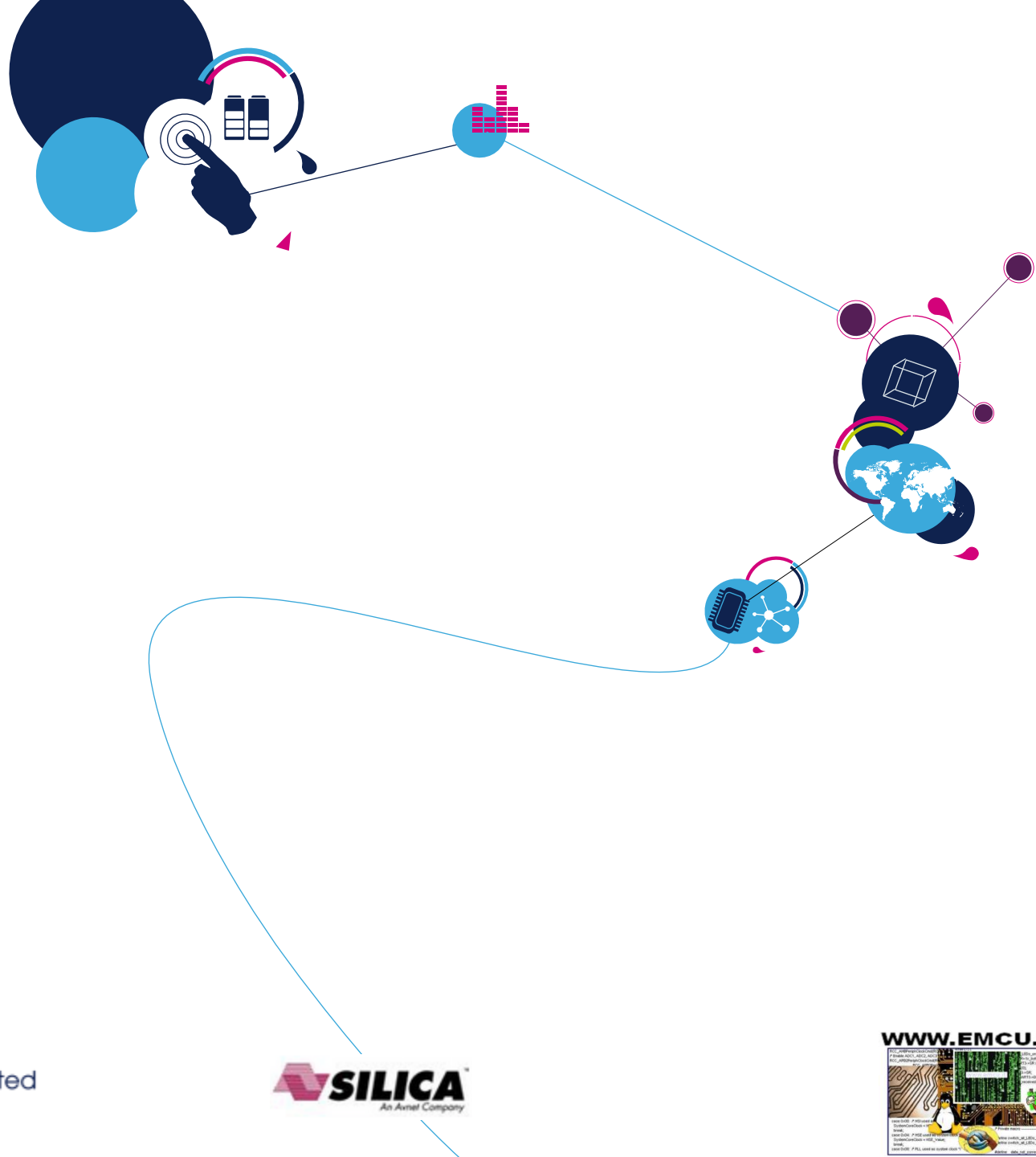


WireLess

Apr. 2013





Wireless Modules

SPWF01Sx WiFi & SPBT2632Cx Bluetooth

See also here: <http://www.emcu.it/Wireless/Wireless.html>



WiFi module SPWF01Sx.11

Module and turnkey solutions with embedded WiFi firmware and AT commands



<http://www.emcu.it/WiFi/WiFi.html>

Drivers for an Explosive WiFi Growth

■ Momentum of Wi-Fi technology

- 10% of the world's population uses Wi-Fi
- Double-digit growth year over year
- Ubiquitous in home, enterprise, industry, education and government environments

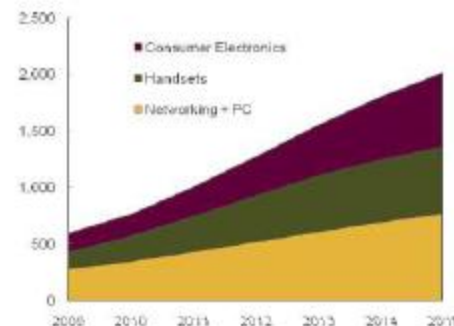
■ Prevalence of Wi-Fi based products

- Home market deployment, installed in 200M homes Worldwide
- Consumer electronic deployment, 100% in Smart Phones, major growth
- PC deployment, ~80% laptops, 100% tablets

■ Characteristics of the technology

- Easy path to the internet (TCP/IP based)
- Secured for machine-to-machine
- Flexible over multiple applications

