Wi-Fi Enabled Sensors

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Company Background

- Founded in 2000
  - Wireless expertise
  - Engineering and manufacturing in Silicon Valley, Singapore, Philippines, Taiwan and India

- Private, profitable Company

- Focused on wireless applications
  - Core technology is compact, intelligent, low-power Bluetooth and low power WiFi modules
  - Provide complete HW and SW solutions
  - Differentiate on simple to use products and excellent support
  - Willing to customize our product for customers
 - Focus on sensor and tracking devices
  - 802.11 b/g System on Chip (SOC)

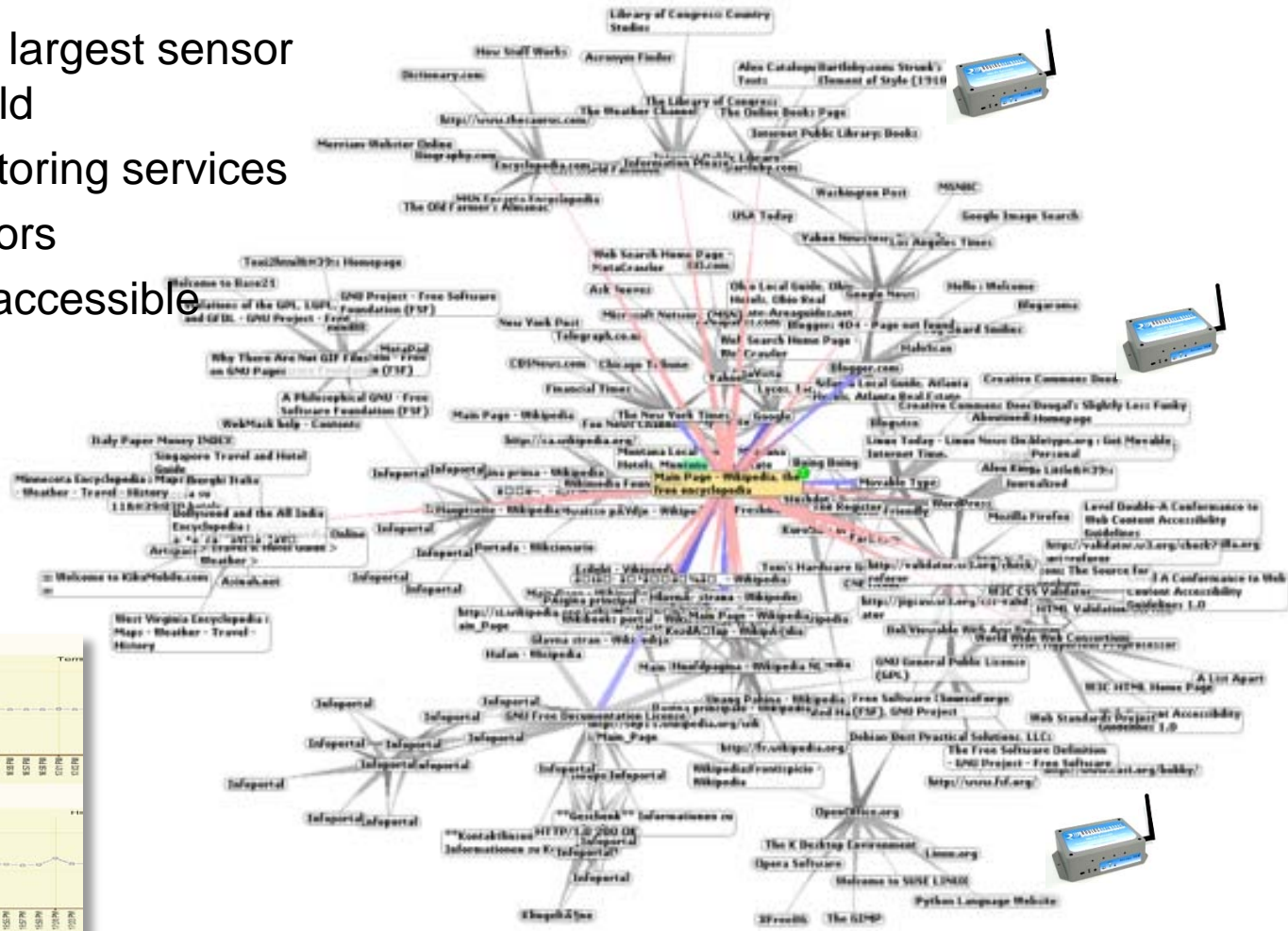*Roving Networks provides complete Bluetooth and WiFi solutions that turn customer's products into wireless solutions.*

