ZigBee Alliance

Wireless control that simply works

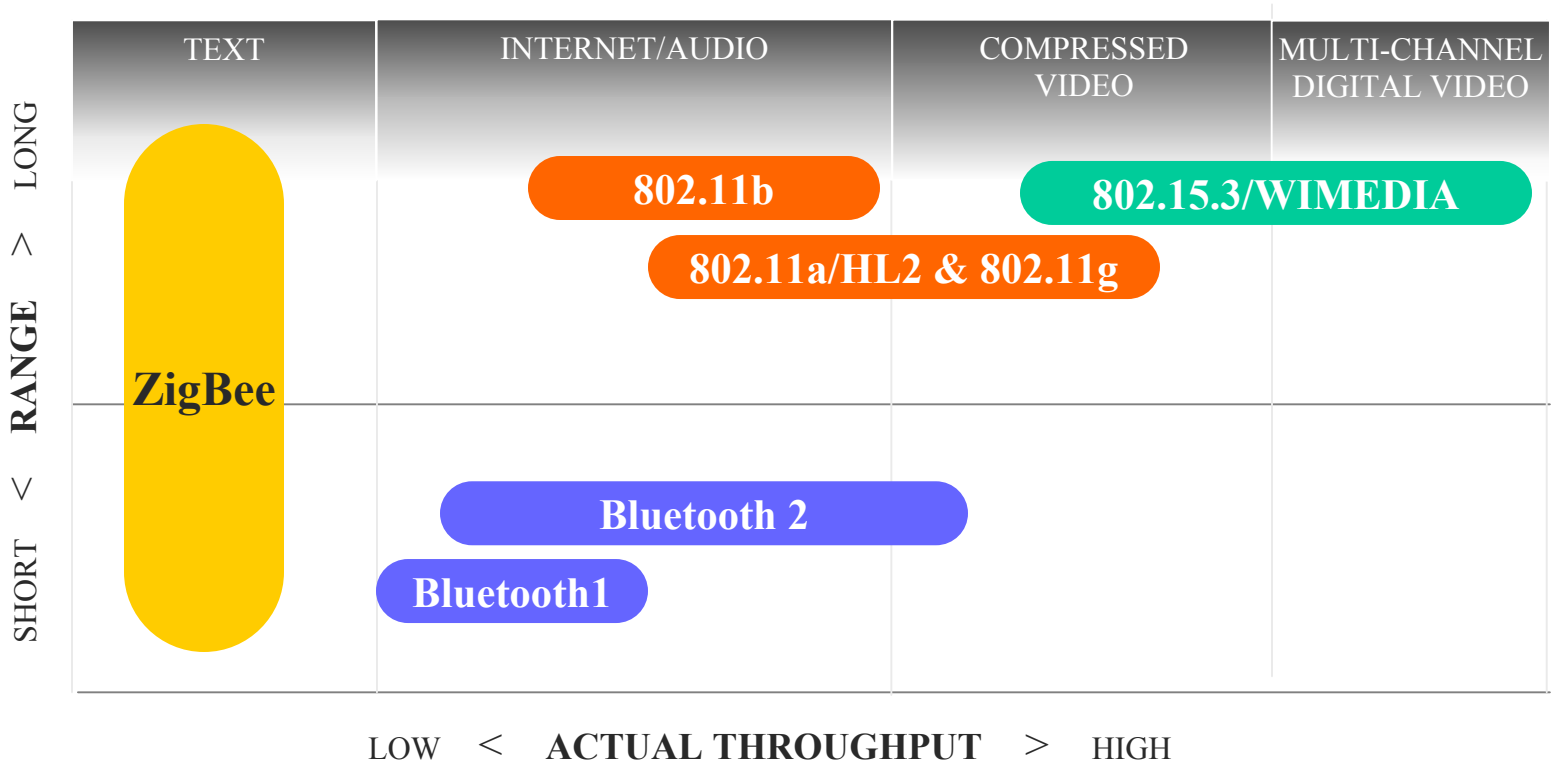
Emerging Standards: Where do ZigBee/UWB fit