Wi-Fi IC Shipments, by Device Type
in Millions - ABI Research, 4Q 2010



SPWF01Sx Modules

Features

- **Radio.** 2.4 GHz IEEE 802.11b/g/n
- **Micro.** STM32 ARM Cortex-M3
- **Memory.** 64KB RAM, 1.5 MB Flash
- **Size (mm).** 26.92 x 15.24 x 2.35
- **Interfaces.**
 - Serial (UART, I2C, SPI)
 - 16 GPIOs
 - JTAG
- **XTAL.** Integrated 32kHz to support low power modes
- Side pads **SMD**
- **Temperature.** Industrial temperature range
- **Antenna Options.** Integrated Antenna/U.fl. Connector
- **Certifications:**
 - FCC, IC and CE certified
 - ROHS Compliant
- **Software.** Multiple Stacks Available
 - Full Stack
 - AT
 - SDK

Serial To WiFi Module

UART/SPI
I2C/GPIO

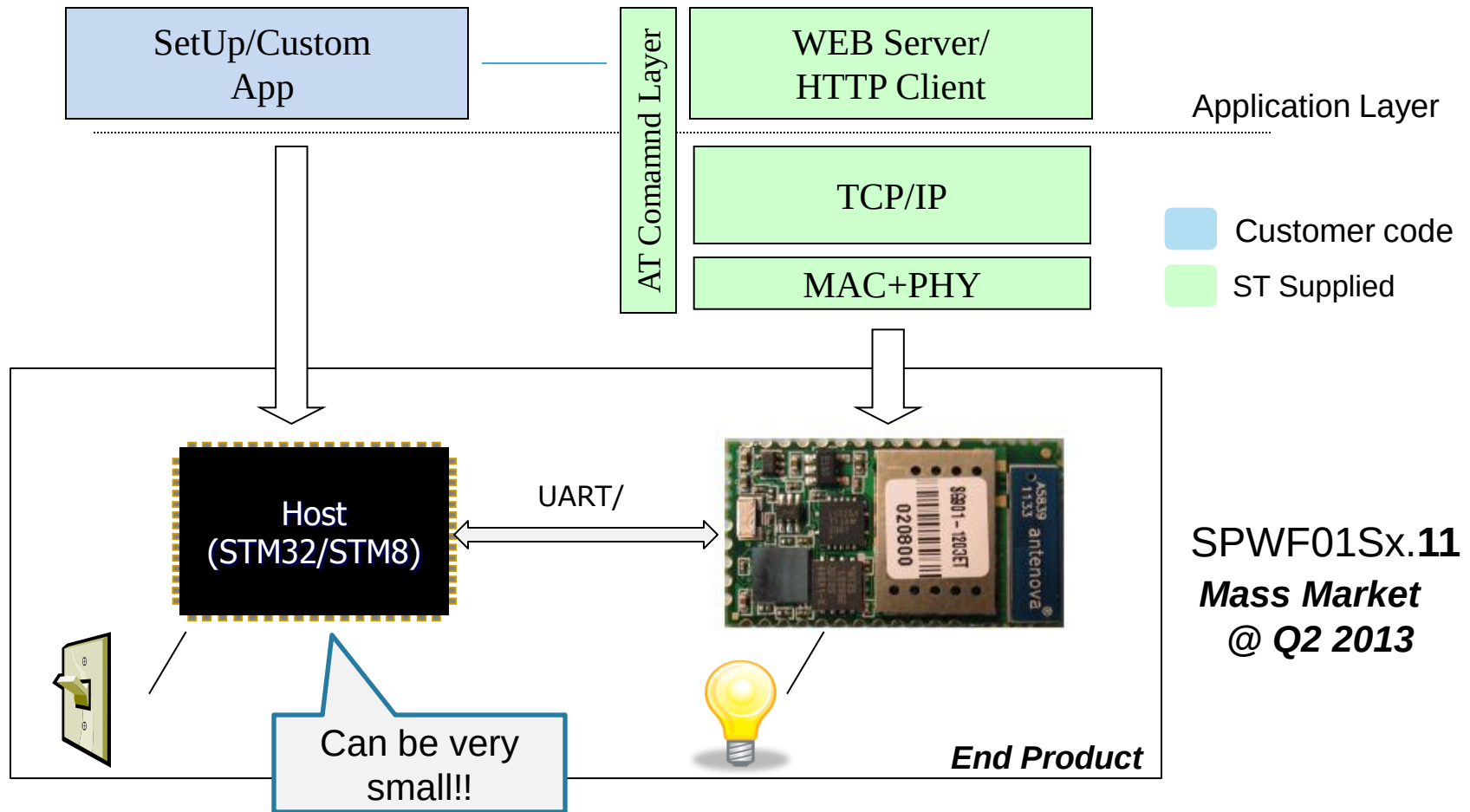


802.11
b/g/n

Part Number	Antenna Options	SW Library
SPWF01SA.11	Chip Antenna	Full Stack (AT)
SPWF01SC.11	U.FL	Full Stack (AT)

