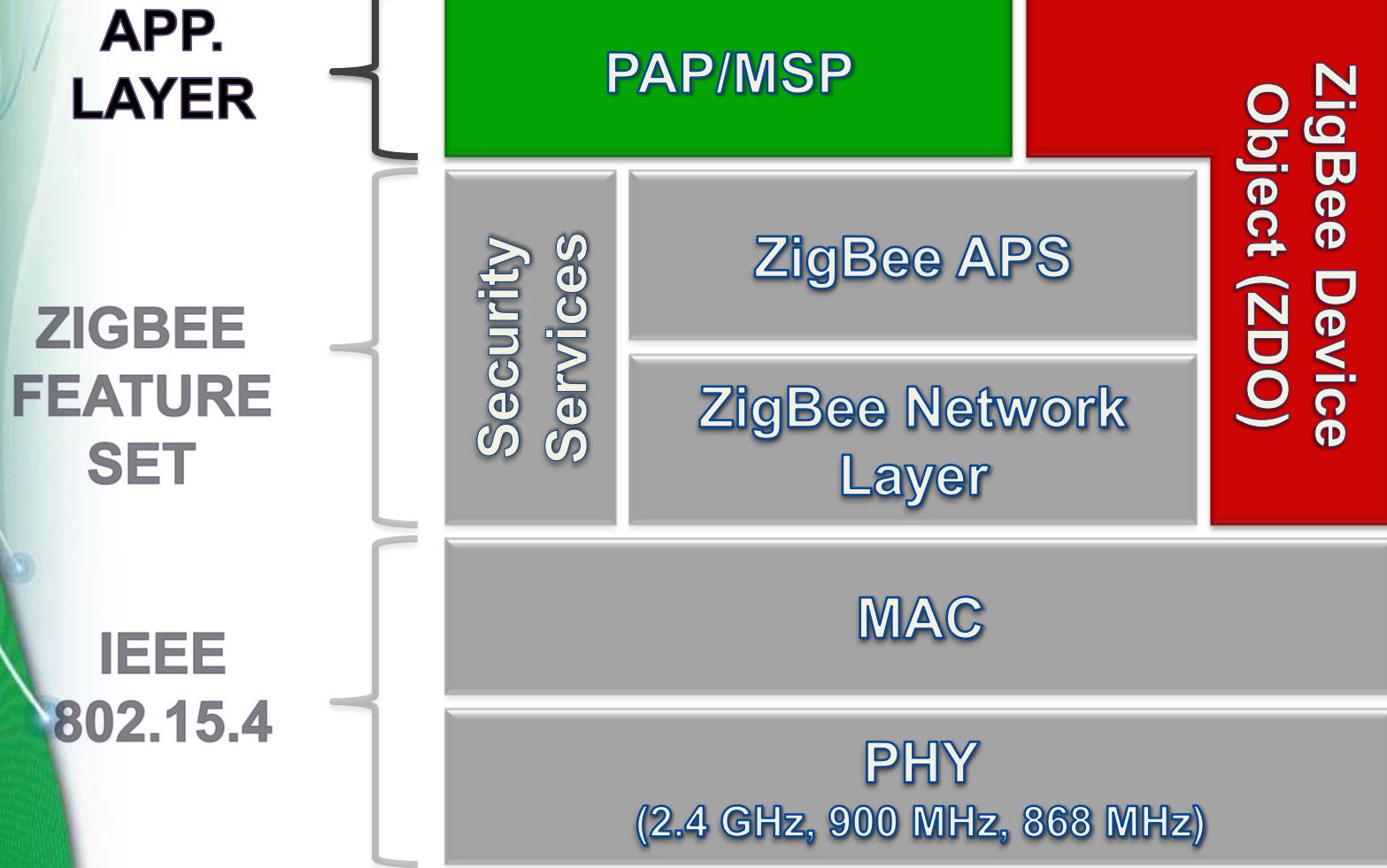
"A Public Application Profile runs on ZigBee devices and contains specific details about what information a device can communicate and how this device should interact with other devices on the ZigBee network."