June 8, 2004

Bob Heile

Chairman, ZigBee Alliance

The Wireless Market



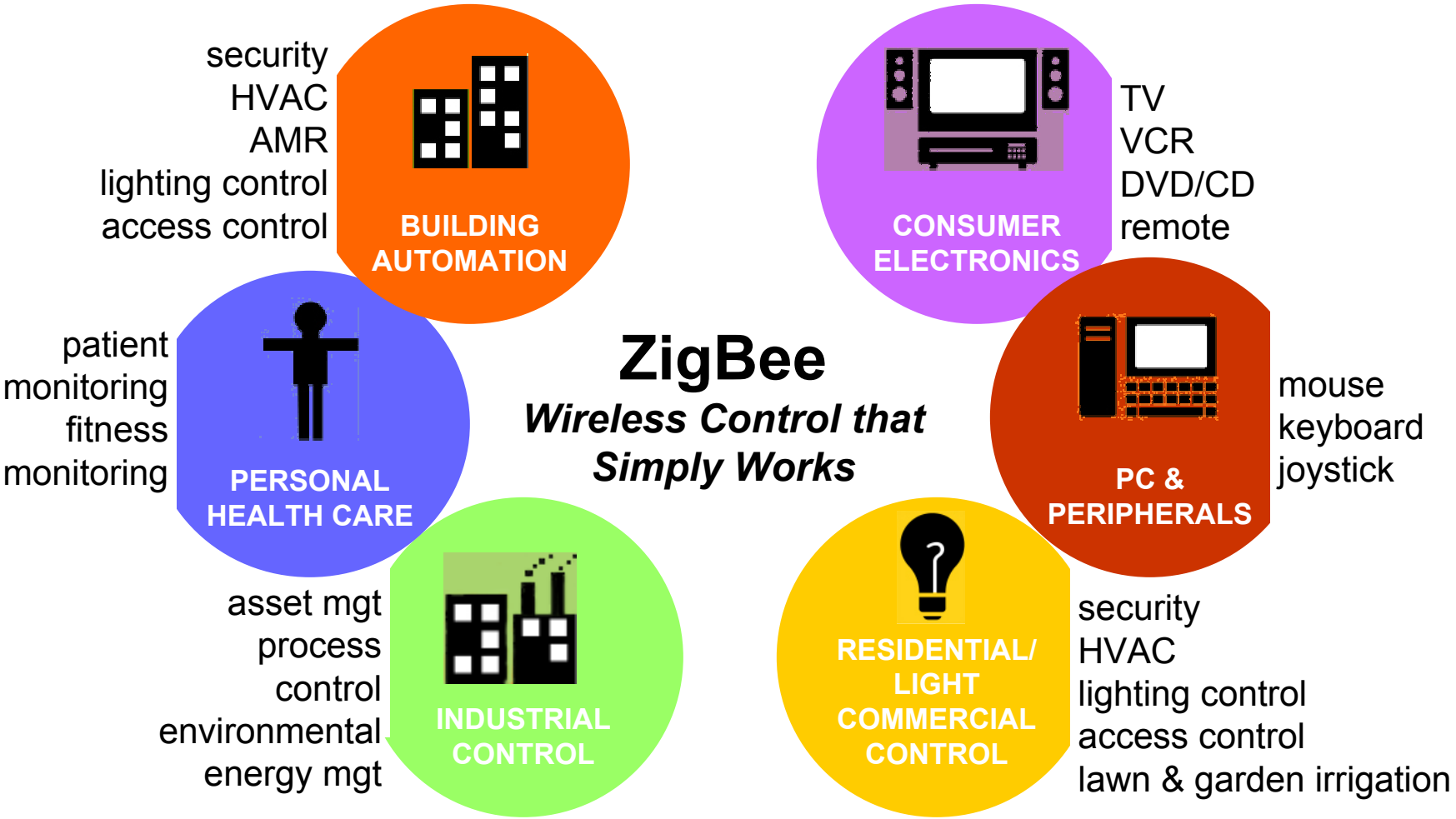
ZigBee™ Alliance

What is the ZigBee Alliance?

