



Crossroads Copenhagen

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Z-Wave & ZigBee

- Why are these protocols interesting now
- Standards
- Protocol characteristics
- Network Topology
- Ensuring Interoperability
- SoC solutions



"El-sparefond" recommends Z-Wave

"Elsparefonden" recommends the Z-wave-technology for Home Automation. This initiative may do more harm than mileage, says Professor. Suppliers of competing technologies are furious.

By Sanne Wittrup, September 14, 2007

"Elsparefonden" is currently running a campaign to get the Danes to adopt the concept of the wireless home. The aim is to cut power consumption in private homes by one third, which will give an estimated saving of up to six billion "Kroner" every year.

"Elsparefonden" will reach the goal by marking a number of products as "Recommended by Elsparefonden" to push the market for Home Automation – techniques that can link the power- and heating-supplies with security and other systems in a wireless network. At the same time one recommends the use of the Danish developed Z-Wave technology.



ZigBee's Improved Spec Incompatible with v1.0

The ZigBee Alliance released an updated specification that should help system developers targeting the home automation market, but large-scale deployments may have to wait.

By Mike Clendenin, September 27, 2006

TAIPEI, Taiwan — The ZigBee Alliance released an updated specification Wednesday (Sept. 27) that should help system developers targeting the home automation market. But those interested in large-scale deployments in the industrial and building-automation markets may opt to wait for another release, due early next year.

Called ZigBee 2006 or "enhanced" ZigBee, the update includes some significant changes from the spec first issued in 2004. Those changes mean that the two versions are also incompatible, which could cause problems for companies that already have products in the market.



Z-Wave Standard

- Proprietary standard
- Invented by Danish/American Zensys



– www.zensys.dk

- Z-Wave Alliance is a consortium of manufacturers



– www.z-wavealliance.org



ZigBee Standard

- Based on the IEEE 802.15.4 standard (MAC/PHY)
- ZigBee Alliance is responsible for the ZigBee standard



– <http://www.zigbee.org>



Z-Wave Characteristics

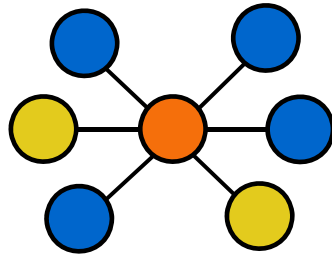
- Wireless low-power communications standard
- Uses the unlicensed ISM band @ 868.42 MHz
- FSK modulation (Frequency-shift keying)
- Manchester / NRZ channel coding
- Mesh network
- Range between single nodes < 30 m. (100 ft)
- A frame can hop a maximum of four nodes ~ 120 m.
- Throughput 40 kb/s (9.6 kb/s for old chips)
- Supports battery operated nodes



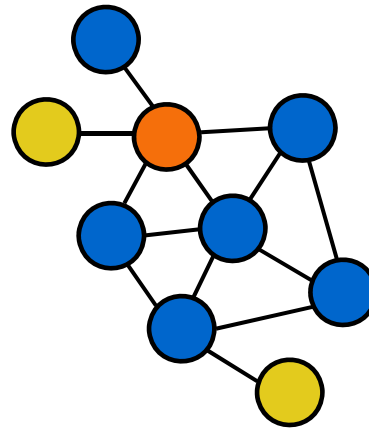
ZigBee Characteristics

- Wireless low-power communications standard
- Uses the unlicensed ISM band @ 868 MHz or 2.4 GHz
- BPSK modulation (Binary Phase-shift keying) @ 868 MHz
- QPSK modulation (Quadrature Phase-shift keying) @ 2.4 GHz
- DSSS (direct-sequence spread spectrum) channel coding
- Star / Mesh / Tree network
- 128-bit AES Encryption
- Range between single nodes < 30 m. (100 ft)
- A frame can hop a maximum of 32 nodes ~ 960 m.
- Throughput 20 kb/s @ 868 MHz / 250 kb/s @ 2.4 GHz
- Supports battery operated nodes

