Wireless Solutions for Industrial Markets
Where can we use wireless in industrial?

**Industrial**
- Autonomous machines
- Solar Inverters / Smart meters
- Safety Wearables
- Test and Measurement
- Point of Sale

**Home/Building Automation**
- Home automation gateways
- Security cameras
- Smart panels
- Light switches
Why Wireless for Industrial Applications

### Cable replacement
- Can replace cables where cost or reliability of cables is an issue
- Saves space
- Mesh network allows seamless cloud connectivity and high wireless throughput with a high range

### Maintenance
- Easy access to hard to reach locations and highly encapsulated products
- Over the air upgrades from phone to equipment
- Remote experts

### Remote Display and Personalization
- Smartphone instead of local display -> more info, historical data, statistics and unit is better protected from the environment
- User gets easy and remote access to data
- Personal operator/user setup and configuration
WiLink (Wi-Fi and BT/ BLE) for Industrial Applications

A well connected and controlled factory
Building Blocks for Wireless Industrial Automation

- Control and Monitoring
- Stack
- Memory
- Wired communication

Sitara™ ARM® Processors

- Wireless communication
- Cable replacement
- firmware

WiLink™ 8 WL 18xx
Building Automation Use Case: Intrusion Control Panel

Intrusion Control Panel with Sitara & WiLink

WiLink 8
- Wi-Fi+BT/BLE Combo solution
- Multi role capability STA/ AP/ P2P
- Easy Provisioning options
- Mesh support for connecting multiple panels

Sitara AM335x
- Capable of driving displays up to 1280x1024, 3D graphics
- Wide array of connectivity options including Ethernet, USB, SD/MMC
- Power efficient
- Mainline Linux supplied from TI through Processor-SDK-Linux
### Building Automation (1/2)

#### Gateways, Control panels

<table>
<thead>
<tr>
<th>Industrial Requirements</th>
<th>Solution Features</th>
</tr>
</thead>
</table>
| Coexistence HW and SW solutions for Sensor - >Gateway -> Cloud | ✓ Zigbee Co-ex with Wi-Fi  
 ✓ Gateway with BLE  
 ✓ BLE 4.2 with on chip Wi-Fi coex  
 ✓ Sitara processors support AWS, IBM Bluemix, and more |
| High throughput for higher performance | ✓ High Performance WiFi/BT combo device  
 ✓ with Multi Role Multi Channel support  
 • IEEE 802.11a,b,g,n MIMO up to 100Mbps  
 • Multirole features (STA / AP / P2P)  
 ✓ Sitara processors support Gb Ethernet, USB2/3, PCIe gen 2, and more for high throughput wired connectivity |
| Certification | ✓ FCC, IC, CE, Telec certified modules with integrated RF and power management reducing the need for wireless expertise |
# Building Automation (2/2)

## Gateways, Control panels

<table>
<thead>
<tr>
<th>Industrial Requirements</th>
<th>Solution Features</th>
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<tr>
<td>Multiple provisioning modes</td>
<td>✓ Various provisioning modes, WPS, AP/P2P, SmartConfig™, WAC™ (Apple)</td>
</tr>
<tr>
<td>Attach to multiple platforms</td>
<td>✓ Out of the Box experience with AM335x EVM</td>
</tr>
<tr>
<td>Range extension and extension and network robustness</td>
<td>✓ <strong>Mesh</strong> feature for range extension and network robustness with low latency to handle faster response</td>
</tr>
</tbody>
</table>
Introduction to Wi-Fi over Mesh

Legacy deployment
Wi-Fi Mesh (802.11s)

Pros:
- Seamless connectivity and range extension
- If access-point is present – mesh offloads it by routing traffic around it
- Mesh can allow network connectivity even without access-point
- Best path is chosen between any two nodes
- Self healing (if one of the nodes is disconnected)
- Suitable for multi-hop (easier network management)
Mesh applications

**Industrial**
- Autonomous machines
- Solar Inverters / Smart meters
- Safety Wearables

**Home/Building Automation**
- Home automation gateways
- Security cameras
- Smart panels
- Light switches

**Range extension** - enables multiple-device connectivity deployment over a large area without adding extra network infrastructure

**Scalable, self-forming & healing secured network**

**Less congestion and better throughput** when some devices are with low coverage
**WiLink 8 802.11s support**

### Highlights
- Software Solution on WiLink 8 R8.7 (Linux) adds **802.11s** (mesh) support – **Now Available !!!**
- Ideal for any application that requires range extension with no additional infrastructure