- An Organization with a mission to define reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard
- Primary drivers are simplicity, long battery life, networking capabilities, reliability, and low cost
- Alliance provides interoperability, certification testing, and branding

ZigBee™ Alliance

Applications



ZigBee™ Alliance

Who is supporting the ZigBee Alliance?

- Seven promoter companies
  - Ember, Honeywell, Invensys, Mitsubishi, Motorola, Philips and Samsung
- A rapidly growing list (now over 70 participants) of industry leaders worldwide committed to providing ZigBee-compliant products and solutions
  - Companies include semiconductor manufacturers, wireless IP providers, OEMs, and end users

ZigBee™ Alliance

How is ZigBee related to IEEE 802.15.4?

- ZigBee takes full advantage of a powerful physical radio specified by IEEE 802.15.4
- ZigBee adds logical network, security and application software
- ZigBee continues to work closely with the IEEE to ensure an integrated and complete solution for the market

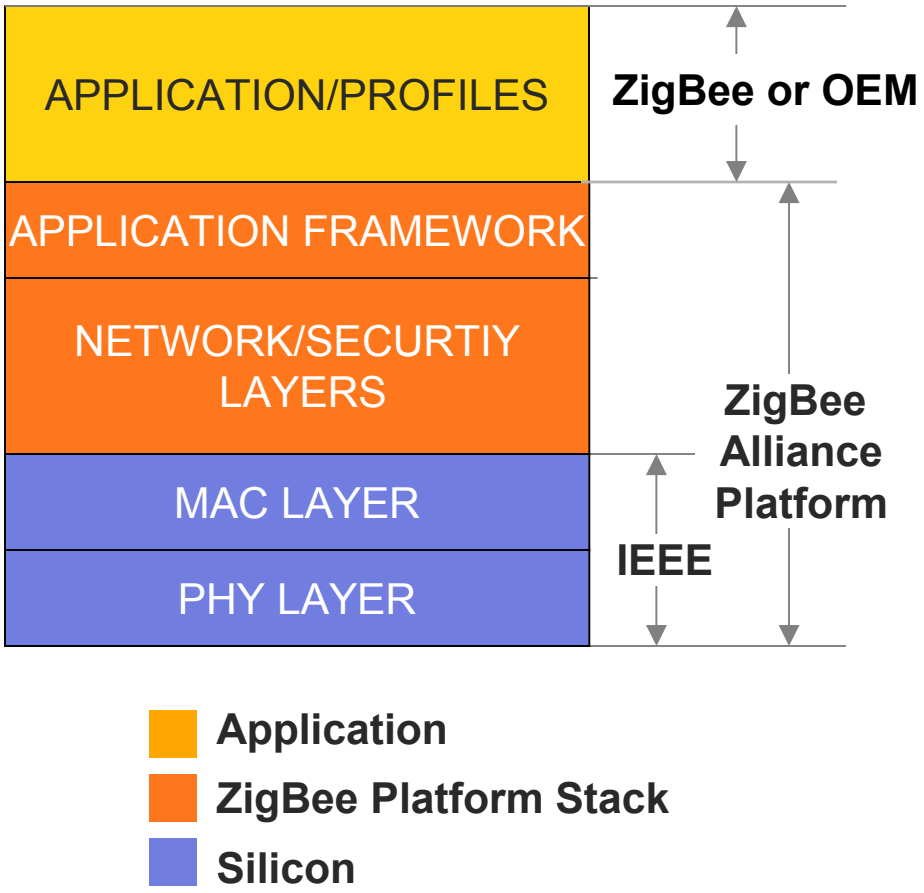
ZigBee™ Alliance

Why do we need ZigBee technology?

