APPA Facilities Drive–In Workshop

Wireless Building Technologies for the Building Automation Industry
Welcome!

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Technology Comparison

Lets Lay a Brief Foundation

Facts, Fiction or Marketing

- EnOcean
- Zigbee
- Z-Wave
- WiFi
- RFID
- Bluetooth
- OneNet
- SP100
- 6LowPAN
Technology Comparison

- Radio Frequency Range
- Speed
- Data Packet
- Range
- Network Topology
- Open Protocols
Radio Frequency Range

**EnOcean** 868.3 MHz, 315 MHz (Garage door, Keyless Door)

**Z-Wave** 900 MHz bands (Cell Phones)

**RFID** 125 KHz, 134 KHz, 13.56 MHz

**Wi-Fi** 2.4 GHz, 5 GHz

**Zigbee** 900 MHz in US, 868 MHz in Europe, and 2.4 GHz

*Note:*
- Industry concern over long term potential conflict in the 2.4 GHz frequency band.
- Some of the other bands are more regional and are not accepted world wide.
### Speed

<table>
<thead>
<tr>
<th>Technology</th>
<th>Speed</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnOcean</td>
<td>120 Kbits/s</td>
<td>Low</td>
</tr>
<tr>
<td>Z-Wave</td>
<td>40 Kbits/s</td>
<td>Very Low</td>
</tr>
<tr>
<td>RFID</td>
<td>?</td>
<td>Low to Medium</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>110 Mbps</td>
<td>High</td>
</tr>
<tr>
<td>Zigbee</td>
<td>192 – 250 Kbits/s</td>
<td>Low</td>
</tr>
</tbody>
</table>

What is the point of the low speeds?
- Saves power by sending very limited data
- Less collisions, less network management
## Data Packet-Security?

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Packet Size</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnOcean</td>
<td>14 Bytes</td>
<td>No security</td>
</tr>
<tr>
<td>Z-Wave</td>
<td>Small</td>
<td>?</td>
</tr>
<tr>
<td>RFID</td>
<td>Variable</td>
<td>Security</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Variable</td>
<td>Security</td>
</tr>
<tr>
<td>Zigbee</td>
<td>128 Bytes</td>
<td>Security capable</td>
</tr>
</tbody>
</table>
## Range

<table>
<thead>
<tr>
<th>Technology</th>
<th>Distance</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnOcean</td>
<td>300 meters</td>
<td>Limited interference on unregulated ban</td>
</tr>
<tr>
<td>Z-Wave</td>
<td>30 meters</td>
<td>Limited interference on unregulated ban</td>
</tr>
<tr>
<td>RFID</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>100 meters</td>
<td></td>
</tr>
<tr>
<td>Zigbee</td>
<td>50 meters</td>
<td>Potential interference with Wi-Fi</td>
</tr>
</tbody>
</table>
Network Topology

• What is a Mesh Network?
  * Allows a device to seamlessly re-route itself when a specific communication route is disrupted. Self Healing.
  * BUT, battery powered devices can’t be used for Mesh routers

• Wireless Network Types
  ❖ EnOcean
  ❖ Z-Wave  Mesh
  ❖ RFID
  ❖ Wi-Fi  Mesh
  ❖ Zigbee  Mesh
# Open Protocols

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnOcean</td>
<td>Proprietary, Published</td>
</tr>
<tr>
<td>Z-Wave</td>
<td>Proprietary</td>
</tr>
<tr>
<td>RFID</td>
<td>Open</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Open</td>
</tr>
<tr>
<td>Zigbee</td>
<td>Open</td>
</tr>
</tbody>
</table>

Reminders of *Lonworks versus BACnet* Open Protocol......