ROVING NETWORKS
WIRELESS FOR LESS

Convergence and Change
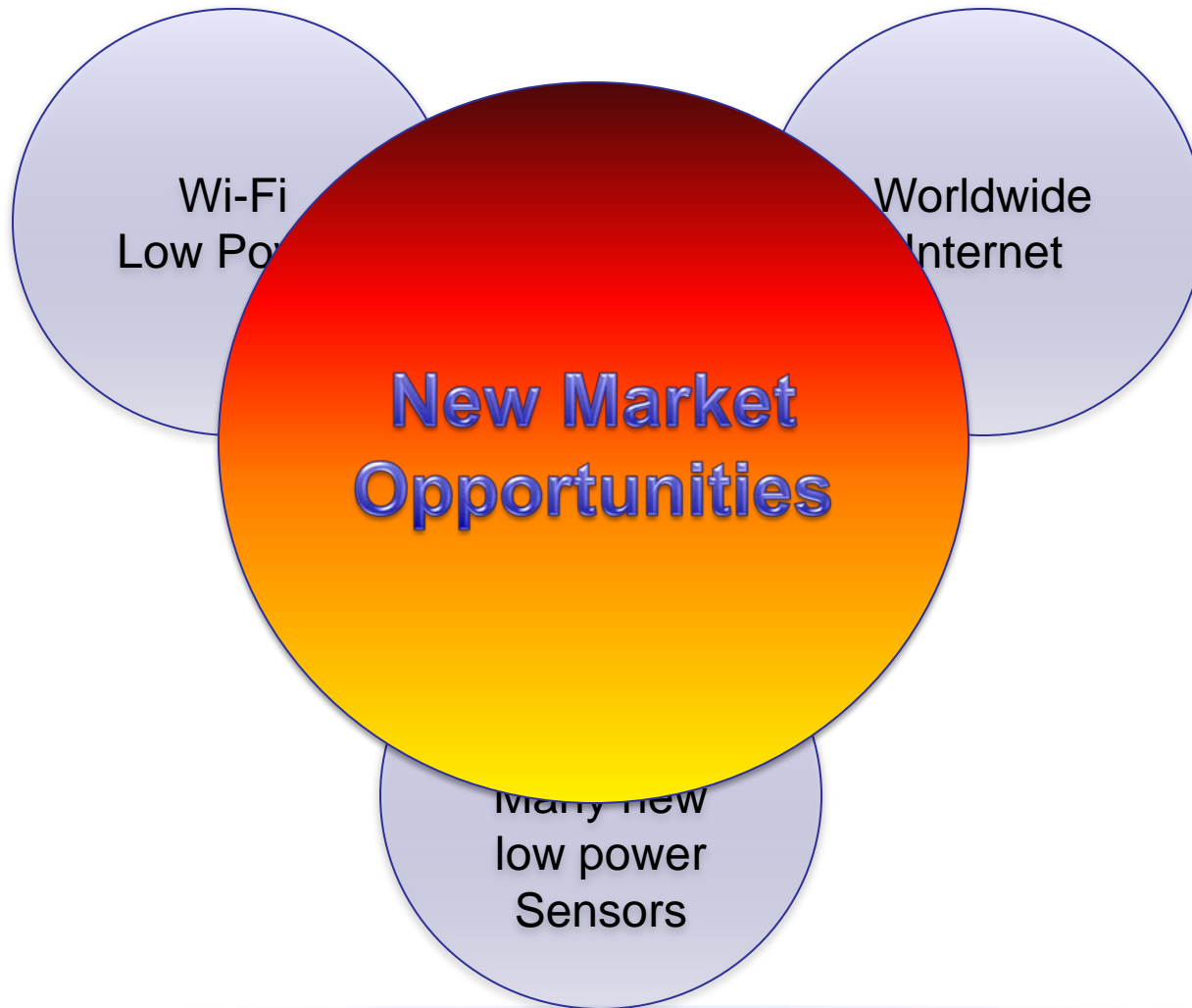
The **World** Wide Web

