STM32平台輕鬆建構工業物聯網

楊正廉
意法半導體亞太區資深經理
Q4 2016
The leading provider of products and solutions for Smart Driving and the Internet of Things.
Making the World “Smarter”

Making driving safer, greener and more connected

Making things smarter, connected and more aware of their surroundings

Making homes smarter, for better living, higher security, and less waste

Enabling the evolution of industry towards smarter, safer and more efficient factories and workplaces

Enabling cities to make more of available resources
STM32 in IoT

The leading platform of the IoT

A valued and broad ecosystem helping innovation for a smarter future
Today - STM32 Portfolio Positioning

10 product series / More than 40 product lines
Broadest 32-bit MCU Product Portfolio

<table>
<thead>
<tr>
<th>DMIPS</th>
<th>Ultra-low-power</th>
<th>Mainstream</th>
<th>High Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>875</td>
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<td></td>
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<tr>
<td>25</td>
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</table>

CoreMark: 75 93 273 106 177 245 398 608 1082 2010 MHz: 875 1000 356
Meet the STM32L0x Series

- **STM32® ultra-low-power DNA** is now built with ARM Cortex-M0+

- 1.71V to 3.6V 32MHz operation
- 139μA/MHz (Run 32MHz)
- 87μA/MHz (Run Optimized)
- 400nA Stop mode + Full Ram
- 3.5 μs wakeup to Run
- -40°C to +125°C range

- Ultra-low-power ADC
  - 12/16-bit resolution
  - Down to 1.65V

- Ultra-low-power time counter with 16-bit low-power timer
- Ultra-low-power UART
  - Up to 9600b in stop mode

- Full Flash Protection
- Sector Flash Protection
- Hardware encryption - AES
- True RNG²
- Unique ID (96-bit)
- Class B
- Built-in ECC

- Battery Charger Detection
- True Random Number Generator

1. Battery Charger Detection
2. True Random Number Generator

USB 2.0 FS Certified
Crystal-less / BCD¹
Ultra-low-power and Flexibility

STM32L4 is based on a new platform optimized to reduce power consumption and increase flexibility

- Down to 8 nA for I/O wake-up with additional Shutdown mode
- RTC available for all power modes (from Active down to V_BAT)
- 2 nA V_BAT mode with charging capability
- USB crystal-less capable (Dedicated crystal oscillator is no longer needed for USB functions)
- Internal oscillator from 100 kHz to 48 MHz (±0.25% int. clock accuracy over voltage/temperature with LSE)
- I/O level kept in low-power modes
- Optimization of system consumption
- Wake up MCU with any peripheral (Communication I/Fs, analog circuits, timers …)
- Down to 170 nA keeping 16 Kbytes of SRAM active in Standby mode
- External level shifter no longer needed
- Separate V_DD supplies (down to 1.08 V)

1 ULP leader and performance booster
Performance Ranking: #1

STM32H7 First 400 MHz ARM Cortex-M7 based MCU

- Cortex-M7 core is leader in DMIPS/MHz, DSP and FPU offering 2.14 DMIPS/MHz and 5 CoreMark/MHz.
  - L1 cache
  - TCM RAM memories
  - AXI bus Matrix
  - Superscalar architecture
  - 6 stage dual-issue pipeline
- 2010 Coremark/856 DMIPS @ 400Mhz in an embedded flash MCU. Double performance of F7 from internal and external memories, graphic support and hardware accelerators.
High Memory Integration and Richest Connectivity

- 40nm Process
- 2MB Flash Dual Bank with ECC
- Large RAM : 1Mbytes with ECC
- More security features (Boot, Tamper …)
- 35 communication peripherals
- New generation of peripherals including fast 14-bit ADC up to 2Mmps Comparators, Op Amp
- New connectivity (TT-CAN and FD-CAN)
- High-Resolution timer (2.5ns)
- Several Low-Power Timers

More RAM, more connectivity & advanced peripheral
Super-Connected Brain

Audio
- Sigma Delta Demod
- SAI / I²S / TDM
- SPDIF

Connectivity
- USB
- U(S)ART, I²C
- SPI
- CAN
- Ethernet

Graphic
- TFT-LCD controller

Memory interface
- NOR, NAND, SDRAM
- Quad-SPI Flash
- 2xSDIO v4.0 Card

Analog
- Fast ADC
- Diff. inputs
- Operational Amp.
- Comparators

More RAM, more connectivity & advanced peripheral
Security on STM32H7
Answering IoT Challenges

