Renesas Technology & Solution Portfolio
## Microcontroller and Microprocessor Line-up

<table>
<thead>
<tr>
<th>Year</th>
<th>Line-up</th>
<th>Speed</th>
<th>Features</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td><strong>1200 DMIPS, Superscalar</strong>&lt;br&gt;Renesas SuperH</td>
<td>1200 DMIPS</td>
<td>Superscalar</td>
<td>Industrial &amp; Automotive, 65nm&lt;br&gt;600µA/MHz, 1.5µA standby</td>
</tr>
<tr>
<td>2012</td>
<td><strong>1200 DMIPS, Performance</strong>&lt;br&gt;Renesas RH850</td>
<td>1200 DMIPS</td>
<td>Performance</td>
<td>Automotive, 40nm&lt;br&gt;500µA/MHz, 35µA deep standby</td>
</tr>
<tr>
<td></td>
<td><strong>500 DMIPS, Low Power</strong>&lt;br&gt;Renesas V850</td>
<td>500 DMIPS</td>
<td>Low Power</td>
<td>Industrial &amp; Automotive, 90nm&lt;br&gt;600µA/MHz, 1.5µA standby</td>
</tr>
<tr>
<td></td>
<td><strong>165 DMIPS, FPU, DSC</strong>&lt;br&gt;Renesas RX</td>
<td>165 DMIPS</td>
<td>FPU, DSC</td>
<td>Industrial, 90nm&lt;br&gt;500µA/MHz, 1.6µA deep standby</td>
</tr>
<tr>
<td></td>
<td><strong>165 DMIPS, FPU, DSC</strong>&lt;br&gt;Renesas RX</td>
<td>165 DMIPS</td>
<td>FPU, DSC</td>
<td>Industrial, 40nm&lt;br&gt;200µA/MHz, 0.3µA deep standby</td>
</tr>
<tr>
<td></td>
<td><strong>25 DMIPS, Low Power</strong>&lt;br&gt;Renesas 78K</td>
<td>25 DMIPS</td>
<td>Low Power</td>
<td>Industrial &amp; Automotive, 150nm&lt;br&gt;190µA/MHz, 0.3µA standby</td>
</tr>
<tr>
<td></td>
<td><strong>44 DMIPS, True Low Power</strong>&lt;br&gt;Renesas RL78</td>
<td>44 DMIPS</td>
<td>True Low Power</td>
<td>Industrial &amp; Automotive, 130nm&lt;br&gt;144µA/MHz, 0.2µA standby</td>
</tr>
<tr>
<td></td>
<td><strong>10 DMIPS, Capacitive Touch</strong>&lt;br&gt;Renesas R8C</td>
<td>10 DMIPS</td>
<td>Capacitive Touch</td>
<td>Industrial &amp; Automotive, 130nm&lt;br&gt;350µA/MHz, 1µA standby</td>
</tr>
</tbody>
</table>

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‘Enabling The Smart Society’

**Challenge:**
“Applications today are migrating from standalone devices to connected systems. Wireless solutions enable easy connectivity both in new and existing applications. There are a lot of wireless technologies available in the market today with varying capabilities. How does one pick the right wireless technology?”

**Solution:**
“This class will look at the key features of any wireless application. We will show how to make an informed decision on picking the right wireless technology by matching capabilities of the wireless technology with your application needs.”
Agenda

1. Overview of Current Wireless Technologies
2. Key Requirements of Wireless Networks
3. Implementation Options & Renesas Solutions
4. Q&A
Overview of Wireless Technologies
Need for Wireless

- **Lower System costs**
  - Reduces cabling & installation costs

- **Scalable & Flexible networks**
  - Easier add-ons, changes and removal of sensors
  - Valuable for frequent & expensive changes

- **Control from anywhere**
  - Increased trust in wireless networking
  - Multiple control platforms
  - Easy accessibility of data