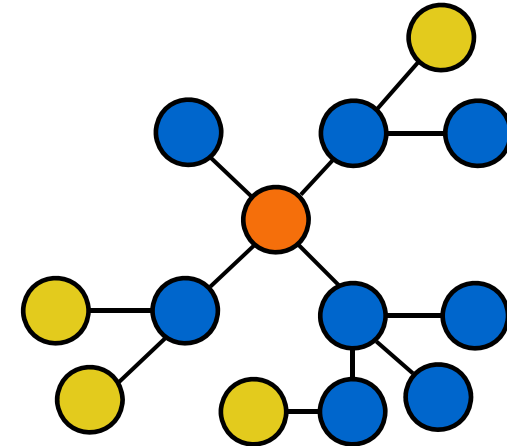
Network Topology






Star Network
(Simplest)



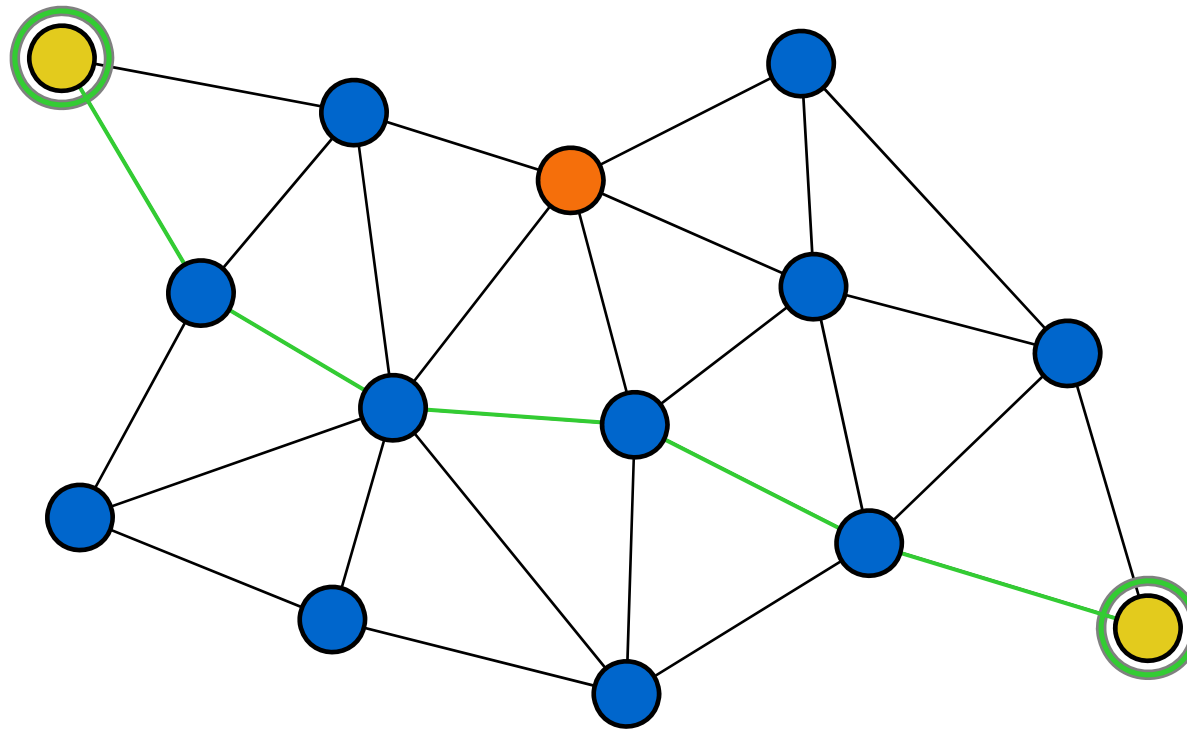
Mesh Network
(Best Reliability)