When specific manufactures control the protocol and licensing it is not “OPEN”
EnOcean

- EnOcean (Siemens) provides the transmitters, receivers, transceivers to manufactures
- EnOcean equipment profiles to insure interoperability
- Self powered devices, NO batteries
- Uses electromagnetic, piezogenerators, solar cells and thermocouples to generate the very small power requirements allowing for sustained energy.
- Uses special techniques to minimize RF energy use
Z-Wave

- Zensys provides embedded software and Z-Wave chip for manufactures use
- Aiming for residential and light commercial markets
- Mesh network
- Large selection of sensors and devices accommodating a wide variety of applications
RFID (radio-frequency identification)

- It can’t control anything, only identifies
- Asset management and security
- Passive and active (requires batteries) tags
Wi-Fi

- Wireless Ethernet
- Very high data capacity
- Seeing wireless Ethernet DDC panels
- Typically requires substantial quantities of power
- World wide acceptance
Zigbee

- Open Protocol
- Residential, Building and Industrial control devices
- Mesh technology
- Requires power source, batteries
- Can support multiple sensing requirements
- May have security support
- Claim to have largest installed base of wireless building automation networks
Focus on Zigbee
What is ZigBee?

- A Standard Global Protocol Developed and Supported by 300+ Companies Around the World
- ZigBee Meets Key Market Needs
  - No new wires
  - Easy to install and maintain (mesh, self-organizing)
  - Reliability (self-healing)
  - Ability to scale to thousands of devices (nodes)
  - Long battery life (years on a AA battery)
  - Low cost (open standard, multi-vendor availability)
- Solutions Available Today From Thriving Ecosystem
  - Robust, Diverse Value and Supply Chain
    - Silicon ➔ Platforms ➔ Modules ➔ Tools ➔ Products
ZigBee and ZigBee PRO Network Communication Model (Mesh Routing)

Note: Mesh networking is a bandwidth and RAM efficient routing method. Mesh is supported by both ZigBee and ZigBee Pro networks.
Security at each layer:
- Network (NWK) layer security for network command frames (route request, route reply, route error)
- Application (APL) layer security for Application Support Sub-layer (APS) frames

Security Mode
- Standard Mode (ZigBee and PRO feature sets) – Mandatory Use of Network keys, Application security can be done via network key. Ability to switch network keys. Optional use of Application Link Keys for pairs of communicating devices at APL.

Security Implementation
- Trust Center – Creates and distributes the Network Keys. Manages switch from active to secondary Network Key.
- Optionally supports Master Keys and Trust Center Link Key establishment and transport
- Application profile determines security level in use in a given network – SE uses ECC to device secure application link keys
Application Profiles
Where are Profiles Targeted?

- **BUILDING AUTOMATION**
  - Security
  - HVAC
  - AMR
  - Lighting Control
  - Access Control

- **ENERGY MGT. & EFFICIENCY**
  - Demand Response
  - Net Metering
  - AMI, SCADA

- **CONSUMER ELECTRONICS**
  - TV
  - VCR
  - DVD/CD
  - Universal Remotes

- **PERSONAL HEALTH CARE**
  - Patient monitoring
  - Fitness monitoring

- **PC & PERIPHERALS**
  - Mouse
  - Keyboard
  - Joystick

- **INDUSTRIAL CONTROL**
  - Asset Mgt
  - Process Control
  - Environmental Energy Mgt

- **TELECOM SERVICES**
  - M-commerce
  - Info Services
  - Object Interaction (Internet of Things)

- **HOME CONTROL**
  - Security
  - HVAC
  - Lighting Control
  - Access Control
  - Irrigation

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Zigbee Mesh Products

- Solar powered
- Battery backup
- External binary input
- Temperature
- Setpoint adjust
- Occupancy button
- Humidity sensor
- CO₂
- Motion
- Lighting relays
- Lighting Switches
More Information....

ZigBee Alliance  http://zigbee.org
Delta Controls  http://deltacontrols.com
ESC Automation  http://escautomation.com
Thank You!

WWW.ESCAUTOMATION.COM

WWW.Deltacontrols.com