- No standard approach today that addresses the unique needs of most remote monitoring and control and sensory network applications
  - Enables the broad-based deployment of wireless networks with low cost, low power solutions
  - Ability to run for years on inexpensive primary batteries for a typical monitoring application
  - Capable of inexpensively supporting robust mesh networking technologies

Protocol Stack Features

- 8-bit microcontroller (e.g. 80c51)
- Full protocol stack <32 k
- Supports Simple slave-only stack
- Coordinators require extra RAM
  - Node device database
  - Transaction table
  - Pairing table



ZigBee™ Alliance

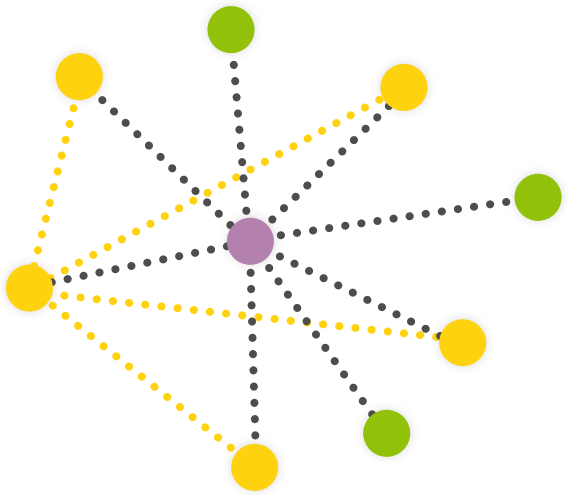
Frequencies and Data Rates

BAND	COVERAGE	DATA RATE	# OF CHANNEL(S)
2.4 GHz	ISM	Worldwide	250 kbps	16
868 MHz		Europe	20 kbps	1
915 MHz	ISM	Americas	40 kbps	10

