TI ARM Sitara for IOT

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How the IoT works – access to the Cloud

Cloud support on PC/Phone/Tablet

- Output displayed on standard web page
- Support for native apps on phones/tablets
Only TI has all the IoT building blocks

- **Nodes**
  - MCU
  - Wired & Wireless Connectivity
  - Analog Signal Chain
  - Power Management

- **Gateway, Bridge or Router**
  - MCUs
  - Processors
  - Sensing
  - Analog Signal Chain

- **Cloud**
  - Multicore Processors
  - Analog Signal Chain
  - Power Management

[Image of Texas Instruments logo]
Only TI has all the IoT building blocks

TI gateway reference design
- Hardware
- Software
- Speeds development

HP Moonshot
- DSP-accelerated ARM server
- Leverages TI's 66K2Hx KeyStone II multicore DSP + ARM® Cortex™-A15 platform
- High-performance computing
- Ideal performance/power
What is Sitara™

• New Sitara™ product family: Market's First ARM® Cortex™-A8 solutions for industrial computing
  – Sitara™ is a TI trademark.
  – ARM only, No DSP

• Sitara ARM® Cortex™ A and ARM9 Microprocessors
  – Cortex™ A8, A9, A15
  – ARM 9

• All named in AMxxxx
  – ex. AM335x, AM437x

Sell image

TI is offering ARM only product for industrial field
Why Sitara™ ARM® Cortex®-A8 & A9 Processors?

Perfect balance of integration, cost & performance

System optimized with richer peripheral set: LCD display, USB, camera inputs, PRU, industrial protocols & more

Reduce barriers to development with low cost dev boards, free & easy access to software, free design tools & large open-source community support
Kick it up a notch

Sitara™ Scalability

- Highest performance per $
- From 300MHz Cortex-A8 to 1.0 GHz Cortex™-A9 devices
- Cortex-A9 devices: 2.5 DMIPS per MHz
- 3D graphics acceleration for advanced user interfaces like Android
- High-speed DDR2 and DDR3 memory performance
Get connected

Sitara™ Connectivity

- High-performance LCD controller with optional touch interface
- Out-of-box support for TI Wi-Fi & Bluetooth™
- CAN 2.0, EtherCAT, PROFINET, Ethernet/IP and more industrial peripheral support
- 10/100/1000 Ethernet switch
- USB 2.0 interface with PHY
- Multiple serial and parallel interfaces per device
Programmable Real-Time Unit (PRU) Subsystem

- PRU is a highly differentiated, low-latency microcontroller subsystem
- Dual PRU cores per subsystem
  - 200MHz – 5ns per instruction
  - Single cycle execution
  - Available on AM335x, AM4, AM5x
- Broad market support collateral
  - New C-compiler – available now in CCS6
  - Linux Driver
  - C & ASM code examples
  - Technical collateral: AM335x TRM &Datasheet, FAQ, GSG
  - PRU Cape for BeagleBone
  - Training
- Example Use Cases
  - Anything requiring low latency
  - Motor Control (PWM)
  - Bit banged serial interfaces
  - 10/100 Ethernet
  - Parallel Camera input

AM335x PRU Subsystem Block Diagram

<table>
<thead>
<tr>
<th></th>
<th>PRU0 Core (8KB IRAM)</th>
<th>PRU1 Core (8KB IRAM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events to ARM INTC</td>
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<tr>
<td>Events from Peripherals + PRUs</td>
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<tr>
<td>Interrupt Controller (INTC)</td>
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<td>UART</td>
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<td>eCAP</td>
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<td>MAC</td>
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<tr>
<td>IEP (Timer)</td>
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<tr>
<td>DRAM0 (8K Bytes)</td>
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<tr>
<td>DRAM1 (8K Bytes)</td>
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<tr>
<td>shared (12K Bytes)</td>
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<tr>
<td>Master I/F (to SoC interconnect)</td>
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<tr>
<td>Slave I/F (from SoC interconnect)</td>
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32-bit Interconnect bus

Industrial Ethernet

MII0 RX/TX

32 GPO

30 GPI

MII1 RX/TX

32 GPO

30 GPI

Scratchpad
AM335x Cortex™- A8 based processors

Benefits
• High performance Cortex-A8 at ARM9/11 prices
• Rich peripheral integration reduces system complexity and cost

Sample Applications
• Industrial / Home Automation
• Portable Navigation Devices
• Robotics
• Consumer electronics

Software and development tools
• Free Linux and Android support packages direct from TI
• StarterWare enables quick and simple programming and migration among TI embedded processors
• WinCE and RTOS (QNX, Wind River, Mentor, etc.) from partners
• Full featured and low cost development board options