- The Internet is the largest sensor network in the world
- Cloud based monitoring services
- Autonomous sensors
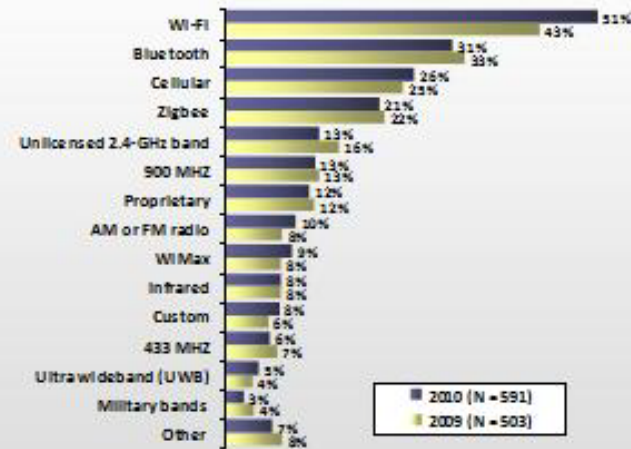- Easy and Unique accessible
  - By anyone
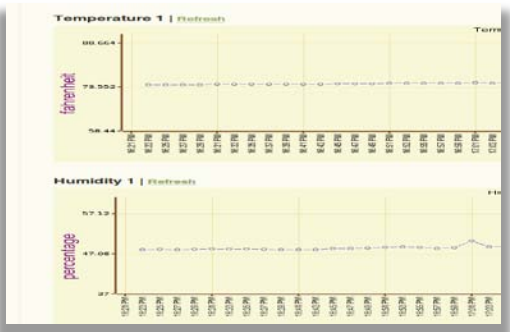
Wi-Fi is a Disruptive Technology

- Wi-Fi is everywhere
- Complementary to wireless sensors applications

WTRS Wireless Sensor Network Technology Report projects strong market growth in the market for Low Power WiFi chipsets used in sensor applications to reach 322% CAGR, over the 2008 to 2013 period.

2010 Embedded Market Study

If wireless, what wireless interfaces does your current embedded project include?

Interface	2010	2009
WI-FI	51%	43%
Bluetooth	31%	33%
Cellular	26%	23%
Zigbee	21%	22%
Unlicensed 2.4-GHz band	19%	16%
900 MHZ	13%	13%
Proprietary	12%	12%
AM or FM radio	10%	8%
WiMax	9%	8%
Infrared	8%	8%
Custom	8%	6%
433 MHZ	6%	7%
Ultra wideband (UWB)	5%	4%
Military bands	3%	4%
Other	7%	9%

2010 (N = 591)
2009 (N = 503)

EETimesGroup

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802.11 Radio Protocol

- Established / proven technology
  - IEEE standard, multiple modulation techniques
  - Wealth of products and expertise available
  - Complex proven large node networks
- Provides interoperability between tools, devices, and vendors
  - TCP/UDP/HTML/DLNA
- Pervasive infrastructure
  - Access points everywhere
  - Many companies developing Wi-Fi products
  - Cities, companies and businesses providing coverage

Examples of "cool" Wi-Fi Products

- **Bread Crumb Sensor**
  - GPS + Temperature + other sensors
  - Battery powered device in a plane, car, package, etc…
  - GPS data and sensors is sampled at regular intervals or interesting conditions
  - Looks for an open or known Wi-FI access points to upload data
  - Examples: delivery vans, planes, rental cars, Asthma breather
- **Asset Tracking Sensor**
  - RSSI + Accelerometer + Temperature + other sensors
  - Multiple Wi-Fi access points used to triangulate location
    - Many corporation and campuses already have Wi-Fi in place
  - Use RFID or a call button to activate
  - Example: Elderly Assisted Care Facilities, Freight, portable equipment locator
- **Home hobbyist Sensor**
  - Temperature, humidity, moisture, etc…
  - Sensors spread across a building, campus or city or country
  - Centralized server application collects data over for email alerts, reporting
  - Examples: Wine cellars, saltwater fish tanks, basements

