Delivering MORE Together

Wireless Connectivity Solutions
For the Internet of Things

Wirelessly connecting everywhere.
Agenda

1. What is the Internet of Things
2. TI's Portfolio
3. Zoom in products – ZigBee, WiFi, BT4.0, Sub 1GHz
4. How to get started

Internet of Things Wireless Solutions
“Internet of Things” Connecting Everything

GSMA predicts there could be 24 billion connected devices by 2020
The “Internet of Things”
Three Major Hubs

- **Mobile Hub**
  - Bluetooth®
  - Bluetooth low energy

- **Wi-Fi Access Point**
  - Wi-Fi

- **Mesh Gateway**
  - ZigBee®
  - 6LoWPAN
  - 802.15.4
  - Sub-1GHz

*GSMA expects the number of total connected devices to increase from approximately 9 billion today, to more than 24 billion in 2020*

Connected devices*

- 2012: 9 billion
- 2020: 24 billion
The industry’s broadest wireless connectivity portfolio:

<table>
<thead>
<tr>
<th>Supported standards</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.4KHz / 13.56MHz</td>
<td></td>
</tr>
<tr>
<td>RFID</td>
<td>Wi-Fi</td>
</tr>
<tr>
<td>NFC</td>
<td>GPS</td>
</tr>
<tr>
<td>ISO14443A/B</td>
<td></td>
</tr>
<tr>
<td>ISO15693</td>
<td></td>
</tr>
<tr>
<td>Sub 1GHz</td>
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<tr>
<td>SimpliciTI</td>
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</tr>
<tr>
<td>6LoWPAN</td>
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<tr>
<td>W-MBus</td>
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<tr>
<td>PurePath</td>
<td></td>
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<tr>
<td>Wireless</td>
<td></td>
</tr>
<tr>
<td>2.4GHz to 5GHz</td>
<td></td>
</tr>
<tr>
<td>ZigBee®</td>
<td></td>
</tr>
<tr>
<td>6LoWPAN</td>
<td></td>
</tr>
<tr>
<td>RF4CE</td>
<td></td>
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<tr>
<td>Bluetooth® technology</td>
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<tr>
<td>Bluetooth® low energy</td>
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<tr>
<td>ANT</td>
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<tr>
<td>Example applications</td>
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</tr>
<tr>
<td>Product line up</td>
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</tr>
<tr>
<td>TMS37157</td>
<td>CC4000</td>
</tr>
<tr>
<td>TRF796x</td>
<td></td>
</tr>
<tr>
<td>TRF7970</td>
<td></td>
</tr>
<tr>
<td>CC1110</td>
<td>CC2500</td>
</tr>
<tr>
<td>CC430</td>
<td>CC2543 / 44 / 45</td>
</tr>
<tr>
<td>CC11xL</td>
<td>CC2590 / 91</td>
</tr>
<tr>
<td>CC1120/21 / 25</td>
<td>CC8520 / 21</td>
</tr>
<tr>
<td>CC1200</td>
<td>CC8530 / 31</td>
</tr>
<tr>
<td>CC1180</td>
<td>CC2530</td>
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<tr>
<td>CC2538</td>
<td>CC2530ZNP</td>
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<tr>
<td>CC2531</td>
<td></td>
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<tr>
<td>CC2533</td>
<td></td>
</tr>
<tr>
<td>CC2520</td>
<td>CC2560 / 64</td>
</tr>
<tr>
<td>CC2540 / 41</td>
<td>CC2570 / 1</td>
</tr>
<tr>
<td>WL1271 / 3</td>
<td>CC3000</td>
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<tr>
<td>WL128x</td>
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<tr>
<td>CC8520 / 21</td>
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<td>CC8530 / 31</td>
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<td>CC2531</td>
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<td>CC2533</td>
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<td>CC2520</td>
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<td>CC4000</td>
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</tr>
</tbody>
</table>

Red = SimpleLink family of self-contained, wireless connectivity solutions
Choosing the Right Technology for You

Range

<table>
<thead>
<tr>
<th>Technology</th>
<th>Range (m)</th>
</tr>
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<tbody>
<tr>
<td>BLE</td>
<td>10</td>
</tr>
<tr>
<td>Zigbee</td>
<td>100</td>
</tr>
<tr>
<td>RF4CE</td>
<td>10,000+</td>
</tr>
<tr>
<td>Bluetooth</td>
<td></td>
</tr>
<tr>
<td>2.4GHz Proprietary</td>
<td></td>
</tr>
<tr>
<td>WiFi</td>
<td></td>
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</table>