- **Better decision making**
  - Deployment of more sensors
  - More real time data
  - Better decision making
Fast Growing Market

World Wide Low Power Wireless Market

Common Wireless Technologies

We will focus on open standards for this class
Key Wireless Technology: Wi-Fi

- Based on IEEE 802.11 standards

- Widespread Adoption
  - 760M devices shipped in 2010
  - >2B devices shipped overall

- Star topology: point to hub

---

<table>
<thead>
<tr>
<th>Wi-Fi Technology Frequency Band</th>
<th>Maximum data rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11a 5 GHz</td>
<td>54 Mbps</td>
</tr>
<tr>
<td>802.11b 2.4 GHz</td>
<td>11 Mbps</td>
</tr>
<tr>
<td>802.11g 2.4 GHz</td>
<td>54 Mbps</td>
</tr>
<tr>
<td>802.11n 2.4 / 5 GHz</td>
<td>450 Mbps</td>
</tr>
</tbody>
</table>

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Wi-Fi cards in Corporate Notebooks

Wi-Fi in residential LAN networks

Wi-Fi in Cell phones

Wi-Fi in Embedded devices

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<table>
<thead>
<tr>
<th>Year</th>
<th>Wi-Fi Technology</th>
<th>Maximum data rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>802.11b</td>
<td>11 Mbps</td>
</tr>
<tr>
<td>2003</td>
<td>802.11g</td>
<td>54 Mbps</td>
</tr>
<tr>
<td>2007</td>
<td>802.11n</td>
<td>150 Mbps</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Key Wireless Technology: ZigBee**

- Builds on top of 802.15.4 standard
  - Adds network, security layers, application framework

- Supports the largest number of interoperable standards
  - Built on top of ZigBee PRO

- Networking topology
  - Ad-hoc, peer to peer, star or mesh

---

**Operating Frequency**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Region</th>
<th>Data Rate</th>
<th>Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>868 MHz</td>
<td>Europe</td>
<td>20 kbps</td>
<td>1</td>
</tr>
<tr>
<td>915 MHz</td>
<td>Americas</td>
<td>40 kbps</td>
<td>10</td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>Worldwide</td>
<td>250 kbps</td>
<td>16</td>
</tr>
</tbody>
</table>
**Key Wireless Technology: Bluetooth**

- Based on IEEE 802.15.1 standard
- Uses frequency-hopping spread spectrum
  - Transmits data in chunks
  - 79 bands (1 MHz each; centered from 2402 to 2480 MHz)
- Topology
  - Ad-hoc, very small networks

<table>
<thead>
<tr>
<th>Version</th>
<th>Variants</th>
<th>Description</th>
<th>Max data rate (Mbit/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.2</td>
<td>Basic rate</td>
<td>Gaussian frequency-shift keying (GFSK)</td>
<td>1</td>
</tr>
<tr>
<td>Version 2.0</td>
<td>+EDR</td>
<td>π/4-DPSK and 8DPSK</td>
<td>3</td>
</tr>
<tr>
<td>Version 3.0</td>
<td>+HS</td>
<td>Uses Wi-Fi AMP (Alternate MAC/PHY)</td>
<td>24</td>
</tr>
<tr>
<td>Version 4.0</td>
<td>Classic Bluetooth</td>
<td>Legacy BT protocols</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bluetooth high speed</td>
<td>Uses Wi-Fi AMP (Alternate MAC/PHY)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bluetooth low energy</td>
<td>new protocol stack for rapid build-up of simple links.</td>
<td></td>
</tr>
</tbody>
</table>
Key Wireless Technology: Cellular (2G)

2G technologies: TDMA & CDMA
- GSM (TDMA-based): 80% WW share
- IS-95/cdmaOne (CDMA-based): 17% WW share

2.5G (GPRS/1xRTT)
- Packet switched technology
- Services: WAP, SMS & MMS, Internet access

2.75G (EDGE)
- Part of the GSM family (3GPP standards)
- 3x capacity of GSM/GPRS networks using 8PSK encoding