IoT architecture

IoT threats

Fake servers
- Unauthorized control
- Business disruption

Eavesdrop
- SW theft
- Credential theft

Fake devices
- Disrupted control
- SW theft
- Financial loss

STM32H7 Solutions

Integrity and authenticity
- Isolated and highly protected system memory and user secure memory
- Embedded and protected cryptographic keys
- Embedded and protected secure install and upgrade services

Secured communications
- Cryptographic HW accelerator
- Hashing HW accelerator
- True random number generator

Trusted execution
- Flash sectors read and write access protection
- Memory Protection Unit
- Tamper protection

Advanced security, made easy
STM32 Ecosystem

HARDWARE TOOLS

- STM32 Nucleo
  - Flexible prototyping

- Discovery kit
  - Key feature prototyping

- Evaluation board
  - Full feature evaluation

SOFTWARE TOOLS

STM32CubeMX featuring code generation and power consumption calculation
Information and Sharing

**STM32 MCU**

**Various social media**

- ST Forums on microcontrollers
- Facebook.com/stm32
- YouTube.com/STonlineMedia
- Twitter.com/@ST_World
- Mbed.org

**Information**

MCU Selection

Communities and Social Media

+ Local trainings / Technical Support
+ Local Sales forces / Distributors
IoT Use Cases

Consumer

Services
• Health tracking
• Food lifestyle
• Weight reduction
• FW update ...

Wi-Fi
BLE

Industrial

3G / 4G / Ethernet
Gateway

Ethernet

Application Server
Admin control

Network Server

LoRa
SIGFOX
Connectivity, Power, Sensing and Control

Solving The Internet Of Things
So You Don't Have To

Ayla’s Enterprise Software Solutions Provide the Powerful Tools Needed to Deploy Connected Products Globally
Vision of IoT

End to End

M2M

Air Conditioner

Lighting

Smoke Detector

Refrigerator

Water Cleaner

Mobile Terminal

Devices

APP / Server / Cloud

Ayla Networks
4 Challenges for Roads to Global IoT Market

Ayla Networks, the professional IoT cloud platform, is the best solution

- Build a future-proofed ecosystem
- Ensure data security and follow local privacy laws & regulations
- Build best product with insights of user behavior
- Cost effective in overseas operation

Ayla Networks
USI IoT Solution

Company Introduction
USI has more than 30 years of experience in offering comprehensive EMS solutions in the global automotive industry. Since established, we utilize thin-film integrated circuit printing technology and assembly capability to design, develop, and manufacture connectors and fixtures. Besides providing high-reliability products and technologies, our global logistic, sourcing, and flexible manufacturing facilitate us to become a leading manufacturer in EMS automotive market. As of today, we are the long-term partner of many international brand customers.

Our services:
- System design
- Supply Chain Management
- High density SMT
- Logistics management
- System Level Test

Product Experience
- Among Top Tier of Module Suppliers
- Qualified by Top Tier Customers
- Broad Application/Technology Coverage: WiFi, NFC, and GPS
- Fast Time to Market with Mature & Advanced Process Technology
- Advanced Miniaturization Technology to Save Space of Wireless Product
- Proven Track Records and High Standard Quality Policy

Contact Information
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Universal Scientific Industrial (Shanghai) Co., Ltd.
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Tel: +86-21-5869-6996 Fax: +86-21-5869-6844
Email: china@usiglobal.com

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No. 141, Lane 351, Tapping Road, Taoyuan County, Nantou, Taiwan 64261
Tel: +886-42-221-2701 Fax: +886-42-232-0561
Email: tai@ms.usi.com.tw

www.usi.com

Product Information

<table>
<thead>
<tr>
<th>Product</th>
<th>WM-N-BM-22 WICED Module</th>
<th>WM-AN-BM-23 WICED Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
</tbody>
</table>
| Bands & SKU | ARM Cortex-M4 up to 100 MHz  
  • 802.11 b/g/n 1x1 2.4GHz with Bluetooth 4.1  
  • 256KB of SRAM and 1MB Flash  
  • Apple Homekit Support  
  • UART, GPIO, SPI, I2C, USB interface support  
  • SPI master interface for serial flash extension | ARM Cortex-R4 up to 320 MHz  
  • 802.11 a/b/g/n 1x1 2.4/5GHz radio  
  • 2MB of SRAM and 64KB ROM  
  • High-speed 4-wire UART interface  
  • SDIO, SPI, I2C, and 125 interface support  
  • SPI master interface for serial flash extension  
  • Option to Enable Antenna Diversity |
| Chipset | SIM4 + BCM4343x          | Broadcom 43907            |
| Form Factor | Metal Shielding Module at 74 Pins | Conformal Shielding Module at 136 Pins |
| Dimension | 11 mm x 12 mm x 1.5 mm at Max | 10 mm x 10 mm x 1.2 mm at Max |