### Features
- Open / Encrypted
- Number of connections per node : 10
- Low latency per hop : Approx. 1ms (low volume traffic)
- Optimized Path selection
- Precise clock synchronization
Factory Automation Use Case: Gateway

**Sitara AM57x**
- ARM Cortex A15
  - 1.5GHz
  - 1MB L2 Cache
- C66x DSP
  - 750MHz
  - 288KB L2 Cache

**Master PLC**
- Siemens S7-1500 PROFINET Controller

**Shared Memory**
- PRU-ICSS1 PROFINET Device
- PRU-ICSS2 EtherCAT Master

**Slave devices**
- Slave devices (PROFINET)
- Slave Devices (EtherCAT)

**WiLink 8**
- Wi-Fi and BT/BLE Connectivity Combo
- Multi-role capability with STA/ AP/ P2P
- FCC, CE, IC, Telec certified RF modules for faster time to Market

**Industry 4.0 Gateway with Sitara & WiLink**

**WiLink 8**
- Connect to two different industrial Ethernet networks simultaneously with 2x PRU-ICSS
- Scalable platform from single A15 at 500MHz to dual-core A15 at 1.5GHz
- Includes support for 2D/3D graphics, video, PCIe, SATA, USB3.0, and more

**Service Port:**
- OPC UA
  - IEEE Ethernet
## Factory Automation (1/2)
### Industrial Gateways

<table>
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</table>
| **Industrial temperature support**          | ✓ Modules from -40C up to 85C  
✓ Sitara processors support -40-100C , with certain devices up to 125C                                                                         |
| **High throughput for higher performance**   | ✓ High Performance WiFi/BT combo device with Multi Role Multi Channel support  
• IEEE 802.11a,b,g,n MIMO up to 100Mbps  
• Bluetooth 4.0 with on chip Wi-Fi coex  
• Multirole features (STA / AP / P2P)  
✓ Sitara processors support Gb Ethernet and industrial Ethernet for wired connectivity |
| **Fully Certified modules**                  | ✓ FCC, IC, CE, Telec certified modules with integrated RF and power management reducing the need for wireless expertise  
✓ Sitara processors have certified implementations of industrial protocols available                                                                 |
| **Best in class robustness**                | ✓ 10 days without recovery  
✓ Mesh feature for range extension and low latency  
✓ Precise Time synchronization for better control                                                                                                      |
| **Attach to multiple platforms**             | ✓ Out of the Box experience with AM335x EVMs  
✓ Other non-TI platforms through third party support ([Clarinox](#))                                                                               |
Grid Infrastructure Use Case: Data Concentrators

Data Concentrator with Sitara & WiLink

**WiLink 8**
- High Performance Wi-Fi supporting up to 100 Mbps
- Scalable solutions from 2.4 GHz to 5 GHz that are pin-to-pin compatible
- Industrial temp grade -40C to 85C options
- Mesh for seamless connectivity and range extension

**Sitara AM335x**
- Scalable performance: 300MHz to 1GHz
- Wide array of connectivity options including up to 6x UART, USB, Gb Ethernet
- TI Designs for G3 and Prime available on TI.com
## Grid Infrastructure

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  • IEEE 802.11a,b,g,n MIMO up to 100Mbps  
  • Bluetooth 4.0 with on chip Wi-Fi coex  
  • Multirole features (STA / AP / P2P)  
✓ Sitara processors support Gb Ethernet and industrial Ethernet for wired connectivity such as IEC61850, as well as power line communications |
| Fully Certified modules | ✓ FCC, IC, CE, Telec certified modules with integrated RF and power management reducing the need for wireless expertise |
| Best in class robustness | ✓ 10 days without recovery  
✓ Mesh feature for range extension and low latency  
✓ <20 ms Time synchronization for better control |
| Attach to multiple platforms | ✓ Out of the Box experience with AM335x EVM  
✓ Other non-TI platforms through third party support *(Clarinox)* |
TI Wireless solution for Industrial automation

Control and Monitoring
Stack
Memory
Wired communication

+ 

Wireless communication
Cable replacement
firmware

Processor SDK
Hardware
WiLink™8: TI Modules

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Wi-Fi</th>
<th>Bluetooth 4.0</th>
<th>Industrial Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.4 GHz</td>
<td>5 GHz</td>
<td>MIMO/MRC</td>
</tr>
<tr>
<td>WL1801MOD</td>
<td>•</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WL1805MOD</td>
<td>•</td>
<td></td>
<td>•</td>
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<tr>
<td>WL1807MOD</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>WL1831MOD</td>
<td>•</td>
<td></td>
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</tr>
<tr>
<td>WL1835MOD</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>WL1837MOD</td>
<td>•</td>
<td>•</td>
<td>•</td>
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</table>