### Evolution of Cellular Technologies

<table>
<thead>
<tr>
<th>1G</th>
<th>2G</th>
<th>3G</th>
<th>4G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Mobility</td>
<td>Roaming capability</td>
<td>Internet access, more services: WAP, SMS &amp; MMS</td>
<td>Very high data rates</td>
</tr>
<tr>
<td>Basic Services</td>
<td>Digital system</td>
<td>Global access</td>
<td>IP based communications</td>
</tr>
<tr>
<td>Analog system</td>
<td>Data services (SMS)</td>
<td>Higher data rates</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.5G Technology</th>
<th>Base Technology</th>
<th>Data rate (kbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPRS</td>
<td>GSM</td>
<td>56 -115</td>
</tr>
<tr>
<td>1xRTT</td>
<td>CDMA</td>
<td>153.6</td>
</tr>
<tr>
<td>EDGE</td>
<td>GSM</td>
<td>384.0</td>
</tr>
</tbody>
</table>
Key Wireless Technology: Cellular (3G)

- IMT-2000 specifications: data rate > 200Kbps
- Target applications: need higher bandwidth
  - Mobile Internet access, video calls and mobile TV.
  - New vendor modules have 3G to leverage available infrastructure

<table>
<thead>
<tr>
<th>Technology</th>
<th>Standard</th>
<th>Regions</th>
<th>Data rate (Mbps)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDMA</td>
<td>EDGE evolution</td>
<td>WW except Japan</td>
<td>0.6</td>
<td>evolutionary upgrade to GSM/GPRS</td>
</tr>
<tr>
<td>CDMA</td>
<td>CDMA2000 (EV-DO)</td>
<td>Americas, Asia</td>
<td>3.1 (forward) 1.8 (reverse)</td>
<td>Designed as end-to-end IP based network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UTMS (HSPA)</td>
<td></td>
<td>WW</td>
<td>14.4 (down) 5.76 (up)</td>
<td></td>
</tr>
<tr>
<td>UTMS (HSPA+)</td>
<td></td>
<td>WW</td>
<td>84 (down) 10.8 (up)</td>
<td></td>
</tr>
</tbody>
</table>
Key Requirements of Wireless Application
Key Requirements of Wireless Applications

- Reach
- Power
- Throughput
- Cost
- Interoperability
Key Requirements

1. **Reach**
   - **ZigBee**: 10-50m single hop
   - **Wi-Fi**: ~100m single hop
   - **Cellular (2G, 3G)**: long reach
     - No mesh networks
   - **ZigBee**: range can be increased by mesh networking
   - **Bluetooth**: power-class-dependent: 100m, 10m and 1m
Key Requirements

- **Wi-Fi**: High throughput
  - 802.b: 11 Mbps, 802.11n: 150 Mbps
  - File transfers, video applications

- **ZigBee**: Low throughput
  - 20, 40, and 250 Kbits/s
  - Status information, data logging

- **Bluetooth**: Moderate throughput
  - 1 Mbps (Basic rate) – 24 Mbps (HS)
Key Requirements

- **ZigBee**: Low power
  - 2yr+ battery life for certification
  - Optimized for low power: fast wake up (15us)
  - System power needs to account for intermediate hops

- **Wi-Fi, Cellular**: Avg battery life
  - Dependant on duty cycle

- **Bluetooth**: Dependant on variant
  - Classic, HS: Maintains connection while communication, needs continuous power. Low battery life.
  - BTLE has very low power consumption: good fit for portable devices
Key Requirements

Cost

- **Wi-Fi:**
  - Higher per unit cost
  - Lower system cost due to availability of existing infrastructure

- **ZigBee:**
  - Low per unit cost
  - System cost high due to need for new routers, access points

- **Bluetooth:**
  - Low unit and system cost

- **Cellular:**
  - Moderate unit cost
  - Operational cost: Cellular connection needs monthly service from wireless provider
## Other Requirements