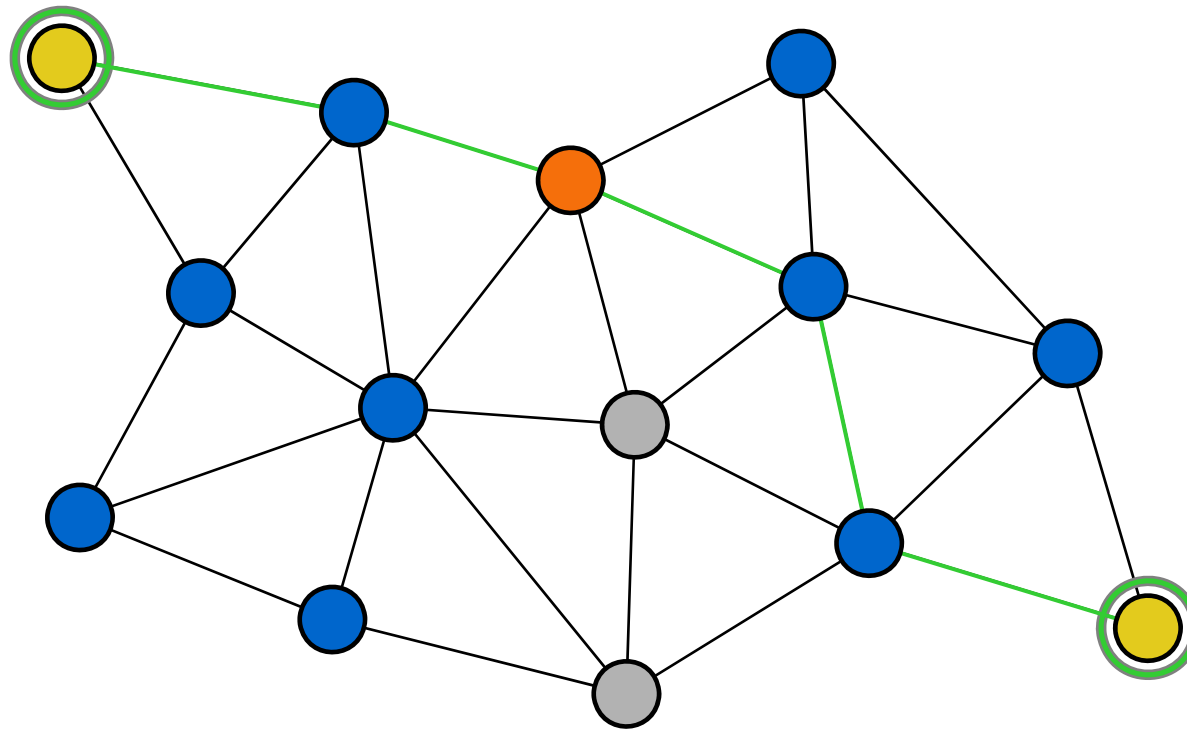
Cluster Tree Network
(Large Scale Networks)

-  PAN Coordinator
-  Full Function Device (FFD)
-  Reduced Function Device (RFD)

Mesh Network Topology



Mesh Network Topology



Insuring interoperability

- Device Classes
 - Set the type of device
 - Portable or Static Controller, Routing or Non-Routing Slave
 - Set the main/generic functionality of the device
 - Ex. Multilevel Switch
 - Set the specific functionality of the device
 - Ex. Power Switch
- Command Classes
 - Determines the request the device can handle
 - Determines the requests the device can send to others



Insuring interoperability

- Profiles
 - Cover Application Domains
 - Bind Clusters to an Application Domain
 - Home Automation
 - Industrial Plant Monitoring
 - Commercial Building Automation
- Clusters (Collected in the Cluster Library specification)
 - Cover Functional Domains
 - Contains mandatory and optional Attributes & Commands
 - Lighting
 - Sensors
 - Security