Throughput

<table>
<thead>
<tr>
<th>Technology</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLE</td>
<td>&lt;2 Mbps</td>
</tr>
<tr>
<td>Zigbee</td>
<td>&lt;250 kbps</td>
</tr>
<tr>
<td>RF4CE</td>
<td></td>
</tr>
<tr>
<td>2.4GHz Proprietary</td>
<td></td>
</tr>
<tr>
<td>Bluetooth</td>
<td>20 Mbps</td>
</tr>
<tr>
<td>WiFi</td>
<td></td>
</tr>
</tbody>
</table>

Typical power source

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li-Ion</td>
<td>BLE, Sub-1GHz, 2.4GHz Proprietary, WiFi</td>
</tr>
<tr>
<td>AAA</td>
<td>BLE, Zigbee, RF4CE, WiFi</td>
</tr>
<tr>
<td>Coin Cell</td>
<td>BLE, Zigbee, RF4CE, WiFi</td>
</tr>
</tbody>
</table>

Typical Topology

<table>
<thead>
<tr>
<th>Topology</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh</td>
<td>Zigbee, Prop Sub 1GHz, Prop 2.4GHz</td>
</tr>
<tr>
<td>Star</td>
<td>WiFi, Bluetooth, RF4CE</td>
</tr>
<tr>
<td>P2P</td>
<td></td>
</tr>
</tbody>
</table>
Why ZigBee?

- ZigBee Compliant Platform
  - IEEE 802.15.4 PHY and MAC
  - ZigBee is a Mesh network, security and application layer functions
  - TI ZigBee development kits are based on ZigBee Compliant Platforms

- ZigBee Compliant Product
  - Product based on a ZigBee Compliant Platform
  - Can use the ZigBee name and logo
  - Can co-exist with other ZigBee systems
  - Interoperable if a public profile is used
# ZigBee Solution from TI

<table>
<thead>
<tr>
<th>SoC</th>
<th>Co-processor</th>
<th>Dual-chip</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>small footprint, high integration, low cost</strong></td>
<td><strong>flexible, easy to use and reduced time to market</strong></td>
<td><strong>ultra low power or high performance</strong></td>
</tr>
</tbody>
</table>

| Application | CC2530 (51 Core)  
CC2538 (M3 core) | Any Processor (e.g. MSP430 or Stellaris ARM) | MSP430 or Stellaris ARM |
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Protocol stack</td>
<td>CC2530 based co-processor with embedded stack and uart/spi/usb interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td>CC2520</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF front end (optional)</td>
<td>CC2590 / CC2591</td>
<td>CC2590 / CC2591</td>
<td>CC2590 / CC2591</td>
</tr>
</tbody>
</table>
CC2538 - Powering IoT

Powerful, scalable and flexible:

- Powerful 32-bit ARM Cortex-M3 MCU
- Up to 512 KB Flash and 32 KB RAM
- 2.4GHz IEEE 802.15.4-2006 compliant RF transceiver
- Very low power consumption RX / TX: 19mA / 24 mA
- Interface support: USB, 2x SPI, 2x UART, I2C, 32 GPIO
- 125°C operation for reliability in high-temp environments
- Robust blocking and selectivity
Why Wifi?

• Over 2.5 billion WiFi units deployed in the market today;
  1 billion units/year projected starting in 2011
• Easiest connection to the Internet
  Native to IP and TCP
• Full house coverage
• Using 2.4Ghz – unlicensed frequency, used globally
What is SimpleLink™ WiFi?

- Universal IP connectivity enabled everywhere
- The fastest way to connect an existing application to a Wifi router and the internet
- Self contained wifi solution with TCP, UDP and IP on a single chip
- Only 6Kb Flash, 3Kb Ram needed

Video: SimpleLink connects your product to the internet

Wi-fi connect your application!
**SimpleLink™ WiFi from TI**

**Smart Config**
Smart Wifi pairing for embedded devices

New **Smart Config** feature enables a device without screen or i/o to pair with a WiFi access point using standard Wifi mechanisms.

**Connect your product to a WiFi access point in a day!**

**Wifi code examples**
Only a few kB of code required! Source code available!

- **Basic WiFi application**
  Tx/Rx UDP, ping

- **Sensor application**
  Log temp and accelerometer data

- **Home automation**
  Adjust temperature via Twitter

- **Data logger**
  Show sensor data over time

**Certified modules**
Wifi, FCC/IC, ETSI tested modules

- **TI Module:**

- **Wilink-tech Module:**

**Development kits**
For MSP430, Stellaris and other MCUs
Why Bluetooth?

- Commonly used in cell phones, computers and cars
- Using 2.4GHz - unlicensed frequency - used globally
- Application throughput up to 2Mbps
- Used to transfer data or stream audio
Bluetooth Solution from TI

CC2560 - Mature & robust Bluetooth solution
2x Range – making it easy to use with great user experience
Provided with stack on MCU royalty free
Modules available for ease of design

Development resources for prototyping and development

Bluetooth Kit
MSP430 + CC2560
Supporting SPP Profile

Bluetooth module
With or Without Antenna
Fully certified

Bluetooth / BLE Kit
Coming soon…
What is Bluetooth low energy?