ZigBee™ Alliance

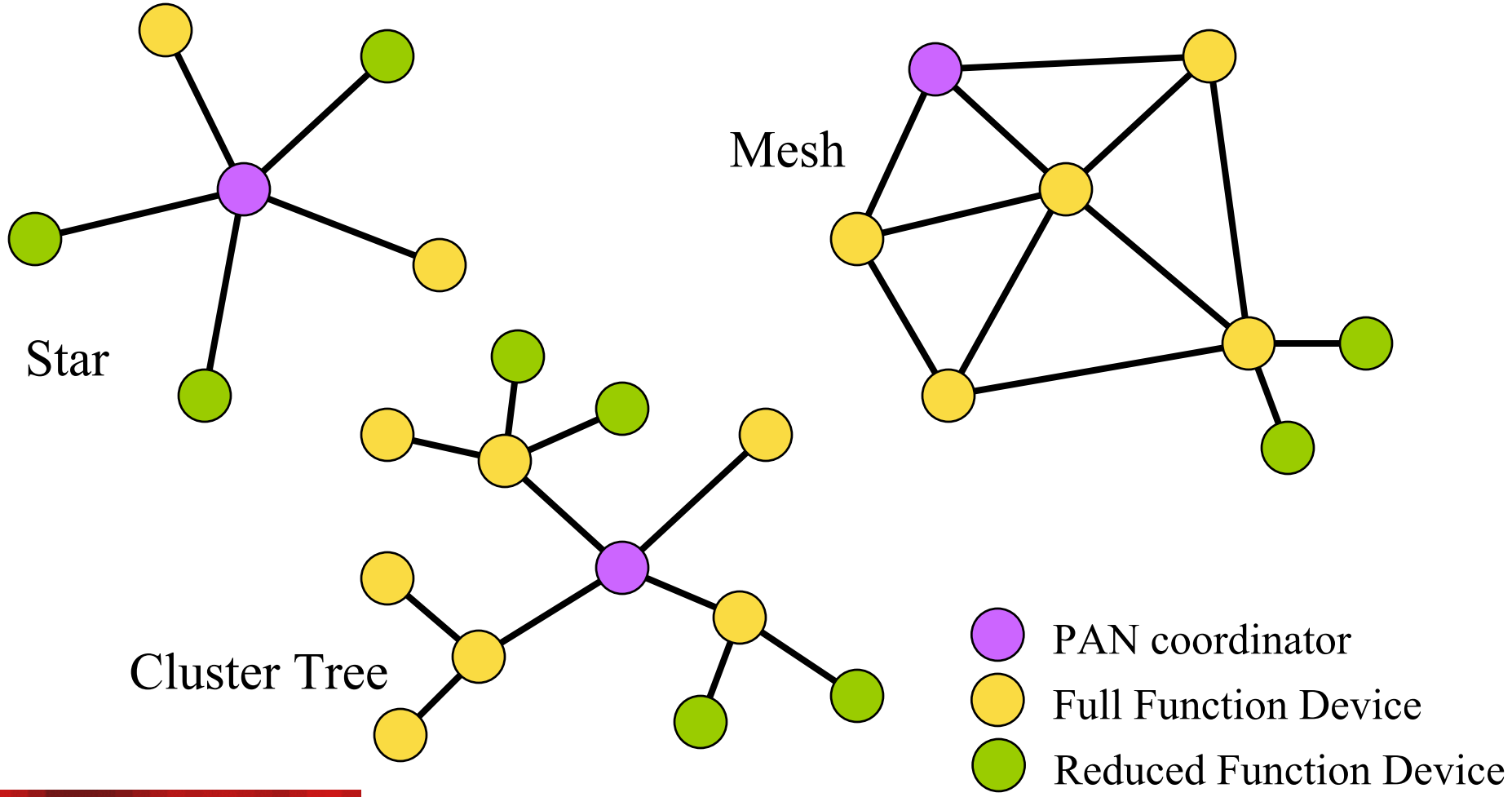
Basic Network Characteristics

- 65,536 network (client) nodes
- 1 fully functional network coordinator (master)
- Optimized for timing-critical applications
  - New slave enumeration:
    30 ms (typ)
  - Sleeping slave changing to active: 15 ms (typ)
  - Active slave channel access time: 15 ms (typ)



ZigBee™ Alliance

Topology Models



ZigBee™ Alliance

Mesh networks overcome barriers to wireless adoption

Barrier #1: reliability

- People can move when wireless reception is poor; machines typically cannot
- Humans tolerate garbled communication; machines do not

Barrier #2: wireless expertise

- Customers (and some installers) do not want to become wireless experts
- Want "wireless control that simply works"

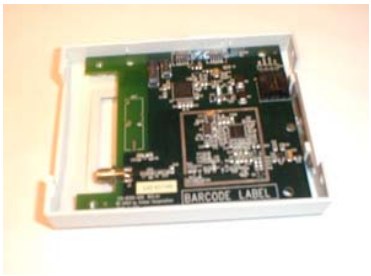
ZigBee™ Alliance

Lighting Control

- Advance Transformer [Philips Lighting]
  - Wireless lighting control
    - Dimmable ballasts
    - Light switches anywhere
    - Customizable lighting schemes
    - Energy savings on bright days
    - Dali [or other] interface to BMS
  - Extendable networks
    - Additional sensors
    - Other networks

HVAC Energy Management

- Hotel energy management
  - Major operating expense for hotel
    - Centralized HVAC management allow hotel operator to make sure empty rooms are not cooled
  - Retrofit capabilities
  - Battery operated t-stats can be placed for convenience
  - Personalized room settings at check-in