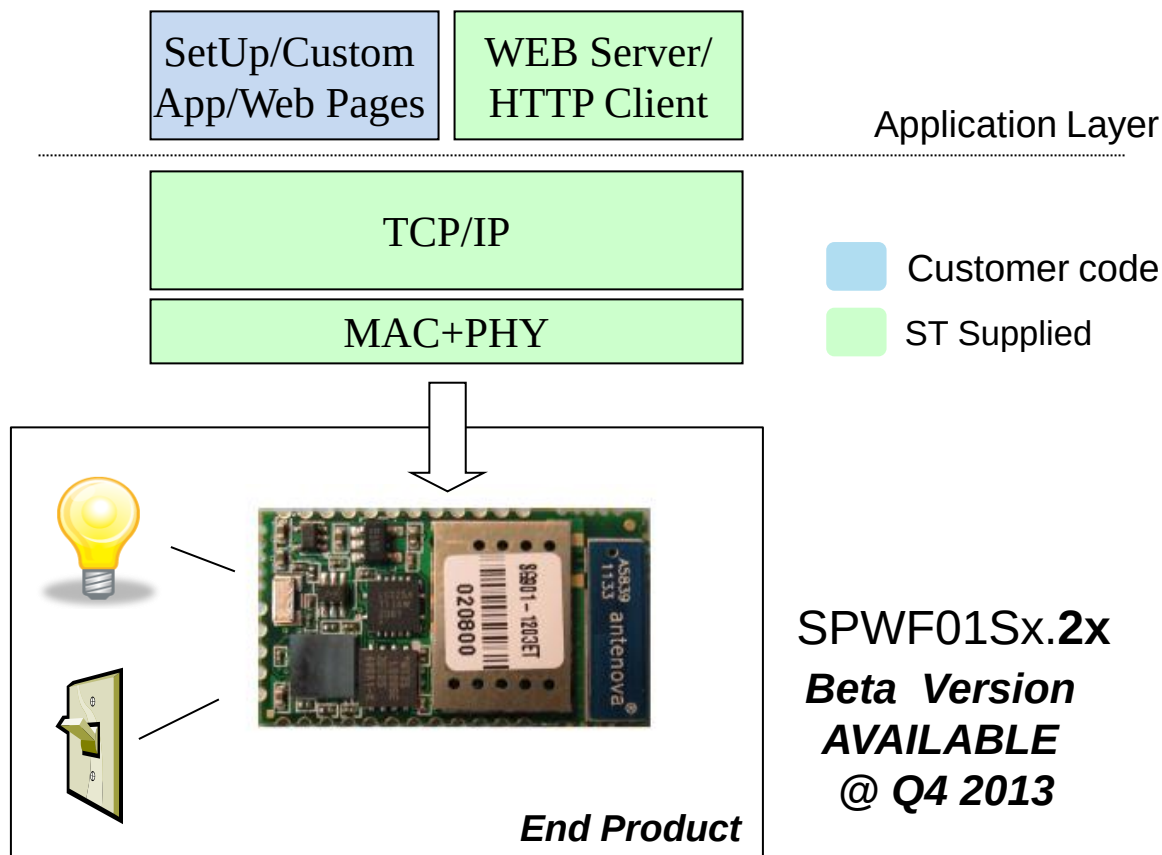
AT Full Stack

Enable the use of the module as a Network Coprocessor



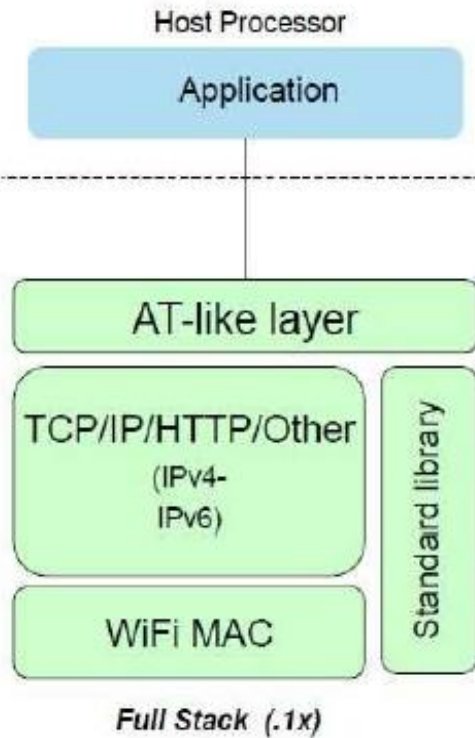
STM WiFi (SPWF01Sx) SDK Full Stack – Q4/13