Power Estimates
• Total Power: 600mW-1000mW
• Standby Power: ~25mW
• Deep Sleep Power: As low as 3mW

Schedule and packaging
• Status: In production
• Dev. Tools: Multiple available today
• Docs: Multiple available today
• Packaging: 13x13, 0.65mm via channel array
15x15, 0.8mm

More Information
• www.ti.com/am335x

* 800 MHz / 1 GHz only available on 15x15 package. 13x13 supports up to 600 MHz.
(1) Use of TSC will limit available ADC channels.
AM335x - A scalable platform with 6 pin-to-pin compatible devices

- **ARM Cortex-A8 (MHz)**
  - AM3359: 800
  - AM3358: 600/800/1000
  - AM3357: 300/600/800
  - AM3356: 300/600/800
  - AM3354: 600/800/1000
  - AM3352: 300/600/800/1000

- **Graphics**
  - 3D graphics

- **PRU-ICSS for Slave Industrial Communications**
  - PRU-ICSS + EtherCAT slave
  - PRU-ICSS

- **Package**
  - 15x15 / 0.8mm
  - 13x13 / 0.65mm*

- **Availability**
  - In Production

- **PRU-ICSS** is used for slave industrial communication protocols such as Profibus, Profinet, Powerlink & Ethernet/IP

<table>
<thead>
<tr>
<th>Package</th>
<th>15x15mm (ZCZ)</th>
<th>*13x13mm (ZCE)</th>
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<tbody>
<tr>
<td>ARM speed</td>
<td>Up to 1000 MHz</td>
<td>Up to 600 MHz</td>
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<tr>
<td>USB 2.0 OTG + PHY</td>
<td>x2</td>
<td>x1</td>
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<tr>
<td>EMAC</td>
<td>2-port switch</td>
<td>Single port</td>
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**Texas Instruments**
A typical IOT application

- Router
- IoT gateway (optional)
- IoT node
- Sensors & Actuators

- Sense
- Store
- Present
- Control
- Decide
- Analyze

Monitor & Analytics
Remote control
How do things connect to the IoT?

**Via IoT Gateways**

- Internet
- Internet Router
- IoT Agent
- IoT Gateway
  - ZigBee Node
  - BLE Node
  - Wired Node
- Sensors & Actuators

**Directly - IoT Nodes**

- Internet
- Internet Router
- IoT Agent
  - Wi-Fi Node
  - Ethernet Node
- Sensors & Actuators

**Directly - Lite IoT Nodes**

- Internet
  - Internet Router
  - 6LoWPAN Gateway
  - IoT Agent
  - 6LoWPAN Node
- Sensors & Actuators
What do we offer -- TBWTIoT

- **TBWTIoT**
- **AM3352BZCZ100**
- **BLE CC2541**
- **ZigBee CC2530**
- **PMIC TPS65217C**
- **DDR3L**
- **NAND 256MB**
- **Z-Wave**
- **3G module**
- **Sub-1G CC11xx**
- **SD CARD**
- **eMMC**
- **NAND and eMMC co-layout**
- **Choice one only**
- **Giga PHY DP83867**
- **PHY DP83848M**
- **NFC RF430CL330H**
- **WIFI+BT +BLE WL7831**
- **UART** (4pin)
- **UART**
- **UART** (4pin)
- **I2C**
- **I2C UART0**
- **MMCO**
- **MMC0**
- **GPMC**
- **UART1 (4 PIN)**
- **MMC2 (4bit)**
- **GPIOs**
- **RGMII1**
- **RMI2**
- **I2C**
- **Connector**
- **Chip**
- **Module**
- **Digital Inputs**
- **Digital Outputs**

**Texas Instruments**
Gateway Software Stack

User Space
- Gateway App
- NFC Pairing App

Qt Embedded
- QGLWidget
- QWidget

OpenGL ES
- FBDEV/V4L2
- DSS2
- LCDC

Gstreamer/FFMPEG
- MPEG4, H.264, MPEG2, AAC, …

Gpio

OpenGL
- ALSA
- McSPI
- McASP

Network
- Touch screen
- Ethernet
- Zigbee
- WiFi
- BT (Stonestreet One)

3P Software
- OpenSSL
- Crypto
- JVM
- OSGI

Applications
- Gateway App
- NFC Pairing App

Target Board
- AM3352
- WL8
- CC2530
- RF430

Not Used
- WiFi
- BT
- NFC Pairing App

3P Software
- NAND
- Flash Memory
- NAND
- Flash Memory
What is OSGi

- OSGi (Open Service Gateway Initiative)
  - It is a specification that defines a dynamic component system for Java.
  - The OSGi framework consists of modularized applications (bundles). An functional API building block for customized application.
  - The OSGi framework needs to run on top of a Java Virtual Machine.

