ZigBee Overview
Introduction
What is ZigBee?

ZigBee is the Global Wireless Language Connecting Dramatically Different Devices to Work Together and Enhance Everyday Life.
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
Purpose of ZigBee

![ZigBee logo]

Create a Much Needed Global Wireless Language

- ZigBee gives a *voice* to the myriad of everyday devices that surround us as we go about our daily lives.
- These devices are overlooked in an IT centric world:
  - Light switches, thermostats, electricity meters
  - More complex sensor devices found abundantly in the commercial building and industrial automation worlds
The goal of the ZigBee Alliance is to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into everyday devices.

ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide.

For the first time, companies will have a standards-based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, low-cost and low-power.
ZigBee Alliance Mission

Focus

- Defining the Network, Security and Application software layers
- Providing Interoperability and Conformance testing specifications
- Promoting the ZigBee brand globally to Build Market Awareness
- Managing the evolution of the technology
Target Markets
ZigBee Use Areas

PERSONAL HEALTH CARE
- Patient monitoring
- Fitness monitoring

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

PC & PERIPHERALS
- Mouse
- Keyboard
- Joystick

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

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ZigBee Target Markets

- Building
- Energy
- Health
- Home
- Telecom

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ZigBee Alliance: Growing Markets for Success

- **Alliance Overview**
  - Independent, vendor-neutral, non-profit corporation founded in 2002

- **Activity Includes**
  - Specification and Public Application Profile creation
  - Certification and Compliance Program development and administration
  - Market Development
  - User Education

- **Open and Global Membership**
  - Anyone can join and participate
  - 300+ Members from the America’s, EMEA, and Asia/Pacific
ZigBee Alliance: Growing Markets for Success

Three Tier Membership Structure

- **Promoter Level** – $50,000 – (Limited) Designed for companies wanting final approval of specification and a seat on the Board of Directors
- **Participant Level** – $9,500 – Designed for companies contributing IP, wanting input to specification/public application profiles and early access to all Alliance work and internal information
- **Adopter Level** – $3,500 – Designed for companies simply wanting participation in public application profile task groups and/or ability to use ZigBee IP in products

Membership Benefits

- Promoters have access to everything, plus seat on Board of Directors
- Participants have access to everything
- Adopters must wait for access to completed specifications and public application profiles

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# ZigBee Alliance: Growing Markets for Success

## Membership Benefits

<table>
<thead>
<tr>
<th>Membership Benefits</th>
<th>Participant $9,500 Year</th>
<th>Adopter $3,500 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute IP to specification</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Contribute/vote on specifications/profiles</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Early access to specifications/profiles</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Use of final specifications/profiles</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Participate and vote in working groups</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Participate and vote in profile task groups</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chair working groups</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Access to Alliance e-mail reflectors</td>
<td>✓</td>
<td>Limited</td>
</tr>
<tr>
<td>Attend Semi-Annual Alliance Meetings</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Attend ZigFest Workshops</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ship products using ZigBee IP</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use ZigBee Logos (per Guidelines)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Access to ZigBee Alliance Member Page</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Access to ZigBee Alliance Adopter Page</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
ZigBee Alliance: Growing Markets for Success

When Membership is Required
- ZigBee Membership is required to use the ZigBee member IP for any organization that is creating/designing products for sale
  - Membership provides access to ZigBee Alliance IP
  - Membership is required regardless of whether the device is certified
  - As long as your company uses the ZigBee name and logo

When Must My Company Join?
- Membership must be placed before selling products or offering products for sale
  - Joining today offers immediate benefits:
    - Networking for strategic partnerships among existing members
    - Gain access to internal information, activities and meetings
    - Events like ZigFest are critical for compatibility and interoperability testing prior to market launch
## ZigBee Alliance: Growing Markets for Success

<table>
<thead>
<tr>
<th>Scenario</th>
<th>ZigBee Membership Required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
</tr>
<tr>
<td>Company creating/designing products for sale</td>
<td></td>
</tr>
<tr>
<td>Company offering services or reselling products</td>
<td>✓</td>
</tr>
<tr>
<td>Installer</td>
<td></td>
</tr>
<tr>
<td>Reseller/Retailer</td>
<td>✓</td>
</tr>
<tr>
<td>User</td>
<td></td>
</tr>
<tr>
<td>Architect, Designers, Builder, Owner</td>
<td></td>
</tr>
<tr>
<td>Contractor designing products for ZigBee member</td>
<td>✓</td>
</tr>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Design House</td>
<td></td>
</tr>
</tbody>
</table>

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Certification Programs
ZigBee: Certified Programs for Your Success