Enable the module to host the whole target application

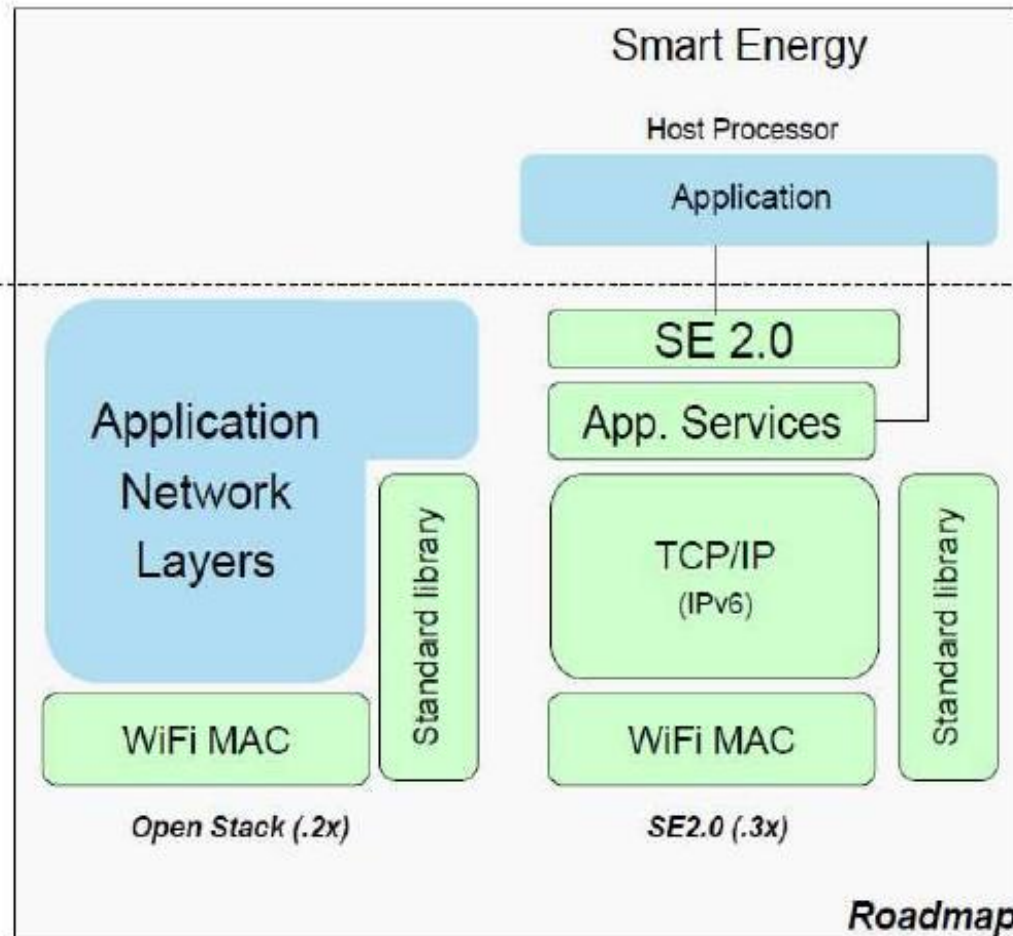


SW Libraries

Internet of Things/M2M



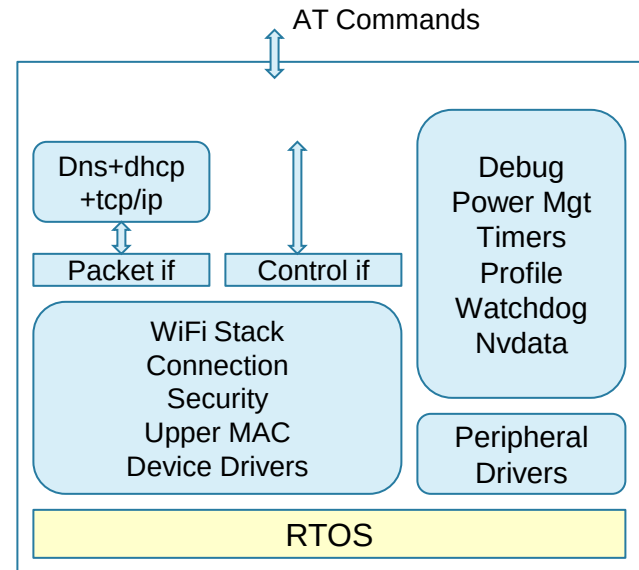
Smart Energy



and more...

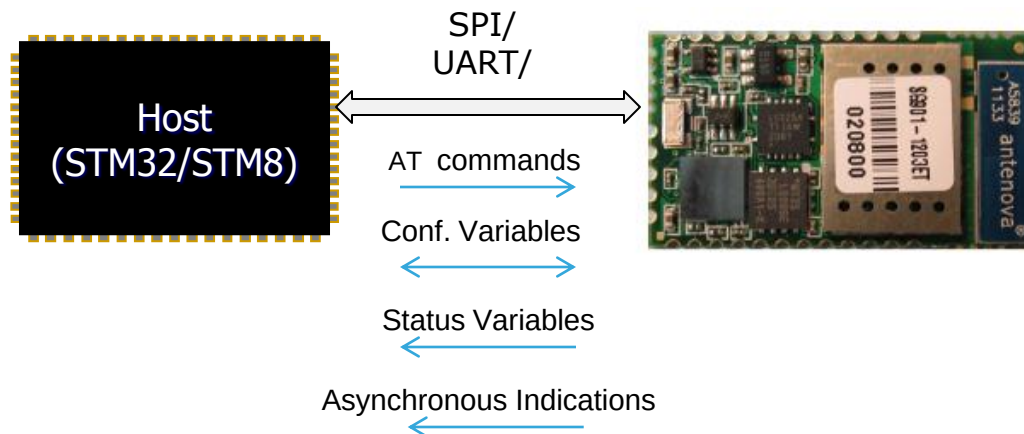
AT Full Stack Features

- Rich AT command set for RS-232
- Standards-compliant 802.11b/g/n operation
- IBSS and BSS Station operation modes
- Advanced Power Saving Modes
- Wireless security (WEP, WPA/WPA2-PSK)
- Full IPv4 stack + TCP + UDP (including DHCP client and DNS Client)
- Field update via WiFi and RS-232
- Rich AT command set for RS-232 control
- TCP/UDP Sockets API
- Built-in application utilities:
 - web server
 - http client (http get) (pull data mode)
 - “http post via get” (push data mode)



AT Full Stack Command Interface

Utilities	Notes
AT-style commands	Multiple Categories: i.e. Utilities, Configuration, Network, GPIO, Files Management
Configuration Variables	Multiple SetUp categories: i.e security, network, applications.
Status Variables	Radio, channels ...
Asynchronous Indications	Radio/Protocol/Status Indication Run-Time Messages that are echoed on the serial port