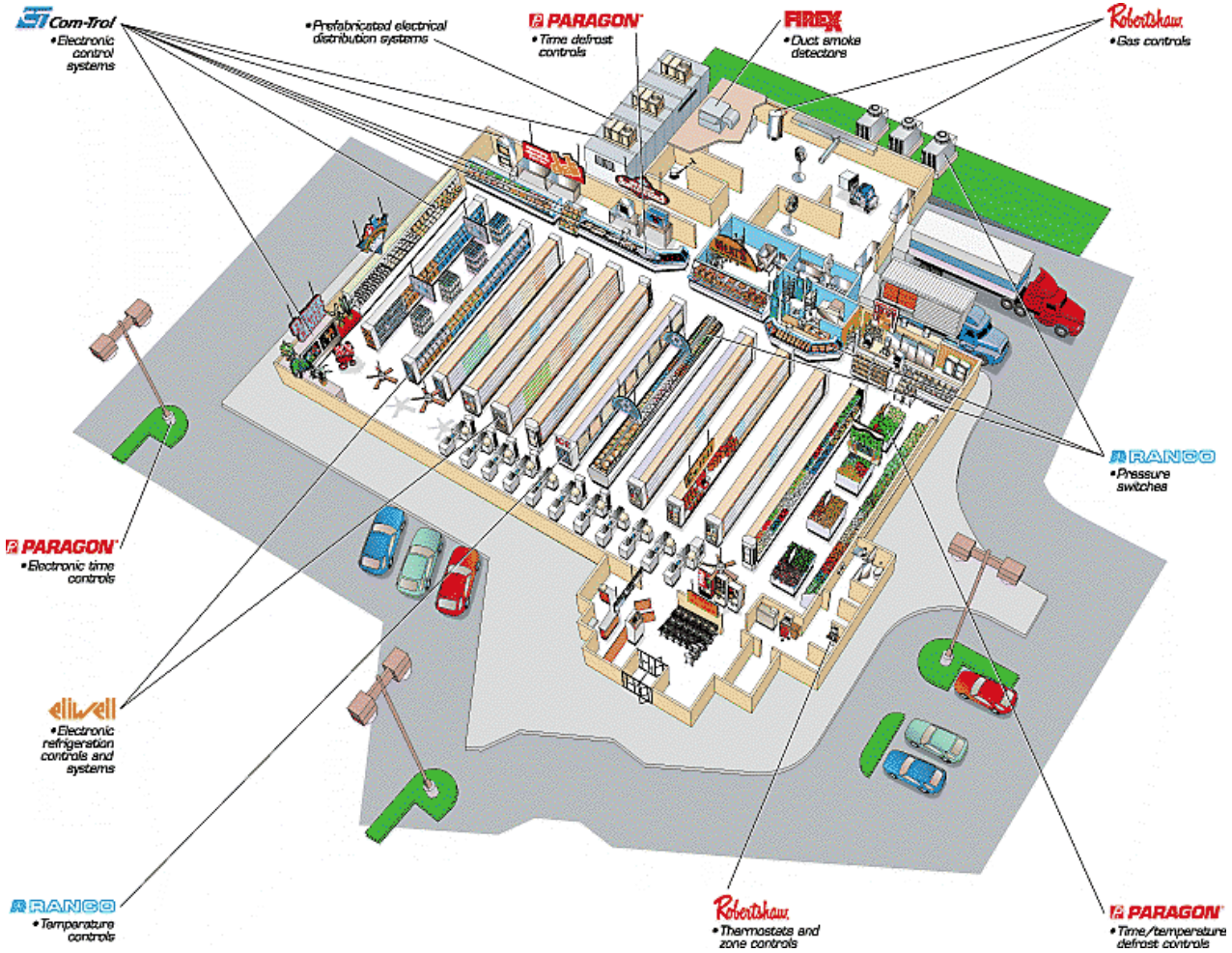


Asset Management

- Within each container, sensors form a mesh network.
- Multiple containers in a ship form a mesh to report sensor data
- Increased security through on-truck and on-ship tamper detection
- Faster container processing. Manifest data and sensor data are known before ship docks at port.