- Why OSGi
  - Modularized bundles for easier application development
  - To reduce software complexity and footprint for large-scale distributed system as well as small, embedded applications.
JAVA/OSGi Demo on Beagle Bone Black

- BeagleBone Black AM335x ARM Cortex-A8
- 512MB DDR3 RAM
- Runs TI Linux SDK 7.0 (Kernel 3.12)
- Prosyst OSGi embedded framework/Server
- Skelmir CEE-J Virtual Machine
What is the cloud?

Applications running on servers, accessible by clients via the Internet are called **Cloud Applications**

Cloud Applications allowing subscribed clients access are called **Cloud Services**
Typical IoT cloud services

- Store data
- Present data on a web site
- Analyze data and create reports
- Create email & text notifications
- Create cloud applications
- Interface with other business applications
- Manage device firmware updated
- Configure devices properties
- Device communication
- Manage user and device access

Cloud service communicate with devices to collect sensor data and control them
Typical IoT cloud services

Collaboration between TI and cloud partners enables customers to develop IoT applications quickly.
The TI IoT cloud ecosystem

Industry leading cloud partners:
- Offers end-to-end solution
- Support multiple TI devices

Direct business engagement between customer and partner

Value proposition
- TI can demonstrate to customers IoT applications
- Customers can started development quickly
- Customers have a choice of multiple cloud partners
HyperTech

- **Hyper Tech International Corporation** is a software company which focus on **Multimedia solution, Mobile TV and IoT** solution development, and founded in end of 2006

- **Solution Categories**
  - Software codec solution
  - DTV solution (DVBT, ISDB-T, ATSC,CMMB)
  - P2P SIP application solution
  - IP camera application solution
  - Personal NAS application solution
  - Streaming application solution
  - Zigbee application solution
  - IoT (Internet of Things) solution

- **Contact Information**

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Morrihan 茂宣 – TBWTIoT Demo SW

Website: http://morrihan-software.herokuapp.com
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IoT Gateway Demo Architecture

- **IoT Gateway**
- **BLE Network**
- **ZigBee Network**
- **WiFi or Ethernet**
- **Wireless AP**
- **IoT cloud service**
- **Smart devices**
# Catalog Processors Gateway Summary

**Flexible, Scalable and Fast Time to Market**

<table>
<thead>
<tr>
<th>High System Integration</th>
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| Greater System Integration for BOM optimization | ✓ Lower system cost with support for DD2/3 memory, integrated dual Gbit-Ethernet, CAN, MMC/SD, USB  
✓ Pin-to-pin compatible offering for gateway with display leveraging integrated Graphics accelerator |

<table>
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<th>Fast Time to Market</th>
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| Quick start and reduce development cycle | ✓ Reference Design Kit with schematic & demo software, for quick start  
✓ Field proven system solution with power, connectivity, and MPU portfolio  
✓ Scalable MPU solution from value line to high performance processor |

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<tr>
<th>Validated Communication Profiles</th>
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| Platform can support multiple communication standards | ✓ Complete Linux driver software support for WiLink8 - WPA supplicant, Networking (TCP/IP) stack, and mac80211 WLAN Driver  
✓ WL1835MOD Bluetooth - Royalty-free certified Bluetooth stack from StoneStreet One  
✓ CC2530 - TI Z-Stack, ZigBee SE 1.1 profile and HA 1.2 profile |
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<thead>
<tr>
<th>Products</th>
<th>Applications</th>
<th><a href="http://www.ti.com/omap">www.ti.com/omap</a></th>
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<tbody>
<tr>
<td>Audio</td>
<td>Automotive and Transportation</td>
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<td>Communications and Telecom</td>
<td><a href="http://www.ti.com/communications">www.ti.com/communications</a></td>
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<td>Data Converters</td>
<td>Computers and Peripherals</td>
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<td>Consumer Electronics</td>
<td><a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a></td>
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<td>Energy and Lighting</td>
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<td>Industrial</td>
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<td>Space, Avionics and Defense</td>
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<tr>
<td>Microcontrollers</td>
<td>Video and Imaging</td>
<td><a href="http://www.ti.com/video">www.ti.com/video</a></td>
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</tr>
<tr>
<td>OMAP Applications Processor</td>
<td></td>
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<tr>
<td>Wireless Connectivity</td>
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