<table>
<thead>
<tr>
<th>Product</th>
<th>WM-N-BM-33 WICED Module</th>
<th>WM-5G-BM-42 LoRa Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo</td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
</tbody>
</table>
| Bands & SKU | ARM Cortex-R4 up to 320 MHz  
  • 802.11 a/b/g/n 1x1 2.4/5GHz radio  
  • Bluetooth 4.2 + BLE  
  • 2MB of SRAM and 64KB ROM  
  • High-speed 4-wire UART interface  
  • SDIO, SPI, I2C, and 125 interface support  
  • SPI master interface for serial flash extension  
  • Option to Enable Antenna Diversity | ARM Cortex-M0+ up to 32 MHz  
  • SEMTECH SX1272 radio  
  • 8KB of SRAM and 512KB Flash  
  • AES-128 HW Crypto embedded  
  • UART, I2C, Lifter Interface support  
  • 3ch ADC 12-bit |
| Chipset | Broadcom 43907 + 20707    | SIM0 + SX1272            |
| Form Factor | Conformal Shielding Module at 136 Pins | Metal Shielding Module |
| Dimension | 11 mm x 11 mm x 1.2 mm at Max | 12 mm x 13 mm x 2 mm at Max |
| Schedule | ES-Q1, 2016              | ES-Q3, 2016              |
## Agriculture - Irrigation

<table>
<thead>
<tr>
<th>Current Solutions</th>
<th>LoRa®</th>
</tr>
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<tbody>
<tr>
<td>No. of fields</td>
<td>1</td>
</tr>
<tr>
<td>Coverage Area</td>
<td>0.5 mile radius / 0.75 Sq. miles</td>
</tr>
<tr>
<td>Solution Cost</td>
<td>High</td>
</tr>
<tr>
<td>Ease of use</td>
<td>Complex</td>
</tr>
<tr>
<td>Battery longevity</td>
<td>1-2 years</td>
</tr>
</tbody>
</table>

### Diagrams:
- 0.5 MILE Radius / 0.75 sq. miles / 20 sensors
- 15 mile radius / 706 sq. miles / 18k sensors
Existing Communication Technology

<table>
<thead>
<tr>
<th>Wireless</th>
<th>2G</th>
<th>3G</th>
<th>LAN</th>
<th>ZigBee</th>
<th>LoRa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>N/A</td>
<td>N/A</td>
<td>300m</td>
<td>90m</td>
<td>&gt;10Km</td>
</tr>
<tr>
<td>Current(Tx)</td>
<td>200~500mA</td>
<td>500~1000mA</td>
<td>50 mA</td>
<td>35mA</td>
<td>20mA</td>
</tr>
<tr>
<td>Current(STBY)</td>
<td>2.3mA</td>
<td>3.5mA</td>
<td>NC</td>
<td>0.003mA</td>
<td>0.001mA</td>
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<tr>
<td>Battery (2000mAhr)</td>
<td>Continuous</td>
<td>4~8 hrs</td>
<td>2~4 hrs</td>
<td>20 hrs</td>
<td>60 hrs</td>
</tr>
<tr>
<td>STBY</td>
<td>36 days</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>10 years</td>
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</table>

Feature of LoRa Technology

- Spread Spectrum
- Penetrating Strong
- Anti-Jamming
- Lowest sleep current

Benefit of LoRa Technology

- Longest Range
- Extended Battery Life

An IoT Solution Company
# AcSiP IoT Products - LoRa Solution

<table>
<thead>
<tr>
<th>Model Name</th>
<th>CW1276SL-915</th>
<th>CW1278SL-470</th>
<th>Al1276-401H</th>
<th>Al1276-071H</th>
<th>Al1278-071H</th>
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<tbody>
<tr>
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<tr>
<td>MCU</td>
<td>X</td>
<td>X</td>
<td>STM32F401CB</td>
<td>STM32F071CB</td>
<td>STM32F071CB</td>
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<tr>
<td>Wireless</td>
<td>LoRa</td>
<td>LoRa</td>
<td>LoRa</td>
<td>LoRa</td>
<td>LoRa</td>
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<tr>
<td>Package</td>
<td>Stamp-16pin</td>
<td>Stamp-16pin</td>
<td>32 pin</td>
<td>32 pin</td>
<td>32 pin</td>
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<tr>
<td>Size</td>
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<td>16*16 mm</td>
<td>18*18mm</td>
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<tr>
<td>Interface</td>
<td>SPI</td>
<td>SPI</td>
<td>I2C/SPI/UART/GPIO</td>
<td>I2C/SPI/UART/GPIO</td>
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<td>RAM</td>
<td>X</td>
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<td>64 KB</td>
<td>16KB</td>
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<td>128 KB</td>
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</table>
The Smallest Module for LoRa
## AcSiP IoT Product: S76S