Key Messages

- **Serial To WiFi** 802.11b/g/n OEM Module
- **Plug&Play** Solution
- Very **Small** Form Size Factor
- **FCC/IC/CE certified**
- Multiple **Antenna** Options
- **Low Power** Use Modes Available
- **Industrial** Operating Temperature Range
- **Infrastructure** Mode
- **AhHoc/WiFi Direct** Mode
- **“Full TCP/IP Stack”** SW Library with
 - Built-in **Wi-Fi** security
 - Built-in **TCP/IP** stack
 - Built-in **DHCP, DNS**
 - Built-in **HTTP** server/client
- Rich **AT-like** commands for host usage

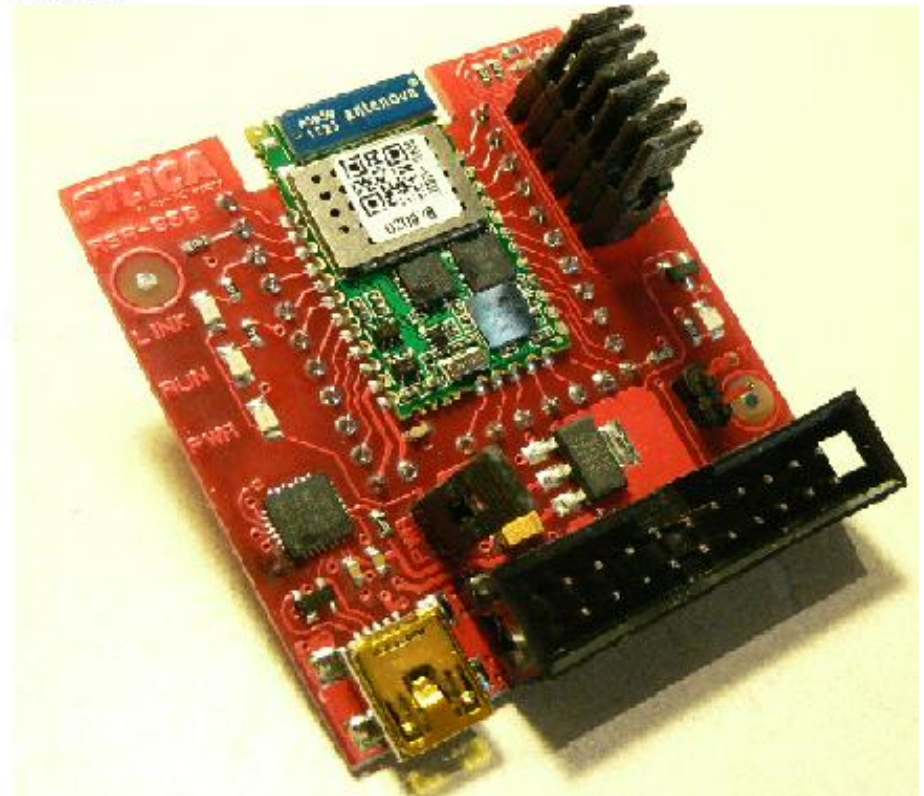
Sales Support (Work In Progress)

Status @ Q4 2012:
Eng. Samples available for alfa customers

**Contact your ST sale representative for alfa projects setup
infos**

Resources

- SPWF01Sx Datasheet
- SPWF01Sx.11 AT Command User Guide
- Tutorial
- SW Library
- EVK HW and User Guide



SILICA STM WiFi EvaBoard: <http://www.emcu.it/WiFi/WiFi.html>

Bluetooth® modules

Modules and turnkey solutions with embedded Bluetooth firmware and AT command



<http://www.emcu.it/Wireless/BT/BlueTooth.html>

Blue Modules series

- The SPBT2532 and SPBT2632 micro-sized **Blue Modules** offer the most advanced Bluetooth® technology on a highly-reliable and affordable platform
- The series includes modules for short and long range (class 2 and class 1), with and without antenna, embedding different FW subsets to meet the requirements of a wide range of applications.

Blue Modules series

SPBT2532 Modules without antenna

SPBT2532C2.AT (Class 2 profile)
SPBT2532C2.AT2 (Class 2 profile, enhanced FW*)



SPBT2632 Modules with antenna embedded

SPBT2632C2A.AT 2 (Class 2 profile, enhanced FW*)
SPBT2632C1A.AT 2 (Class 1 profile, enhanced FW*)



** Supports communication with smartphones and Apple iOS Bluetooth enabled devices*

Why use Blue Modules

Key factors

- Compliant with Bluetooth 2.1 or latest Bluetooth version 3.0
- BQB certified and listed and End Product Listing (EPL)
- Bluetooth radio, microprocessor, memories and RF design fully integrated in a unique device
- Pre-qualified and tested
- RF certified CE, FCC, IC
- Low power mode supported
- Smart cable featured
- Remote mode supported
- No need of a driver or SW stack in the host
- Micro-sized form factor

Key benefits

- Future-ready module, enhanced security, easier pairing, compatible with Apple products
- Enables EPL without further BQB process; Bluetooth logo can be used on final product
- Easier design saves development resources and time, shortens time-to-market
- High-reliable solution not requiring specific RF and Bluetooth knowledge on customer side
- Reduces effort and cost on customer side
- Reduces power consumption, increasing final application's battery life
- Realizes automatic connection between predefined devices
- Enables GPIOs and UART setting via Bluetooth link from a remote device
- Easier integration in final application not requiring further Bluetooth qualification
- SMD-like component to fit miniaturized applications