Health Care related Device Classes

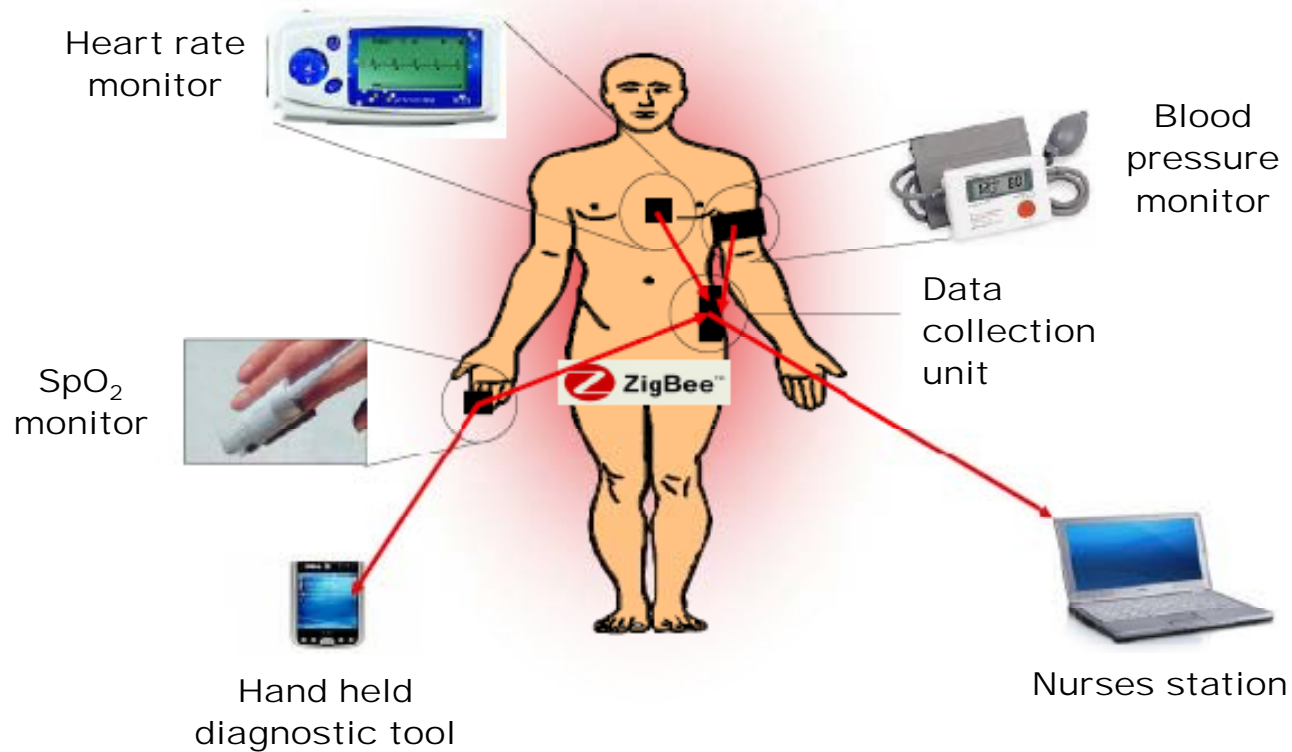
- Blood Pressure Monitor Device Class
 - to identify and define telemetric health related data and factors in regards to the pressure of blood within the human body.
- Weight Scale Device Class
 - to identify and define telemetric data in regards to measuring the weight of objects and the capabilities of such devices.



Health Care related Profiles

- Personal, Home and Hospital Care (PHHC)
 - The PHHC profile will be used by all the devices which jointly cooperate to fulfil the requirements of a non-invasive health care application. The devices involved in a health care application could be separated in medical devices (blood pressure monitor, oxygen saturation monitor, EEG, etc.) and non-medical devices (gateway, cell phone, light system, etc.). The health care application use cases presented in this document can be logically separated into the following categories:
 - Chronic disease monitoring
 - Personal wellness monitoring (ensuring an individual's wellness and safety)
 - Physical fitness