<table>
<thead>
<tr>
<th>Security</th>
<th>Internet Connectivity</th>
<th>Available Infrastructure</th>
<th>Network Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wi-Fi</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early encryption systems WEP, easy to break</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPA2 using AES is very secure: deployed in enterprise apps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPS (Wi-Fi Protected setup) has known security weakness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support for higher layer security: SSL, TLS</td>
<td>Uses AES 128 encryption (128 bit key)</td>
<td>Based on SAFER + block cipher (64, 128 bit blocks)</td>
<td>Moderate level of service security: GEA/1, GEA/2</td>
</tr>
<tr>
<td>[ ][ ][ ]</td>
<td>Security weakness when adding new device to network: exchange of keys.</td>
<td>Key generation based on PIN entered into both devices</td>
<td>Some networks use GEA/0: no encryption</td>
</tr>
<tr>
<td>[ ][ ][ ]</td>
<td>Obtain initial master key secure medium</td>
<td>Susceptible to denial-of-service attacks, eavesdropping, etc.</td>
<td>Higher layer security such as SSL/TLS</td>
</tr>
<tr>
<td>[ ][ ][ ]</td>
<td>[ ][ ][ ]</td>
<td>[ ][ ][ ]</td>
<td>[ ][ ][ ]</td>
</tr>
</tbody>
</table>
### Other Requirements

#### Internet Connectivity

<table>
<thead>
<tr>
<th>Wi-Fi</th>
<th>ZigBee</th>
<th>Bluetooth</th>
<th>Cellular</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.11 interfaces directly with TCP/IP layers: allows native connectivity to Internet.</td>
<td>Needs gateway to interface to TCP/IP</td>
<td>Support for IP in Bluetooth</td>
<td>Support for IPv4</td>
</tr>
<tr>
<td></td>
<td>6lowPAN allows to use 802.15.4 radio with TCP/IP</td>
<td></td>
<td>Support for PPP: allows tunneling of IP to phone</td>
</tr>
</tbody>
</table>
## Other Requirements

<table>
<thead>
<tr>
<th>Security</th>
<th>Internet Connectivity</th>
<th>Available Infrastructure</th>
<th>Network Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wi-Fi</strong></td>
<td><strong>ZigBee</strong></td>
<td><strong>Bluetooth</strong></td>
<td><strong>Cellular</strong></td>
</tr>
<tr>
<td>* Ubiquity of Wi-Fi in the home and enterprise</td>
<td>* Deployed on most smart meters in NA</td>
<td>* Installed in most smart phones and PCs/laptops</td>
<td>* Uses widely available cell phone network (GSM/CDMA)</td>
</tr>
<tr>
<td>* Wi-Fi Alliance has certified &gt;10K devices: proven interoperability</td>
<td>* Popular with building automation devices</td>
<td>* Popular with personal communication devices</td>
<td></td>
</tr>
</tbody>
</table>
## Other Requirements

<table>
<thead>
<tr>
<th>Security</th>
<th>Internet Connectivity</th>
<th>Available Infrastructure</th>
<th>Network Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Wi-Fi | ZigBee | Bluetooth |
----------|--------|-----------|
Network size | 32 | 65536 | 7 |
Connection time | Device connection requires 3-5 seconds | Devices can join an existing network in under 30ms | Device connection requires up to 10 seconds |
System resources | 32-128KB | 256KB-1MB | 256KB |
Channel bandwidth | 22MHz | 5MHz | 8MHz |
## Application Needs vs. Wireless Capabilities

<table>
<thead>
<tr>
<th>Application Needs</th>
<th>Importance (1-10)</th>
<th>Wi-Fi</th>
<th>ZigBee</th>
<th>Bluetooth</th>
<th>Cellular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach</td>
<td>7</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Throughput</td>
<td>6</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>8</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>3</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Security</td>
<td>3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet access</td>
<td>2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available infrastructure</td>
<td>2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Misc. network parameters</td>
<td>1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Summary**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>18</td>
<td>3</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
Implementation Options
Approach