SPBT2632CyA.AT2 series - what's new

Fully qualified

- SPBT2632 series is **BQB qualified and listed**. Ready to enable your end product Listing (EPL) at SIG website
- EPL enables use of Bluetooth logo in just a few clicks - **easy, fast and free of charge**
- SPBT2632 series is **modular approved FCC** qualified and **IC qualified**
- SPBT2632 series is **CE 1051 approved**

Key features

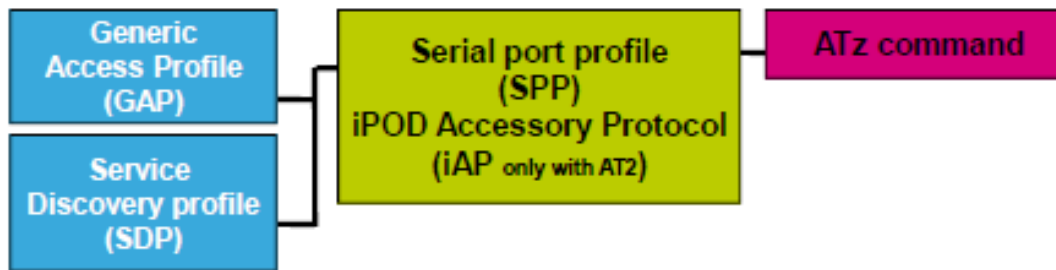
- Based on STM32 ARM-Cortex-M3 microcontroller and STE *Bluetooth* Radio
- Compliant with *Bluetooth* 3.0
- Equipped with high speed UART, SPI, I²C and GPIOs
- FW upgradable via UART
- Integrated antenna
- Supporting low-power mode
- Implement cable replacement through SPP and AT2 command
- AT2 embedded FW enabling communication with most Bluetooth enabled devices (supporting SPP), Android smartphones and Apple iOS Bluetooth enabled devices. *
- The smallest form factor

* The external Apple authentication coprocessor and MFI certification are required.

Blue Modules characteristics (1/3)

Key features	SPBT2532C2.AT SPBT2532C2.AT2 	SPBT2632C2A.AT2 	SPBT2632C1A.AT2 
Core devices	STM32 ARM-Cortex-M3 MCU + STE STLC2500DB* <i>Bluetooth</i> IC	STM32 ARM-Cortex-M3 MCU + STE STLC2690* <i>Bluetooth</i> IC	STM32 ARM-Cortex-M3 MCU + STE STLC2690* <i>Bluetooth</i> IC
Class	Class 2, typ output 0dBm	Class 2, typ output 0dBm	Class 1, typ output 10dBm
BT standard	<i>Bluetooth</i> 2.1 + EDR	<i>Bluetooth</i> 3.0	<i>Bluetooth</i> 3.0
SPP and ATz command	■	■	■
Antenna and shield	-	■	■
Low power mode	-	■ with external LPO	■
Pin count	14	16	24
Form factor	Best-in-class: 10.5 x 13.5 mm	Micro-sized : 11.6 x 13.5 mm	Small : 15 x 27 mm
Supply voltage	3.3 V	2.5 V	2.5 V
Voltage regulator	■	■	■
Clock integrated	■	■	■
WLAN coexistence	■	■	■
Operating temperature	- 40 ÷ 85 °C	- 40 ÷ 85 °C	- 40 ÷ 85 °C

Blue Modules FW profile and application



Key features	AT command	AT2 command	
Bluetooth version (**)	2.1 + EDR	2.1 +EDR	3.0
Point-to-point communication	■	■	
Multipoint communication	-	■	
Profiles			
SPP	■	■	
iAP	-	■	
Phone support			
BlackBerry	-	■	
Android	-	■	
iPhone	-	■	

Generic Access Profile (GAP)

- Discovers and connects to other devices
- Security (authentication)
- idle mode procedure: inquiry
- linking, paging, connection

Service Discovery Profile (SDP)

- Locates/describes services from/to other devices

Serial Port Profile (SPP)

- Emulates legacy serial communication
- Cable replacement

iPOD Accessory Protocol (iAP)

- Supports communication with Apple iOS Bluetooth enabled device*

(*) The external Apple Authentication coprocessor and MFI certification are required

(**) depending on BT radio chipset.
 - STLC2500DB supports BT V2.1 +EDR
 - STLC2890 supports BT V3.0

Blue Modules - Certifications

Blue Modules are **CE** and **Bluetooth®** certified. Radio type compliant for US and Canada.

