ZigBee

By
Presentation Outline

- What ZigBee is
- What ZigBee does
- How ZigBee works
- The hype cycle
- Academic research
- Products
- Future
What is ZigBee?

- Technological Standard Created for Control and Sensor Networks
- Based on the IEEE 802.15.4 Standard
- Created by the ZigBee Alliance
IEEE 802.15.4 & ZigBee In Context

**Application**
- API
- Security
  - 32-/64-/128-bit encryption
- Network
  - Star / Mesh / Cluster-Tree

**Customer**

ZigBee Alliance
- “the software”
- Network, Security & Application layers
- Brand management

**IEEE 802.15.4**
- “the hardware”
- Physical & Media Access Control layers

Source: http://www.zigbee.org/resources/documents/IWAS_presentation_Mar04_Designing_with_802154_and_zigbee.ppt

20 JAN 2009
ZigBee
The 802 Wireless Space

Source: http://www.zigbee.org/en/resources/
## ZigBee and Other Wireless Technologies

<table>
<thead>
<tr>
<th>Market Name</th>
<th>ZigBee™</th>
<th>3G</th>
<th>Wi-Fi™</th>
<th>Bluetooth™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>802.15.4</td>
<td>GSM/GPRS</td>
<td>802.11b</td>
<td>802.15.1</td>
</tr>
<tr>
<td>Application Focus</td>
<td>Monitoring &amp; Control</td>
<td>Wide Area Voice &amp; Data</td>
<td>Web, Email, Video</td>
<td>Cable Replacement</td>
</tr>
<tr>
<td>System Resources</td>
<td>4KB - 32KB</td>
<td>16MB+</td>
<td>1MB+</td>
<td>250KB+</td>
</tr>
<tr>
<td>Battery Life (days)</td>
<td>100 - 1,000+</td>
<td>1 - 7</td>
<td>0.5 - 5</td>
<td>1 - 7</td>
</tr>
<tr>
<td>Network Size</td>
<td>Unlimited (2^64)</td>
<td>1</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Bandwidth (KB/s)</td>
<td>20 - 250</td>
<td>64 - 128+</td>
<td>11,000+</td>
<td>720</td>
</tr>
<tr>
<td>Transmission Range (meters)</td>
<td>1 - 100+</td>
<td>1,000+</td>
<td>1 - 100</td>
<td>1 - 10+</td>
</tr>
<tr>
<td>Success Metrics</td>
<td>Reliability, Power, Cost</td>
<td>Reach, Quality</td>
<td>Speed, Flexibility</td>
<td>Cost, Convenience</td>
</tr>
</tbody>
</table>

ZigBee Aims Low

- Low data rate
- Low power consumption
- Small packet devices
ZigBee Frequencies

- Operates in Unlicensed Bands
- ISM 2.4 GHz Global Band at 250kbps
- 868 MHz European Band at 20kbps
- 915 MHz North American Band at 40kbps
What Does ZigBee Do?

- Designed for wireless controls and sensors
- Operates in Personal Area Networks (PAN’s) and device-to-device networks
- Connectivity between small packet devices
- Control of lights, switches, thermostats, appliances, etc.
How ZigBee Works

- Topology
  - Star
  - Cluster Tree
  - Mesh

- Network coordinator, routers, end devices
How ZigBee Works

- States of operation
  - Active
  - Sleep
- Devices
  - Full Function Devices (FFD’s)
  - Reduced Function Devices (RFD’s)
- Modes of operation
  - Beacon
  - Non-beacon
ZigBee Mesh Networking

Slide Courtesy of Control 4

Source: http://www.zigbee.org/en/resources/#SlidePresentations
ZigBee Mesh Networking

Slide Courtesy of Control 4

Source: http://www.zigbee.org/en/resources/#SlidePresentations
ZigBee and the Hype Cycle

Source: http://computing.arizona.edu/networkmasterplan/tech_hpe_0703.pdf
ZigBee and the Hype Cycle

ZigBee and the Hype Cycle
Research in ZigBee

- The IEEE 802.15.4 standard was completed in May 2003.
- The ZigBee specifications were ratified on 14 December 2004.
- The ZigBee Alliance announced public availability of Specification 1.0 on 13 June 2005.
- Much research is still going on with ZigBee.
Academic Research

Research in ZigBee is being conducted in different fields:

- Wireless and sensor networks
- Wireless communications
- Neuroengineering
Research Papers

- Time Synchronization for ZigBee Networks
- ZigBee: “Wireless Control That Simply Works”
- Journal of Neuroengineering and Rehabilitation
- Development of Ubiquitous Sensor Network
- Wireless Technologies for Data Acquisition Systems
ZigBee and the Market

- The next big thing
- Expected to hit the market full force in 2009
- Companies have already invested millions
ZigBee Products

- Development Kits
- Sensors
- Transceivers
- Modules
Current ZigBee Uses

- Environmental Monitoring
- Agricultural Monitoring
- Home Automation Still on Horizon
Product Applications

- Road map products-tracking
- Consumer electronics
- PC
- Personal and healthcare
- Commercial and residential control
ZigBee’s Future
ZigBee Product Companies

- Helicomm
- MaxStream
- Luxoft Labs
- Crossbow Technology
- Innovative Wireless Technologies
References

- http://computing.arizona.edu/networkmasterplan/tech_hpe_0703.pdf
- http://www.embedded.com/shared/printableArticle.jhtml?articleID=52600868
- http://www.technologyreview.com/articles/04/08/wo_brown081904.asp
- http://www.wisegeek.com/what-is-zigbee.htm?referrer=adwords_campaign=zigbee_ad=013761&_content_kw=what%20is%20zigbee
- http://www.ece.uah.edu/~milenko/docs/dc_ssst05_synch.pdf
- http://en.wikipedia.org/wiki/ZigBee
DOUBTS PLEASE?

THANKYOU