- **Module**
  - MCU + Transceiver + Antenna on a printed circuit board
  - Ready to use solution
    - Eliminates need for antenna design
    - Some flavors have protocol stacks integrated into the MCU
  - Usually FCC certified
  - Quick time to market
  - Cost effective solution for small, medium volume applications

- **Chipset**
  - Cost effective for large volume applications
Module based approach: Renesas Solution For Wi-Fi
Traditional vs. Embedded Wi-Fi

Traditional Wi-Fi

- Large Host
  400MHz+ processor

- Networking and high level Wi-Fi software on host
  (WPS, Security, etc.).

- Need TCP/IP software stack

- Large device driver
  (WinCE, Linux, etc.)

- Long wake up time:
  Code downloaded at start-up

- Higher power solution:
  operated on AC supply or large batteries

Low Power Embedded Wi-Fi

- Small, low cost Host
  20-100 MHz processor

- Small device driver
  AT commands

- Networking and high level Wi-Fi software in module
  (WPS, Security, etc.)

- TCP/IP stack integrated in module

- Quick wake up time:
  Code present in module.

- Low power solution.
  Operated on small AA or coin cell batt.
Renesas WiFi Solutions

- Use Renesas MCUs with partner Wi-Fi modules
  - Partners: Redpine Signals, Gainspan
- Modules
  - All Wi-Fi Components (baseband, radio, power amplifier, antenna) integrated into a single module
  - TCP/IP stack fully integrated into module
  - Modules support multiple standards 802.11 b/g/n or 802.11 a/b/g/n
- MCU interface
  - Interface to MCU is either SPI or UART
  - Driver source code included for SPI or UART
  - Small Memory Footprint 2-4K UART, 10-30K for SPI
  - Free source code to drivers and demo application
Wi-Fi Module Benefits

- Wi-Fi hardware such as RF, antenna included in module
  - No RF expertise required resulting in shorter design cycles
- Products are already fully certified to regulatory requirements FCC/CE/IC and Wi-Fi certification
  - Less burden in certifying products (Wi-Fi and conformance testing)
- TCP/IP stack integrated on module
  - Customers do not need any networking expertise

Allows Customers to Focus On Their Own Application
## Renesas Wi-Fi Partners

<table>
<thead>
<tr>
<th></th>
<th>Redpine Signals</th>
<th>GainSpan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protocols supported</strong></td>
<td>802.11 a/b/g/n</td>
<td>802.11 b/g/n</td>
</tr>
<tr>
<td><strong>Dual band (2.4/5 GHz)</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Access Point mode for easy provisioning</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
<td>High throughput</td>
<td>Low power operation in 802.11b, fast wake up times, long battery life</td>
</tr>
<tr>
<td></td>
<td>Best in class range and link budget at 802.11n</td>
<td></td>
</tr>
<tr>
<td><strong>Wi-Fi Solutions</strong></td>
<td>1. Wi-Fi module cards</td>
<td>1. WiFi module cards</td>
</tr>
<tr>
<td></td>
<td>2. Wi-Fi solution kits with Renesas MCU RDKs</td>
<td>2. RL78 RDK</td>
</tr>
<tr>
<td><strong>Typical applications</strong></td>
<td>File transfers, Code Downloads, Images</td>
<td>Sensors, monitoring</td>
</tr>
</tbody>
</table>
Wi-Fi Solutions

Starter Kits, Wi-Fi Cards

- Starter kits: RDK, WiFi cards, demos to enable quick prototypes
- RL78/G14 RDKs with WiFi modules on main board
- Wi-Fi cards that plug into RDKs

Demos

- iPhone sensor demo
- Sensor + throughput demo
- Wireless configuration through web interface
- Cloud connectivity
Chipset-Based Approach: Renesas Solution For ZigBee
Renesas’ ZigBee PRO Solution