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Low power (1/2)

How can a WiFi sensor operate multiple years on a single battery?
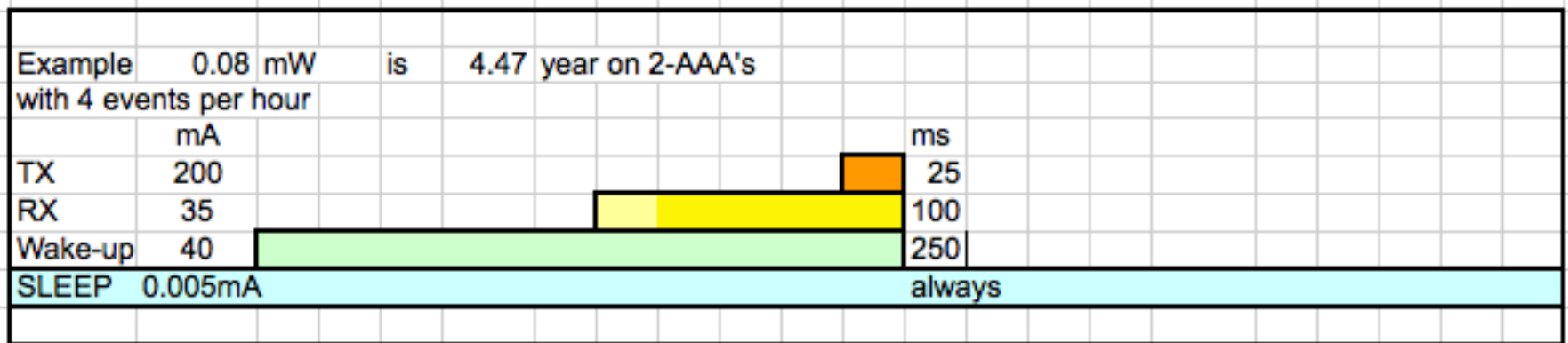
- Normally a WiFi device uses a few Watt and is designed to transport mega bits in seconds
- ZigBee, Z-wave and other wireless sensor networks use mW's and are designed to transport a few hunderd bits in seconds,

Low Duty Cycle + Fast network access + Low Sleep current + battery power management ➔ multiple year life time

(during sleep the sensor interface must be low power as well)

Low power (2/2)

- The questions are
  - 1. What battery?
  - 2. Duty Cycle? How much MCU work?
  - 3. Sleep current?