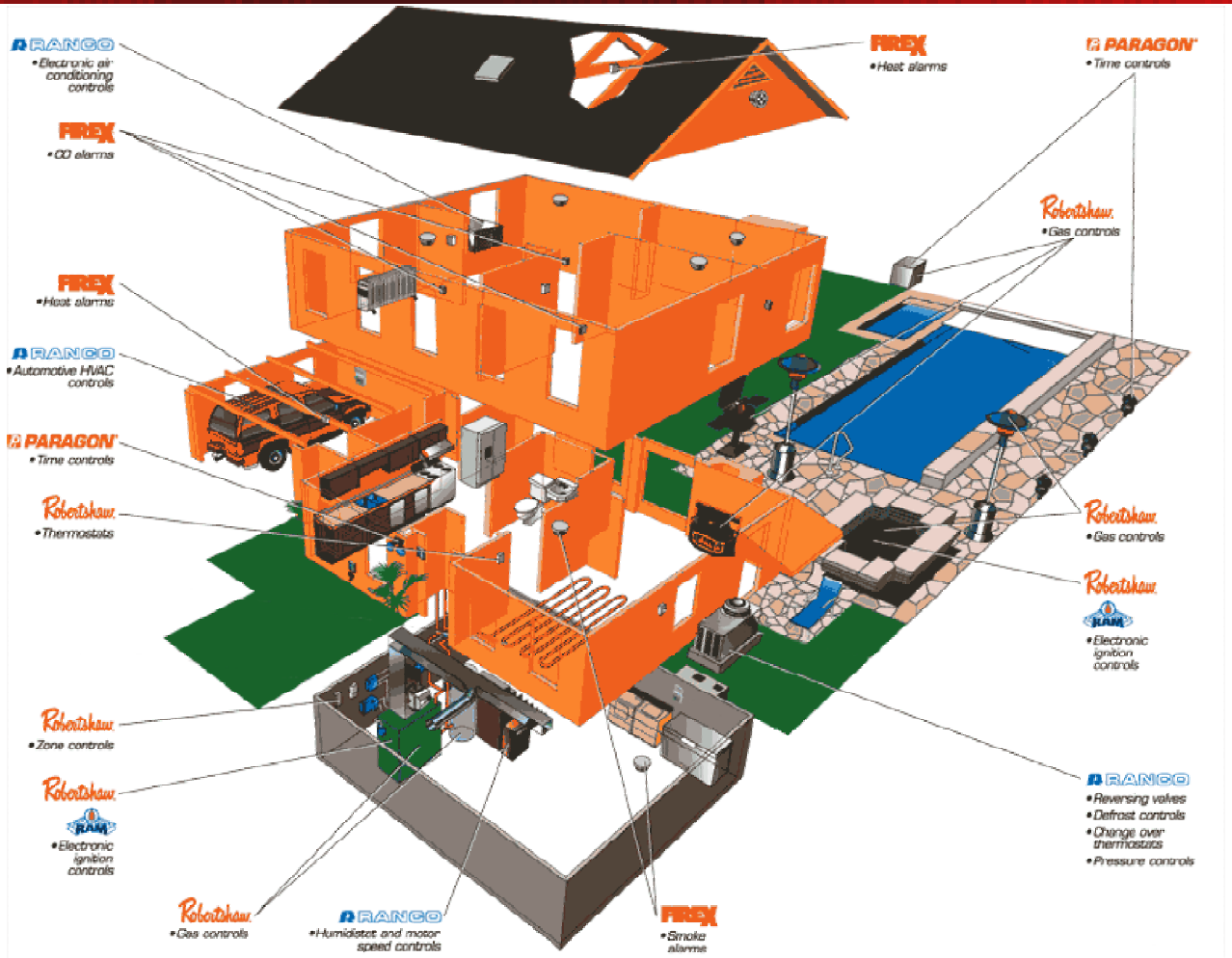
ZigBee™ Alliance

Supermarket Management



ZigBee™ Alliance

Residential Control



Why ZigBee?

- Reliable and self healing
- Supports large number of nodes
- Easy to deploy
- Very long battery life
- Secure
- Low cost
- Can be used globally

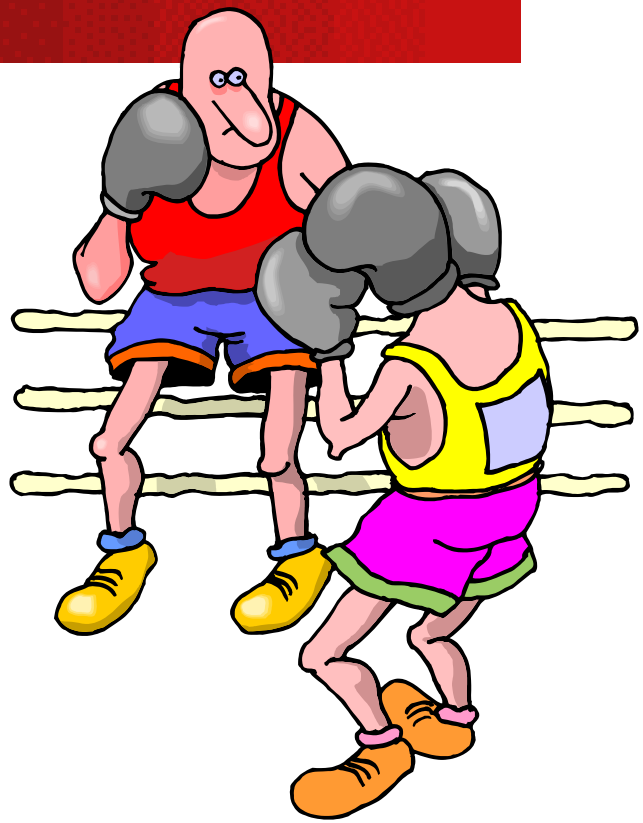
ZigBee™ Alliance

Advantages of ZigBee over proprietary solutions?