<table>
<thead>
<tr>
<th>Category</th>
<th>AI1276-073S Spec.</th>
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<tbody>
<tr>
<td>MCU</td>
<td>ARM® Cortex®-M0+ STM32L073 xZ</td>
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<tr>
<td>Standard</td>
<td>Suitable PHY for LoRaWAN</td>
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<td>ANT</td>
<td>External</td>
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<td>Modulation</td>
<td>SF6~SF12</td>
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<td>RF Solution</td>
<td>Semtech SX1276</td>
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<tr>
<td>Package</td>
<td>Molding type with LGA landing</td>
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<tr>
<td>Size</td>
<td>13x11x1.1mm</td>
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<tr>
<td>Output power</td>
<td>20 dBm (Max.)</td>
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<tr>
<td>Interface</td>
<td>UART, SPI, I2C, USB</td>
</tr>
</tbody>
</table>

**Sample Out:** July.2016
Application Scenario #1

It has advantages of signal transmission and noise resistance than WiFi regardless of indoor and outdoor.
GlobalSat LoRaWAN Eco-system

Tracker Node
- LT-100
- by GlobalSat

Gateway

Network Server
- by 3rd Party

Tracking Application
- by GlobalSat

Sensor Node
- LM-130
- Module
- by GlobalSat

by 3rd Party

by 3rd Party

by 3rd Party

Module

by GlobalSat

by GlobalSat

by GlobalSat

Webtra2

ezFinder

by 3rd Party

by 3rd Party

by 3rd Party

GlobalSat

WORLDCOM GROUP
LM-130H/E LoRa WAN Compliant Module

LM-130H/E Features

- LoRaWAN Compliant certified module
- Frequency: 902–928Mhz (H), 865-868MHz (E)
- Ultra-high sensitive receiving ability by LoRa spread spectrum modulation technology
- Maximal output power 100mW (20dBm) · output power adjustable between 2-20dBm
- Long-distance transmission (1KM to 10KM)
- Built-in watchdog
- Accord FCC, ETSI standard

Optional:
- PIN type form factor
- Mini-PCI Express form factor
- Evaluation board w/battery, sensor I/O, antenna

Dimension: 25x18 mm

LM-110
- PIN type module

LR-M003
- mPCIe module

LM-130 EVB
- Evaluation board
LT-100H/E LoRa GPS Tracker

LT-100H Feature List

- LoRaWAN compliant GPS Tracker
- Frequency: 902–928Mhz (H), 865-868MHz (E)
- Built-in 820mA rechargeable Li-on battery
- Built-in 3 axis accelerometer for motion detection
- Vibrating alert / Buzzer alert
- Built-in help button for emergency
- Power Low/Off alert
- Support both OTAA and APB mode
- IPX7 water proof
- Optional:
  - Collar pouch for pet/animal
  - Multiple sets power charging station

Application Server:

- EzFinder platform & App for personal/pet/SMB tracking application
- WebTraQ platform for commercial AVL/Asset tracking application

Dimension: 69.5x45.5x19.6 mm
Weight: 56g
LS-11x LoRa Sensor Node

**LS-111 Carbon Dioxide CO₂ + Temp/Hum Node**
- Integrated with calibrated CO₂ sensor
  - Accuracy ±30 ppm
  - Range 0 ~ 2000 ppm
- Integrated with Compensated Temp/RH sensor
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V
- Display CO₂ concentration, Temp/ RH

**LS-112 Carbon Monoxide CO + Temp/Hum Node**
- Integrated with calibrated CO sensor
  - Accuracy ±5% or ±20ppm
  - Range 0 ~ 500 ppm
- Integrated with Compensated Temp/RH sensor
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V
- Display CO concentration, Temp/ RH

**LS-113 Particles (PM2.5) + Temp/Hum Node**
- Integrated with Dust Particles sensor
  - Accuracy µg/m³
  - Range 0 ~ 500 µg/m³
- Integrated with Compensated Temp/RH sensor
- Wide range DC power-in, 8~24V /or Micro-USB DC power-in, 5V

Dimension: 113.57(H) x 80(W) x 28.79(D) mm
Releasing Your Creativity
with the new STM32

www.st.com/stm32