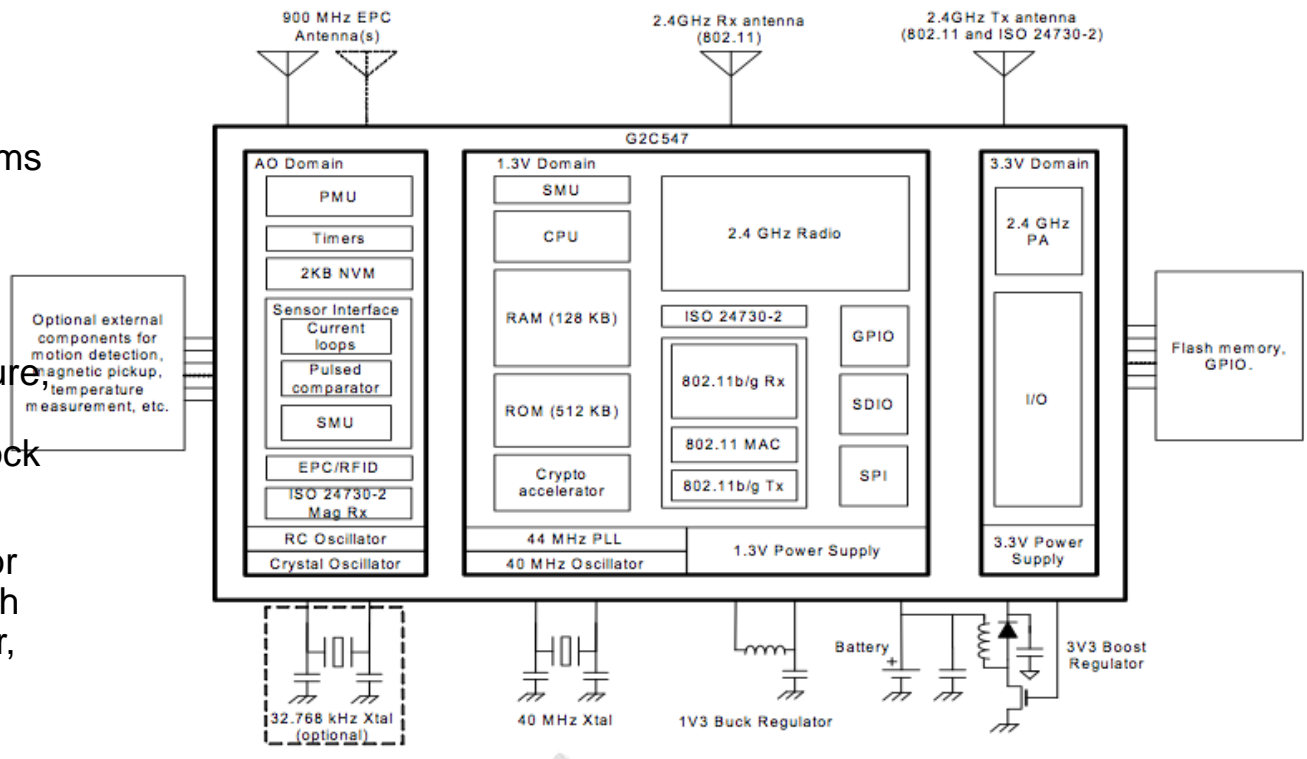| Example	0.08	mW	is	4.47	year on 2-AAA's			
with 4 events per hour								
		mA					ms	
TX	200						25	
RX	35						100	
Wake-up	40						250	
SLEEP	0.005mA					always		