- Product interoperability
- Vendor independence
- Increased product innovation as a result of industry standardization
- A common platform is more cost effective than creating a new proprietary solution from scratch every time
- Companies can focus their energies on finding and serving customers

ZigBee™ Alliance

ZigBee and Bluetooth

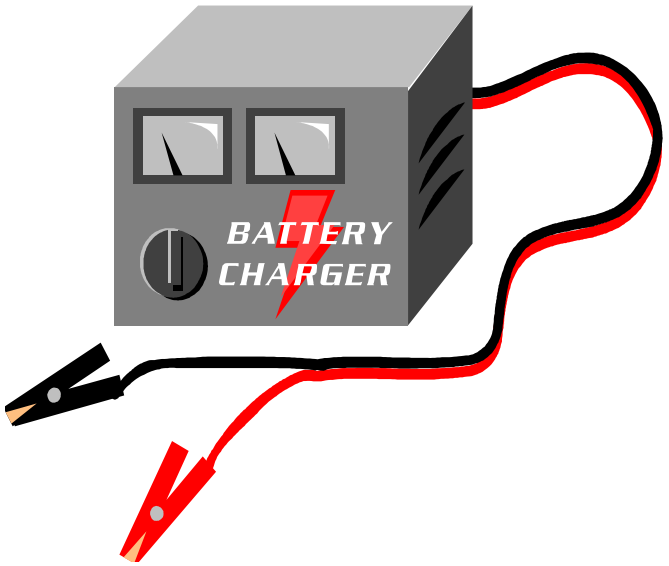


Competitive or Complementary?

ZigBee and Bluetooth

Address Different Needs

- Bluetooth is a cable replacement for items like Phones, Laptop Computers, Headsets
- Bluetooth expects regular charging
  - Target is to use <10% of host power



ZigBee and Bluetooth

Address Different Needs

- ZigBee is better for devices Where the battery is ‘rarely’ replaced
  - Targets are :
    - Devices where only a tiny fraction of host power is available
    - New opportunities where wireless not yet used

ZigBee™ Alliance

ZigBee and Bluetooth

Optimized for different applications

- **ZigBee**
  - **Smaller packets over large network**
  - **Mostly Static networks with many, infrequently used devices**
  - **Rapid Network Join**
- **Bluetooth**
  - **Larger packets over small network**
  - **Ad-hoc networks with only a few devices**
  - **Long Network Join Times**

ZigBee™ Alliance

ZigBee and Bluetooth-- Conclusion

- Protocols are substantially different and designed for different purposes
- ZigBee designed for low to very low duty cycle static and dynamic environments with many active nodes
- Bluetooth designed for high QoS, variety of duty cycles, moderate data rates in networks with limited active nodes

ZigBee™ Alliance

Comparison of key features of complementary protocols

Feature(s)	IEEE 802.11b	Bluetooth	IEEE 802.15.4
Power Profile	Hours	1 Week	1Year+
BOM	$9	$6	$3
Complexity	Complex	Very Complex	Simple
Nodes/Master	32	7	64000
Latency	Enumeration upto 3 seconds	Enumeration upto 10 seconds	Enumeration 30ms
Range	100 m	10m	70m
Extendability	Roaming possible	No	YES
Data Rate	11Mbps	1Mbps	250Kbps
Security	Authentication Service Set ID (SSID)	64 bit, 128 bit	128 bit AES and Application Layer user defined

HVAC control in building automation

ZigBee™ Alliance

More Information

ZigBee Alliance web site

http://www.ZigBee.org

Bob Heile, ZigBee Alliance Chairman

bheile@ieee.org

ZigBee™ Alliance