1 MIMO (Multiple Input Multiple Output) & MRC (Maximum Ratio Combining) is only supported in 2.4 GHz band with 20 MHz Channels.
TI’S SCALABLE & FLEXIBLE SITARA ARM PORTFOLIO:
Perfect balance of integration, cost, and performance for industrial applications

I/O Modules, Gateways, entry-level HMI

AM335x
- Highly integrated, power-efficient
- ARM Cortex-A8 from 300MHz to 1GHz
- Low system cost with support for PRU-ICSS for industrial protocols, as well as GbE, CAN, and graphics.

Connected Industrial Drives, PLC, mid-range HMI

AM437x
- High performance, highly efficient
- ARM Cortex-A9 from 300MHz to 1GHz
- Expanded peripherals, including upgraded PRU-ICSS for encoder feedback, sigma-delta filtering

Master PLC, Motion Control, high-end HMI, Ethernet switches

AM57x
- Top-of-the-Line Sitara performance
- Single or dual core ARM Cortex-A15 up to 1.5GHz
- Integrated M4 and DSP cores.
- Upgraded graphics performance, dual PRU-ICSS, PCIe
# Evaluation Kits for Sitara + WiLink

## Evaluation Platforms

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<thead>
<tr>
<th>BeagleBone Black Wireless</th>
<th>The BeagleBone Black Wireless:</th>
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<td></td>
<td>• Features the Octavo Systems OSD3358 SIP which integrates AM335x, memory, and power into a single package</td>
</tr>
<tr>
<td></td>
<td>• Also features WL1837 for dual-band Wi-Fi/BT/BLE</td>
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<tr>
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<td><a href="beagleboneblackwireless">[BeagleBone Black Wireless]</a></td>
<td><a href="processorsdklinuxam335x">[Processor SDK Linux for AM335x]</a></td>
<td><a href="wl8wiki">[WL8 wiki]</a></td>
</tr>
<tr>
<td><a href="sitaraam335x">[Sitara AM335x]</a></td>
<td><strong>BeagleBone Black:</strong></td>
<td></td>
</tr>
<tr>
<td>Low-cost, open source, community-supported development platform for AM335x</td>
<td>Boot Linux in under 10-seconds and get started developing in less than 5 minutes with just a single USB cable.</td>
<td></td>
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<tr>
<td><strong>Element 14 WiLink 8 cape:</strong></td>
<td></td>
<td></td>
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<tr>
<td>Onboard WL1837 module with dual-band Wi-Fi/BT/BLE</td>
<td>Supports IEEE 802.15.4, 5GHz diversity, MIMO and Industrial temp grade -40 to +85°C.</td>
<td></td>
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<td>Zigbee CC2540 chip included to evaluate Wi-Fi – Zigbee Coexistence</td>
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<td>Wireless Connectivity for BeagleBone Black</td>
<td><strong>AM335x EVM:</strong></td>
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<td>Full-featured development board with LCD and wide array of connectivity</td>
<td><strong>WiLink8 Combo Module:</strong></td>
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<td>Quick integration with GP EVM kit, supports dual-band Wi-Fi/BT/BLE</td>
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<th>AM335x GP EVM + WL1837 Module</th>
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## Resources for Sitara Connectivity with TI WiLink™ 8

### Processor Platforms
- AM335x EVM, BeagleBone Black, AM437x EVM, AM57x EVM

### WLAN Features & Standards
- 40 MHz Channels or 2x2 MIMO; 100 Mbps (UDP), 80 Mbps (TCP)
- WiFi supporting station, AP and Wi-Fi Direct Concurrent Operation (Multichannel, Multirole)
- Fully Certified module FCC/CE/ETSI reducing production costs

### Bluetooth Features & Standards
- Bluetooth® 4.0 Compliant including Bluetooth & Bluetooth Low Energy support
- BT Profiles: A2DP, SPP, OPP, FTP, HID
- BLE: ATT, GATT, Proximity, Findme

### Availability
- Today

### OS Support
- Linux SDK & Android ADK

### Integration
- Complete integration of all components including Firmware, Drivers and Demo apps into Sitara SDK

### Validation
- Component and System validation of all features, functionality and use cases with Sitara SDK

### Dev Tools & Software
- WiLink8 Combo on Ti.com
- WiLink8 Getting Started

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**Texas Instruments**