1. Battery lifetime would be >7 years on 2 AAA batteries with a 1 sample per hour reading. (for instance AMR)

2. A sensor device can last for at least 2 years, reading every 2 minutes.

G2C547 Architecture

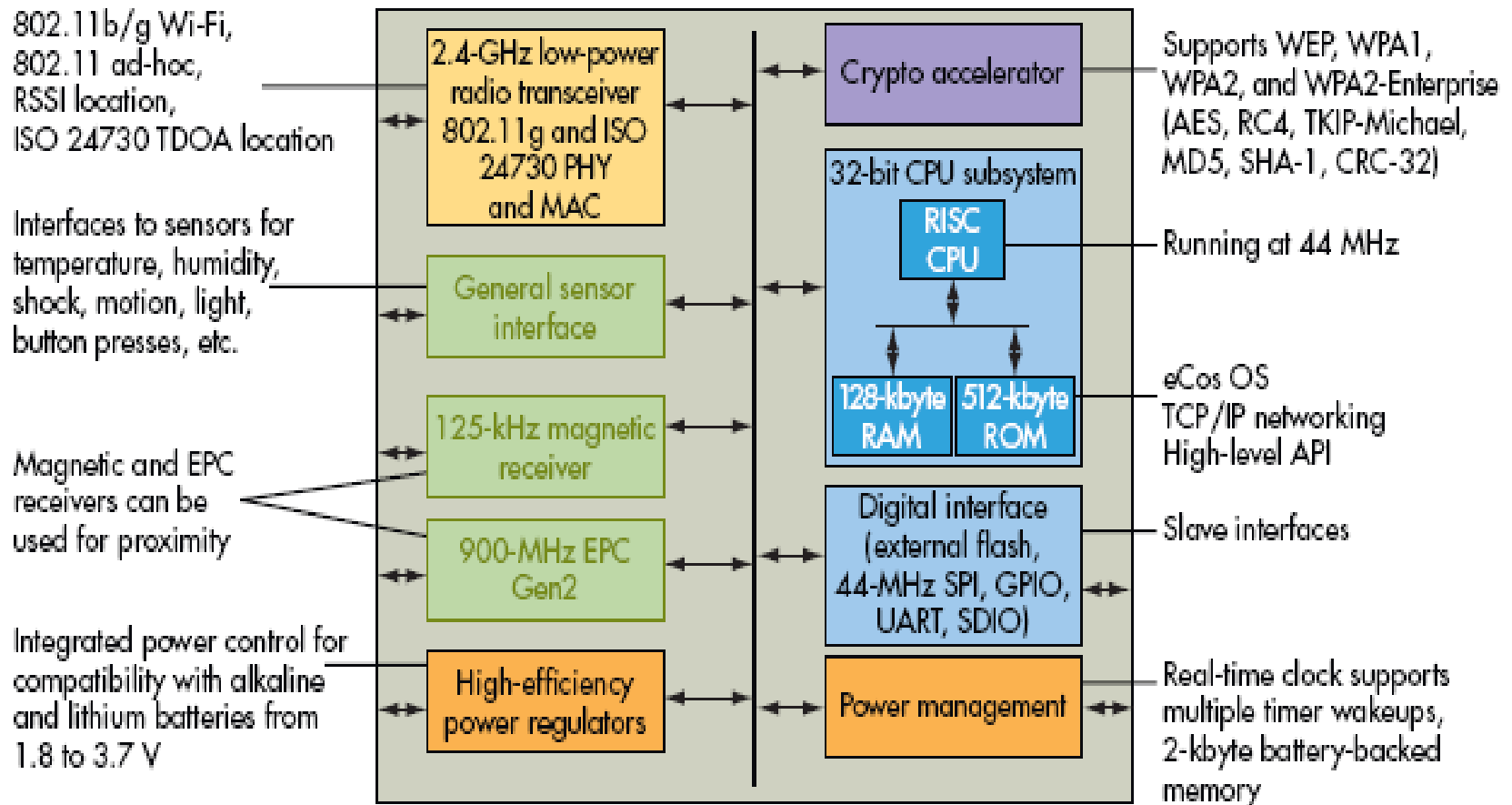- Full TCP/IP stack, IEEE802.11b/g, ISO24730-2

- Consumes 5uW when asleep, 90mW with WI-FI enabled, 12ms time to get connected

- RFID and battery powered sensor applications

- Sensor Interface for temperature, humidity, accelerometers, motion, security seals and shock sensors.

- Incorporates a 32-bit processor clocked at 44Mhz and built with up to 15 GPIOs for SPI master, SDIO client and UART interfaces.

G2C547 Architecture

802.11b/g Wi-Fi,
802.11 ad-hoc,
RSSI location,
ISO 24730 TDOA location

Interfaces to sensors for temperature, humidity, shock, motion, light, button presses, etc.

Magnetic and EPC receivers can be used for proximity

Integrated power control for compatibility with alkaline and lithium batteries from 1.8 to 3.7 V

2.4-GHz low-power radio transceiver 802.11g and ISO 24730 PHY and MAC

General sensor interface

125-kHz magnetic receiver

900-MHz EPC Gen2

High-efficiency power regulators

Crypto accelerator

32-bit CPU subsystem

RISC CPU

128-kbyte RAM

512-kbyte ROM

Digital interface (external flash, 44-MHz SPI, GPIO, UART, SDIO)

Power management

Supports WEP, WPA1, WPA2, and WPA2-Enterprise (AES, RC4, TKIP-Michael, MD5, SHA-1, CRC-32)

Running at 44 MHz

eCos OS
TCP/IP networking
High-level API

Slave interfaces

Real-time clock supports multiple timer wakeups, 2-kbyte battery-backed memory

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MEMBER Wi-Fi ALLIANCE

New Class of Wi-Fi Radios

- There has been significant technology advancements in the last few years
  - Order of magnitude reduction in power consumption
    - < 10 microwatts in (active) sleep mode
    - < 100 milliwatts while connected
    - < 12ms to connect
  - Small, integrated solutions
    - Single chip SOCs / Pre-certified modules
    - Complete 802.11 networking products (TCP/HTTP/UDP/DNS/DHCP/TELNET/FTP)
    - Integrated analog sensor inputs, battery management