Proven Silicon
M16C/6B3
M16C/6B4

Certified In-House ZigBee PRO Stack

Hardware Development Platform

+ 

+ 

M16C/6B Group
MCU with 2.4 GHz built-in transceiver
Proven Silicon: RF Embedded MCU

M16C/6B3
- Flash: 256KB
- RAM: 20KB
- Package: 64-QFN (9×9mm)

M16C/6B4
- Flash: 192KB
- RAM: 20KB
- Package: 48-QFN (7x7mm)

- Embedded RF transceiver circuit compliant with IEEE802.15.4 in 2.4GHz band
- Low supply voltage operation: 1.8V – 3.6V
- Embedded AD converter (M16C/6B3)
- In-House robust ZigBee PRO protocol stack
Certified ZigBee PRO Stack

- Achieved ZigBee Compliant Platform (ZCP) in April 2010
- Both licensed and license-free version.
- In-house development optimized for M16C controller and customer needs
- ZigBee PRO SDK contains an object library and the header files of the protocol stack.
- Fully owned by Renesas Electronics.
Hardware Development Platform
M16C/6B ZigBee Evaluation Board

- Evaluate ZigBee/IEEE802.15.4 MAC using the Renesas the M16C/6B device

Available software:
- Protocol Stack
  - ZigBee PRO Protocol Stack
  - IEEE802.15.4 -2003 Stack
- Sample Software
  - ZigBee PRO sample application
  - IEEE802.15.4 MAC
    - Serial command program
    - Network program
  - AES driver
  - RF driver
  - RF characteristic eval program

Evaluation board
Renesas “Mini-MAC” Solution

Proven Silicon

R8C/3MQ

+ 

“Mini-MAC” In-House Stack

Users' Application

- ZRC Stack
- RF4CE stack
- IEEE802.15.4 MAC
- RF driver
- µTRON
- R8C/3MQ

Simple, low-cost, 2-way radio solution
- 802.15.4-based short range, low data rate
- Complete HW and SW solution provided by BNS Solutions
- Low cost and easy TTM compared to ZigBee and RF4CE protocols

Hardware Development Platform

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DevCon
Enabling the Smart Society
R8C/3MQ Group Features

MCU Embedded Low Power Transceiver for ZigBee RF4CE
   - Low Supply Current
     Transmitter : 18mA @ 4MHz operation
     Receiver : 25mA @ 4MHz operation

Embedded Flash and data Flash, enable to Read and Write at 1.8V
   - ROM size( maximum ) : 128KB
   - RAM size (maximum ) : 7.5KB
   - Data Flash : 4KB

Small Package, embedded
   - 6mm x 6mm 40pin small( HWQFN ) Package

< Package Outline >
Summary

- **Embedded Wireless**: fast growing market
- **Common wireless technologies:**
  - Wi-Fi, ZigBee, Bluetooth, Cellular
- **To pick the best technology**
  - Pick the wireless that meets the applications requirements on throughput, power, range and cost
  - Consider secondary requirements such as security, connectivity to internet, existing infrastructure and network parameters
- **Consider module based approach**
  - Quick time to market: Ready to use solution, FCC certified
- **Renesas has solutions for Wi-Fi and ZigBee**
  - Wi-Fi: Modules from Redpine, Gainspan
  - ZigBee: Fully integrated silicon (M16C, R8C)
Questions?
‘Enabling The Smart Society’

- **Challenge:**
  “Applications today are migrating from standalone devices to connected systems. Wireless solution enable easy connectivity both in new and existing applications. There are a lot of wireless technologies available in the market today with varying capabilities. How does one pick the right wireless technology?”

- **Solution:**
  “This class will look at the key features of any wireless application. We will show how to make an informed decision on picking the right wireless technology by matching capabilities of the wireless technology with your application needs.”

- **Did we accomplish the above statement?**