- Low power: >1 year battery life on a coin cell
- Low data rate: Application throughput up to 100kbps
- Smartest way to connect your product to iOS devices and other BLE enabled smartphones, tablets and PCs

Many brand products on the market already!
Bluetooth Low Energy from TI

Most mature single-mode BLE solution: CC2541/CC2540

Development resources for prototyping and development

BLE Sensor kit
An app developer can access:
- IR temp sensor
- Humidity sensor
- Accelerometer
- Pressure sensor
- Magnetometer
- Gyroscope
- Pushbuttons, LEDs

Available in October

iOS app on appstore
Source code available!

BLE Key fob
More than 6000 sold!

Btool for BLE device exploration

RF Packet Sniffer

USB stick
For PC connectivity

Power consumption estimator
Why Sub-1GHz RF?

- **Longest RF transmission** range, more than 10’s of kilometers (“Wide Area Networks”)

- Good range in urban environments

- **Full-house coverage** with a star topology network.

- Regulatory restrictions allowing the communication to be more robust (example: maximum 1% duty-cycle in the band)

- Popular applications: home security, home automation and automatic meter reading systems

Video: 25km range test in Cape Town, South Africa

Best technology for robust, long range wireless communications
Sub1-GHz RF solutions from TI

Value Line vs Performance Line

Value Line
- CC110L transceiver
- CC113L receiver
- CC115L transmitter

Performance Line
- CC1120 transceiver
- CC1121 transceiver
- CC1125 transceiver
- CC1175 transmitter

Dev tools and software for eval, design and production test

SmartRF Studio
RF Packet Sniffer

New features for more robust and lower power RF links

- DSP WaveMatch, no false or missed packets!
- RX Sniff Mode, <3mA!

Industry’s broadest and most advanced offering
Sub 1Ghz Global Frequencies for your Product

- 315/915 MHz
  - USA
- 433 MHz
- 433/868 MHz
- 433/915 MHz
- 415/433 MHz
- 470 MHz
- 433 MHz
- 779 MHz
- 415/433 MHz
- Local ISM bands
- 426 MHz
- 920 MHZ
- Japan
- 433 MHz
- 433 MHz
- China
- 426 MHz
- 920 MHZ
- Japan
- 433 MHz
- Asia
- 433 MHz
- 779 MHz
- 433 MHz
- Africa
- 433 MHz
- 915 MHz
- Australia
- 433/915 MHz
- 2.4 GHz

GLOBAL

TExAS INSTRUMENTS
# How to Get Started

Use below resources and this training to understand technology & applications

## Get a development kit & demo
- **SimpleLink Wifi**
- **Bluetooth Low Energy**
- **Bluetooth**
- **Sub1-GHz RF**
- **ZigBee**

## Contact TI
- WirelessChina@list.ti.com

## Web resources
<table>
<thead>
<tr>
<th></th>
<th>SimpleLink</th>
<th>BLE technology</th>
<th>Bluetooth technology</th>
<th>RF Value Line</th>
<th>RF Performance Line</th>
<th>ZigBee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web resources</td>
<td>SimpleLink</td>
<td>BLE technology</td>
<td>Bluetooth technology</td>
<td>RF Value Line</td>
<td>RF Performance Line</td>
<td>ZigBee</td>
</tr>
</tbody>
</table>

## Development kits
<table>
<thead>
<tr>
<th></th>
<th>CC3000 FRAM EMK</th>
<th>CC2541DK-MINI kit</th>
<th>eZ430-RF256x kit</th>
<th>Value Line DK</th>
<th>Performance Line DK</th>
<th>CC2530ZDK</th>
</tr>
</thead>
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<td>Development kits</td>
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<td>Value Line DK</td>
<td>Performance Line DK</td>
<td>CC2530ZDK</td>
</tr>
</tbody>
</table>

## Where to get support
- **www.ti.com/connectivitywiki**
- **www.ti.com/wicconforum**
- BLE support forum
- BT support forum
- HW support forum
- ZigBee support forum

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See Our Demos

SimpleLink™ WiFi – CC3000

TI CC3000 + Sensors + MSP430 + WiFi AP = Internet connected Sensors

BLE – CC2541 – Wireless Sensors

TI BLE Sensor Tag + iOS Reference App = Endless opportunities

BLE – CC2541 – Wireless Game

Race Car + 2541 PCB + RC Car App + iPhone = Lots of Fun

Wireless Audio – CC8520

Speaker + CC8520 + PC Filters = Wireless Active Speakers

Sub 1Ghz – CC1120

CC1120 DK + Embedded Easy RF link Test = Test how far you can go
Thank You

wirelesschina@list.ti.com