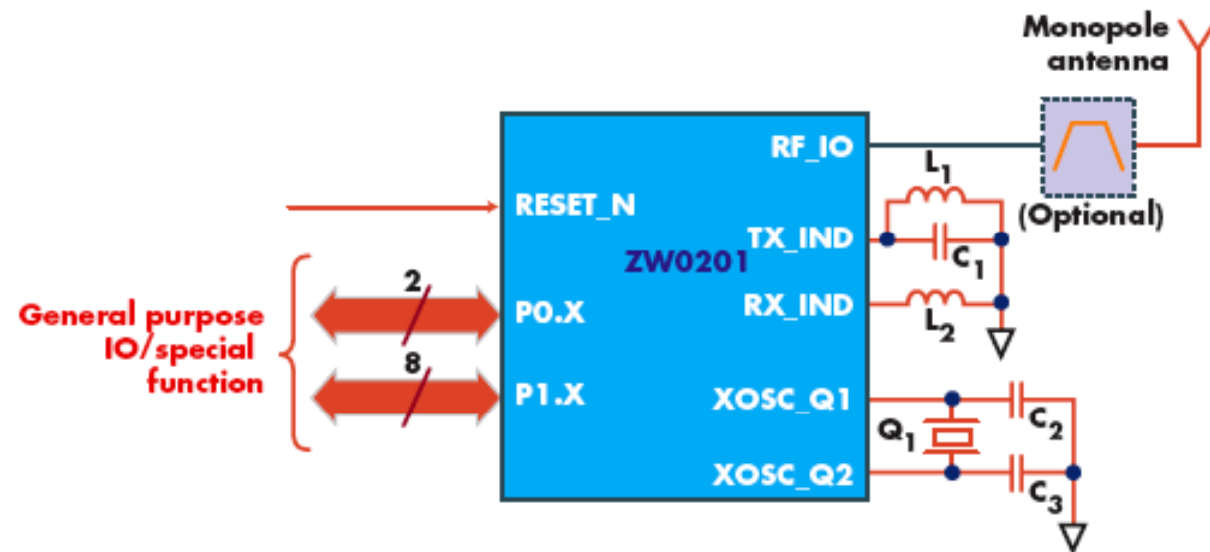
Health Care related Profiles



SoC solutions

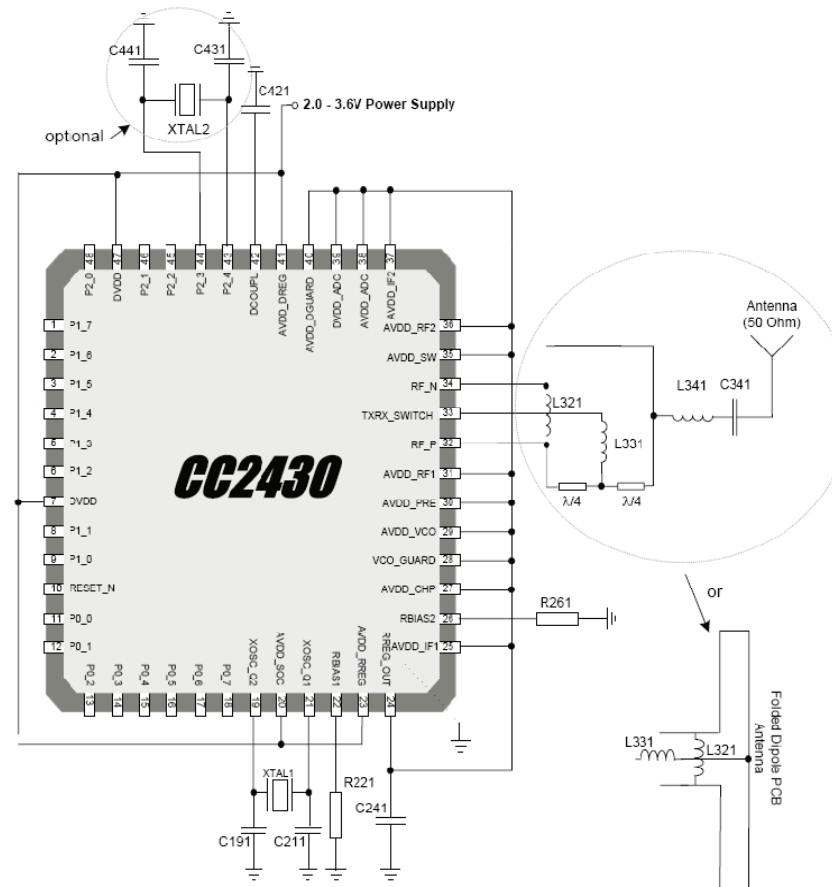
- 8051 μ C
- 32 kB Flash
- 2 kB SRAM
- 12 bit ADC
- SPI
- UART
- PWM
- Triac controller
- Watchdog
- Battery Monitor

Demonstration of ZM2102 module's form factor and typical application circuit for IC