-- ZigBee Alliance Definition

Profiles

- From the Alliance:
  - A set of devices required in the application area
  - Set of clusters to implement the functionality (clusters represent a set of attributes and commands shared between a client/server binding)

- From Digi:
  - With the Feature Set, we were thinking "Networking Protocol". Beyond this, Profiles define how Devices themselves behave.

- Profiles can be "Public" or "Private/Manufacturer-Specific"

Manufacturer-Specific Profile

- Interoperable with other ZigBee devices at the networking layer (joining, routing, etc…)

- For manufacturer specific or proprietary applications

- Developed privately, outside of the Alliance

- Must use a ZigBee allocated profile identifier

- Ultimately must undergo network testing to ensure they function as "good ZigBee citizens"

Public Application Profiles

- Interoperable at the network & application layers (beyond networking, interoperable at the device level)

- More generic applications than MSP

- Developed publicly within the Alliance, with significant peer-review

- There is an established process within the Alliance to vet and develop Public Application Profiles (Profile Lifecycle)

- Enable end products to undergo certification

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CURRENT PUBLIC APPLICATION PROFILES

Commercial Building Automation (CBA)

- Applications targeted at commercial building environment. May: have a coverage area in excess of 100,000 sq ft; be professionally managed; have unique access control/security requirements; require working with other protocols (e.g. BACnet).

- Status:
  - MRD Complete
  - Profile Specification Complete
  - Test Program In-Progress

Home Automation (HA)

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

- Status:
  - MRD Complete
  - Profile Specification Complete
  - Test Program Complete

Personal Home & Hospital Care (PHHC)

- PHHC profile will be used by all the devices which jointly cooperate to fulfill the requirements of a non-invasive health care application. Use cases include:
  - Chronic Disease Monitoring
  - Personal Wellness Monitoring
  - Physical Fitness

- Status:
  - MRD Complete
  - TRD Complete
  - Profile Specification In-Progress

Smart Energy (SE)

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

- Status:
  - MRD Complete
  - TRD Complete
  - 1.0 Profile Specification Complete
    - 1.7 & 2.0 underway
  - Test Program Complete

Telecom (TA)

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

- Status:
    - MRD Complete
    - TRD Complete
    - Specification In-Progress

Wireless Sensor Applications

- This profile is designed to enable wireless sensors networks (WSN) applications, including:
  - Environmental Monitoring
  - Asset Tracking
  - Structural or Machine Monitoring
- Status:
  - MRD Complete
  - Profile Specification In-Progress

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TECHNOLOGY PARTNERSHIPS

Building Automation & Control Network (BACnet)

- Open Standard deployed in 1995

- Protocol using various wired technologies (including MS/TP, PTP, LonTalk, ArcNet, and Ethernet) to manage building assets (HVAC, Lighting, Access Control, Fire Detection, and more).

- ZigBee & BACnet: Work being done on the Commercial Building Automation (CBA) profile to "tunnel" BACnet protocol through a ZigBee network.

HomePlug Powerline Alliance

- "Ethernet in your power outlet": Turn your home or office's power outlet and existing wiring into an Ethernet connection.

- Some limitations with split phase wiring; coverage is not always complete.

- ZigBee & HomePlug: Work being done in the Smart Energy (SE) profile to make SE devices seamless with HomePlug devices.

RF For Consumer Electronics (RF4CE)

- New open standard, became known as "ZigBee RF4CE" per the Alliance, in March of 2009.

- Using RF technology instead of Infrared (IR) technology to control consumer electronics.

- ZigBee RF4CE: New Public Profile in development.

Future of ZigBee & Profiles

- More Public Application Profiles (member-submitted)
- Maturing and iterative improvement of existing Public Application Profiles.
- Smart Energy will fully adopt a 2.0 profile that will likely be a substantial departure from the current version (not compatible).
- RF4CE will likely merge with Home Automation.
- More work will be done to bridge profiles to one another.
- More technology partnerships will likely come— focused on empowering wireline protocols with wireless functionality.