	BQB qualified design	CE Statement of opinion*	FCC and IC
SPBT2532C2.AT SPBT2532C2.AT2	QD ID: B016360 Product type: End Product TGP Version: Core 2.1/2.1 + EDR TCRL-2009-1 Core Spec Version: 2.1/2.1 +EDR Product Description: Bluetooth Module	0307-ARAJ00079 Measurements in accordance with : EN 300 328 V 1.7.1 (2004-11) EN 301 489-17 V 1.2.1:2002 EN 60950-1 CE 0051①	Not Applicable FCC qualification is strictly related to RF section design; therefore it doesn't apply to module without antenna on board. For this reason SPBT2532C2.AT module is not formally qualified, however it is FCC ready.
SPBT2632C1A.AT2	QD ID: B019224 Product type: End Product TGP Version: Core 3.0 Core Spec Version: 3.0 Product Description: Bluetooth Module, spec V3.0	0447-ARAM00002 Measurements in accordance with: EN 300 328 V 1.7.1 (2006-10) EN 301 489-17 V 2.1.1 (2009) EN 60950-1:2006 +A11:2009+A1:2010 CE 0051①	FCC ID: X3ZBTMOD3 IC: 8828A-MOD3 In accordance with FCC part 15, the SPBT2632C1A.AT2 is listed above as a modular transmitter device
SPBT2632C2A.AT2	QD ID: B019224 Product type: End Product TGP Version: Core 3.0 Core Spec Version: 3.0 Product Description: Bluetooth Module, spec V3.0	0307-ARMJ00003 Measurements in accordance with : EN 300 328 V 1.7.1 (2006-10) EN 301 489-17 V 2.1.1 (2009) EN 60950-1:2006 +A11:2009+A1:2010 CE 0051①	FCC ID: X3ZBTMOD4 IC: 8828A-MOD4 In accordance with FCC part 15, the SPBT2632C2A.AT2 is listed above as a modular transmitter device

* Reports available on request



ST modules are Bluetooth SIG qualified



Bluetooth SIG | Bluetooth.com

Select Language: Search: Search

End Product Detail



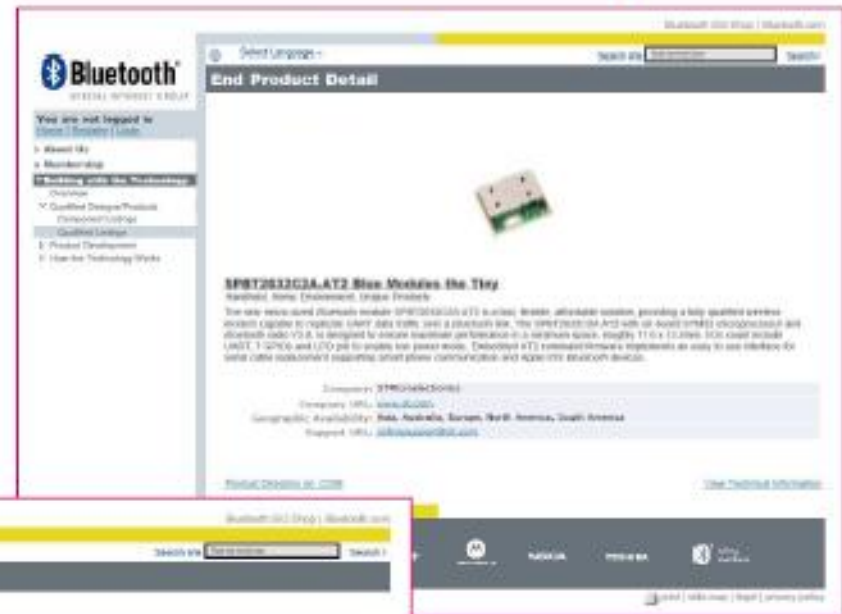
SPBT2632C2.AT Blue Module 24 Tty
Single Products, Home Environment, Handheld

The new micro-sized Bluetooth module SPBT2632C2.AT is a fast, flexible, affordable solution, providing a wireless modem capable to replicate UART data traffic over a Bluetooth link. The SPBT2632C2.AT with on-board STMCU microprocessor and Bluetooth radio IC 1+2DR, is designed to ensure maximum performance in a minimum space, roughly 10 x 12mm. IC1 core module UART, 1+2DR and LDO pin for power are power mode. The on-board AT2 command firmware implements an easy to use interface for serial cable replacement supporting smart phone communication and Apple iOS Bluetooth device.

Company: [STMicroelectronics](#)
Company URL: [www.st.com](#)
Geographic Availability: Asia, Australia, Europe, North America, South America
Support URL: [stmicroelectronics.com](#)

[Product Overview for STM](#)

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Bluetooth SIG | Bluetooth.com

Select Language: Search: Search

End Product Detail



SPBT2632C3A.AT2 Blue Modules the Tiny
Handheld, Home Environment, Unique Products

The new micro-sized Bluetooth module SPBT2632C3A.AT2 is a fast, flexible, affordable solution, providing a fully qualified wireless modem capable to replicate UART data traffic over a Bluetooth link. The SPBT2632C3A.AT2 with on-board STMCU microprocessor and Bluetooth radio V2.0, is designed to ensure maximum performance in a minimum space, roughly 11.6 x 12.2mm. IC1 core module UART, 1+2DR and LDO pin for power are power mode. The on-board AT2 command firmware implements an easy to use interface for serial cable replacement supporting smart phone communication and Apple iOS Bluetooth device.

Company: [STMicroelectronics](#)
Company URL: [www.st.com](#)
Geographic Availability: Asia, Australia, Europe, North America, South America
Support URL: [stmicroelectronics.com](#)

[Product Overview for STM](#)

[View Technical Information](#)

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Bluetooth SIG | Bluetooth.com

Select Language: Search: Search

End Product Detail



SPBT2632C1A.AT2 Blue Modules
Handheld, Home Environment, Unique Products

The new Bluetooth module SPBT2632C1A.AT2 is a fast, flexible, affordable solution, providing a class 1 fully qualified wireless modem capable to replicate UART data traffic over a Bluetooth link. The SPBT2632C1A.AT2 with on-board STMCU microprocessor and Bluetooth radio V2.0, is designed to ensure maximum performance in a minimum space, roughly 16 x 21mm. IC1 core module UART and 16-GHz LDO Low Power Operation is on-board ensuring low power mode for battery powered applications. Embedded AT2 command firmware implements an easy to use interface for serial cable replacement supporting smart phone communication and Apple iOS Bluetooth device.