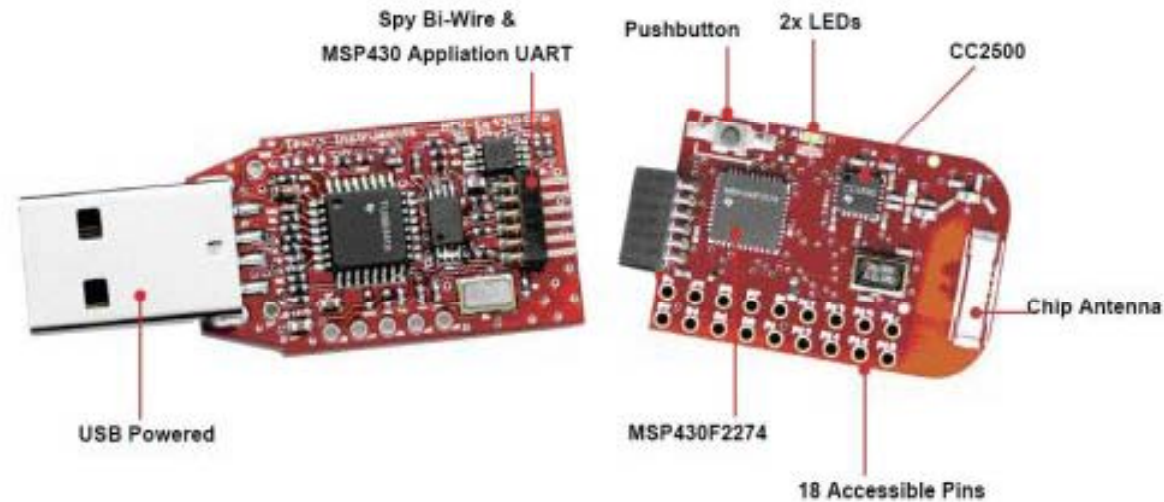


SoC solutions

- 2.4 GHz ZigBee RF
- 8051 μ C
- 32/64/128 kB Flash
- 8 kB SRAM
- 8x12 bit ADC
- 2xUART
- 21 GPIO pins
- Watchdog
- Temperature sensor
- Battery Monitor



SoC solutions



- **Start designing today with the worlds smallest wireless development tool!**
- This USB stick based tool combines the ability of the ultra-low-power MSP430 with [MSP430 and Wireless](#) transceivers in a single device
- [Start designing your own wireless sensor network today for only \\$49!](#)

Z-Wave vs. ZigBee

Z-Wave vs. ZigBee

RF/ PHY Layer	Z-Wave from Zensys		IEEE 802.15.4/ZigBee		
	U.S.	U.E.	U.S.	U.E.	U.S./U.E.
Operation Frequency, (MHz)	908	860	908	860	2400
Number of channels	1	1	10	1	16
Max. data rate (Kbit)	40	40	40	20	250
Modulation	FSK, GFSK, narrowband		BPSK/BPSK/O-QPSK, DSSS		
Avr. distance between nodes (free space)	30m/100feet		30m/100feet		
Addressing / MAC Layer	Z-Wave from Zensys		IEEE 802.15.4/ZigBee		
Nodes per network	Up to 232 nodes		Up to 64K, depending on the topology		
Node's address	Assigned by primary controller		64bits IEEE address, optional short address assigned by coordinator		
Media Access Algorithm	Random back off		CSMA – CA		
Network	Z-Wave from Zensys		IEEE 802.15.4/ZigBee		
Topology	Mesh		Star, mesh, tree		
Main device types	Controllers and slaves		Coordinator, router, edge devices		
Node to node retransmission	Up to 4 hops		32 hops, depending on latency req.		
Routing principle	Source routing		Tree routing, mesh routing		
Security/encryption	Yes		Yes		
Applications / Logistics	Z-Wave from Zensys		IEEE 802.15.4/ZigBee		
Target application(s)	Residential lighting and automation		General application of automation, sensing and control for industry, commercial and residential buildings		
Node functionality	Supports multiple command classes		Supports multiple application profiles		
Hosting requirements	8051@16MHz, 32K/2K		8bits MCU@16MHz, 32K/2K		
Protocol's Logistic	Proprietary		Standard		
IC suppliers	Single source, Zensys		Chipcon, Freescale, ZMD, etc.		
Protocol stack suppliers	Single source, Zensys		Chipcon, Ember, etc.		
Integrated Modules	Single source, Zensys		L.S. Research, MaxStream, etc.		
Target price upon acceptance	< \$2		< \$3		