10 Step Certification Process:
1. Join the Alliance
2. Apply for Certification
3. Submit Platform/Product(s) to Authorized Test Provider
4. Test Provider Notifies ZigBee Alliance of Successful Completion
5. Member Company Submits Certification Paperwork to Certification Body
6. ZigBee Management Firm Confirms Membership
7. ZigBee Alliance Conducts Review and Approval
8. Alliance Conducts Compliance Audit
9. Notification and Publication of Certification
10. Certification Issued
ZigBee: Certified Programs for Your Success

ZigBee Certified Platform

- The basic hardware/software (chipset and stack) combination needed to create any ZigBee device
- Testing for new platforms is more complicated and takes substantially more time
- Device is promoted on ZigBee.org website
- No ZigBee logo use but may state ZCP is “ZigBee Compliant”
ZigBee Certified Products

- Product is based on an approved and unchanged ZigBee Certified Platform
- A product for use
  - By an end-user (will have a SKU or UPC)
  - Or to be implemented (module) by a manufacturer
- Testing for simple pre-qualified end-products, typically takes one day or less of test lab time
  - Prequalification can be achieved by successfully operating at a ZigFest or similar testing against existing ZigBee Certified Products
- Product is promoted on ZigBee.org website
- Qualifies for ZigBee Certified Product Logo use
ZigBee: Certified Programs for Your Success

- **Designed for ZigBee**
  - Products that have agreed to seek ZigBee Certified Product status may use this temporary description
  - Device is promoted on ZigBee.org website for six months
  - No logo usage allowed
ZigBee: Certified Programs for Your Success

ZigBee Logo Usage on Products

- The ZigBee logo may be used for ZigBee Certified Products based on Public Application Profiles
- Logo may be used on product specific brochures, advertising product packaging, or product specific content
Technology Overview
ZigBee Operates Within IEEE 802 Wireless Standards Family

- ZigBee (802.15.4, 802.15.4c)
- IEEE 802.20 (WiMax)
- IEEE 802.22
- Wi-Fi (802.11, 802.15.3, 802.15.3c)
- Bluetooth (802.15.1)

Data Rate (Mbps)

Range:
- WPAN
- WMAN
- WWAN

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ZigBee Operates Within IEEE 802 Wireless Standards Family

IEEE 802.1.5.4 Standard Co-existence Features:

- Complementary Channel Mapping
- Direct Sequence Spread Spectrum (DSSS)
- Frequency Division Multiple Access (FDMA)
- Low Data Rate
- Built-In Scanning and Reporting
- Carrier Sense Multiple Access (CSMA)

Additional ZigBee Coexistence Features:

- Network Formation Procedures
- Mesh Networking and Path Diversity
- Network-Layer Frequency Agility
- End-to-End Acknowledgement and Retransmission
ZigBee: Robust, Reliable, Relentless Performance

White Paper Demonstrates ZigBee Performs in Harsh Environments
ZigBee Standard: Technology Overview

ZigBee: A High Level Communication Protocol
- Uses small, ultra low-power digital radios based on the IEEE 802.15.4 standard for wireless networks

Targeted at RF Applications Requiring:
- Low data rate
- Long battery life
- Secure networking

IEEE 802.15.4
- Serves as the standard upon which ZigBee is built

<table>
<thead>
<tr>
<th>ZigBee Technology Facts</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>ZigBee</td>
</tr>
<tr>
<td>Number of Channels</td>
<td>27</td>
</tr>
<tr>
<td>Radio Frequency Band[s]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4 GHz with 16 channels for global use</td>
</tr>
<tr>
<td></td>
<td>915 MHz with 10 channels for N. America, Australia and a few additional countries</td>
</tr>
<tr>
<td></td>
<td>868 MHz with 1 channel for EU countries</td>
</tr>
<tr>
<td>Network Capabilities</td>
<td>Self-organizing and self-healing dynamic mesh network based on ZigBee public standard</td>
</tr>
<tr>
<td>Network Size</td>
<td>Thousands of devices per network</td>
</tr>
</tbody>
</table>
ZigBee Standard: Technology Overview

ZigBee Specification Offers the Most Choices for Product Manufacturers

- ZigBee Feature Set – supports hundreds of devices and has two optional features: Frequency Agility and Fragmentation
- ZigBee PRO Feature Set – supports thousands of devices with a number of optimizations designed specifically for larger networks

ZigBee Specification

- ZigBee Application (APL) Layer
  - NLDE-SAP
  - NLME-SAP
- ZigBee Network (NWK) Layer
  - MLDE-SAP
  - MLME-SAP
- IEEE 802.15.4 2003 Medium Access Control (MAC) Sub-Layer
  - PD-SAP
  - PLME-SAP
- IEEE 802.15.4 2003 Physical (PHY) Sub-Layer
Two Types of Application Profiles:

1. Public Application Profiles
   - Interoperable application software developed by the Alliance that accomplishes a specific task. Can be used by all Alliance members in products and allows device interoperability regardless of device manufacturer
   - Products certified can wear ZigBee Certified Product logo

2. Manufacturer Specific Profiles
   - Private application profile developed by a company to operate a ZigBee device

Available Public Application Profiles:
- ZigBee Smart Energy
- ZigBee Home Automation

Public Application Profiles in Development Today:
- Commercial Building Automation
- Telecommunication Services
- Personal Home Healthcare
ZigBee & Other Wireless Standards

<table>
<thead>
<tr>
<th>Data Rate (Mbps)</th>
<th>WPAN</th>
<th>WMAN</th>
<th>WWAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>ZigBee 802.15.4</td>
<td>802.22</td>
<td>802.15.3</td>
</tr>
<tr>
<td>0.1</td>
<td>ZigBee 802.15.4c</td>
<td>WiMax 802.16</td>
<td>802.15.3c</td>
</tr>
<tr>
<td>1</td>
<td>Bluetooth 802.15.1</td>
<td>IEEE 802.20</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market Name</td>
<td>ZigBee®</td>
<td>---</td>
<td>Wi-Fi™</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td>802.15.4</td>
<td>GSM/GPRS CDMA/1xRTT</td>
<td>802.11b</td>
</tr>
<tr>
<td><strong>Application Focus</strong></td>
<td>Monitoring &amp; Control</td>
<td>Wide Area Voice &amp; Data</td>
<td>Web, Email, Video</td>
</tr>
<tr>
<td><strong>System Resources</strong></td>
<td>4KB - 32KB</td>
<td>16MB+</td>
<td>1MB+</td>
</tr>
<tr>
<td><strong>Battery Life (days)</strong></td>
<td>100 - 1,000+</td>
<td>1-7</td>
<td>.5 - 5</td>
</tr>
<tr>
<td><strong>Network Size</strong></td>
<td>Unlimited (2^{36})</td>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td><strong>Bandwidth (KB/s)</strong></td>
<td>20 - 250</td>
<td>64 - 128+</td>
<td>11,000+</td>
</tr>
<tr>
<td><strong>Transmission Range (meters)</strong></td>
<td>1 - 100+</td>
<td>1,000+</td>
<td>1 - 100</td>
</tr>
<tr>
<td><strong>Success Metrics</strong></td>
<td>Reliability, Power, Cost</td>
<td>Reach, Quality</td>
<td>Speed, Flexibility</td>
</tr>
</tbody>
</table>
Comparing ZigBee and Bluetooth:

- ZigBee was developed to serve very different applications than Bluetooth and leads to tremendous optimizations in power consumption. Some of the key differentiators are:

<table>
<thead>
<tr>
<th>ZigBee</th>
<th>Bluetooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low duty cycle, very long primary battery life</td>
<td>Moderate duty cycle, secondary battery lasts same as master</td>
</tr>
<tr>
<td>Static and dynamic star and mesh networks, &gt;65,000 nodes, with low latency available</td>
<td>Very high QoS and very low, guaranteed latency</td>
</tr>
<tr>
<td>Ability to remain quiescent for long periods without communications</td>
<td>Quasi-static star network up to seven clients with ability to participate in more than one network</td>
</tr>
<tr>
<td>Direct Sequence Spread Spectrum allows devices to sleep without the requirement for close synchronization</td>
<td>Frequency Hopping Spread Spectrum is extremely difficult to create extended networks without large synchronization cost</td>
</tr>
</tbody>
</table>
Sample ZigBee Product Development Cycle

Start

Develop and Test Product

Academic, Experimental or Research Purpose?

Y

Contribute to ZigBee specification?

N

Join as Adopter Member US$3500

Y

Join as Participant Member US$9500

ZigBee Logo

More products?

N

Participate in Test Events

Certification Testing through Test House

Pay listing fee to Alliance. US$1000 1st SKU US$500 subsequent SKUs

End

Y

Participate in Test Events

Certification Testing through Test House

Take Certification Letter to Alliance

More products?

N

End

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Adopt ZigBee Today
The Time to Adopt ZigBee is NOW

ZigBee Benefits Outweigh Investment of Membership and Testing
- Reduced development time
- Standards-based
- Interoperability
- High ZigBee brand recognition

ZigBee Logo Provides Brand Recognition and Market Pull
- Program designed to ensure customer confidence
- Leverages economy of scale
- Association with global powerhouse brands
- ZigBee news coverage dwarfs proprietary solutions
Resources for Companies

Key Links

- Technology Downloads

- How To Join

- White Papers

- News
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