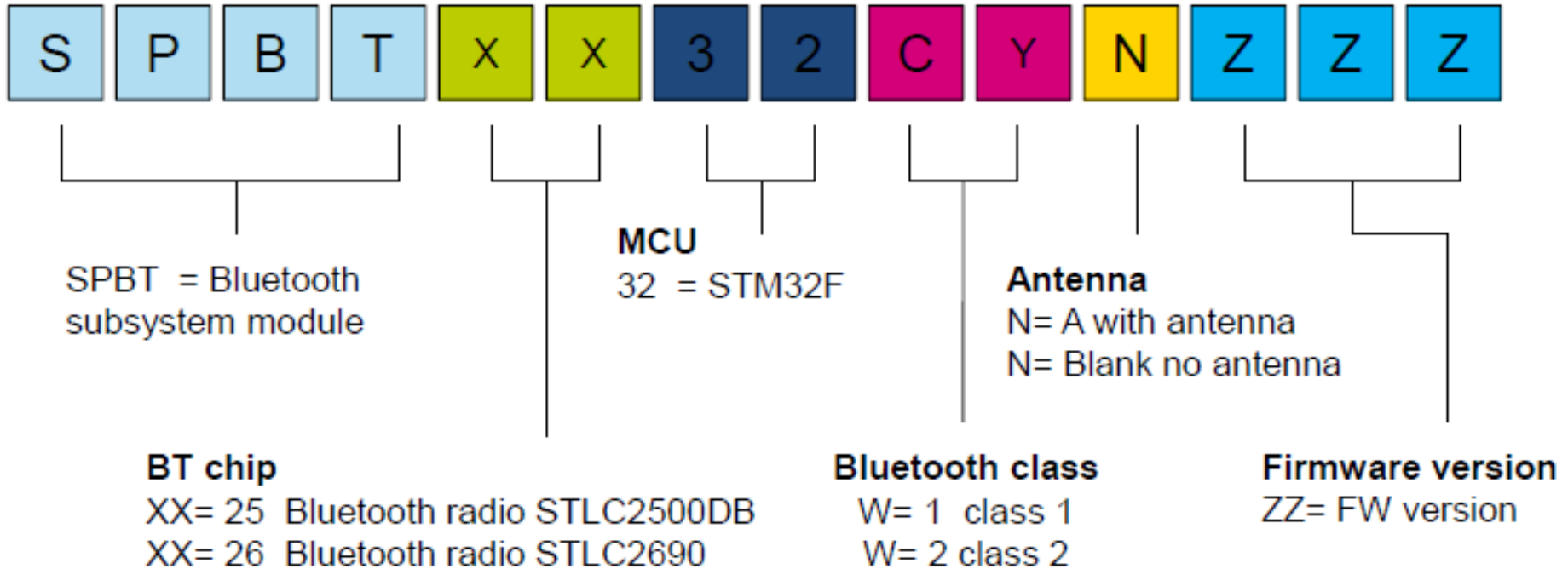
Company: [STMicroelectronics](#)
Company URL: [www.st.com](#)
Geographic Availability: Asia, Australia, Europe, North America, South America
Support URL: [stmicroelectronics.com](#)

[Product Overview for STM](#)

[View Technical Information](#)

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Part numbering schema



Order codes



Order code	Description
SPBT2532C2.AT	Bluetooth V2.1+EDR, Class2, antennaless, AT command FW
SPBT2532C2.AT2	Bluetooth V2.1+EDR, Class2, antennaless, AT2 command FW
SPBT2632C2A.AT2	Bluetooth V3.0, Class2, antenna, AT2 command FW
SPBT2632C1A.AT2	Bluetooth V3.0, Class1, antenna, AT2 command FW

Evaluation boards



Order code	Description
STEVAL-SPBT2ATV2	USB dongle, evaluation board for SPBT2532C2.AT
STEVAL-SPBT2ATV3	USB dongle, evaluation board for SPBT2532C2.AT2
STEVAL-SPBT3ATV3	USB dongle, evaluation board for SPBT2632C2A.AT2
STEVAL-SPBT4ATV3	USB dongle, evaluation board for SPBT2632C1A.AT2

Wireless Modules – Key Messages

- **Off-the-shelf RF plug&play solutions**
 - Enable short **time-to-market** product development
 - **No RF specific knowledge** is required for the integration of the modules in the target application
- **Cost-effective** for design of multiple platforms or multiple versions of the same platform
 - Save 8-12 months in design cycle
 - Significantly reduce engineering and production costs
- **Pre-certified RF modules**
 - Reduce the effort and certification cost on the customer side





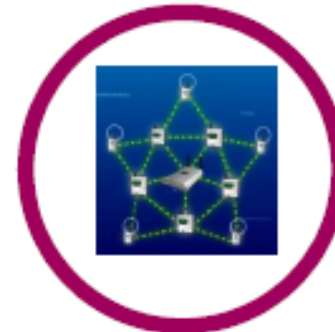
Sub-GigaHertz Transceiver **SPIRIT1Q (Quad Band)**

WIDE APPLICATION COVERAGE

HOME/BUILDING AUTOMATION



SMART METERING



WIRELESS SENSOR NETWORKS



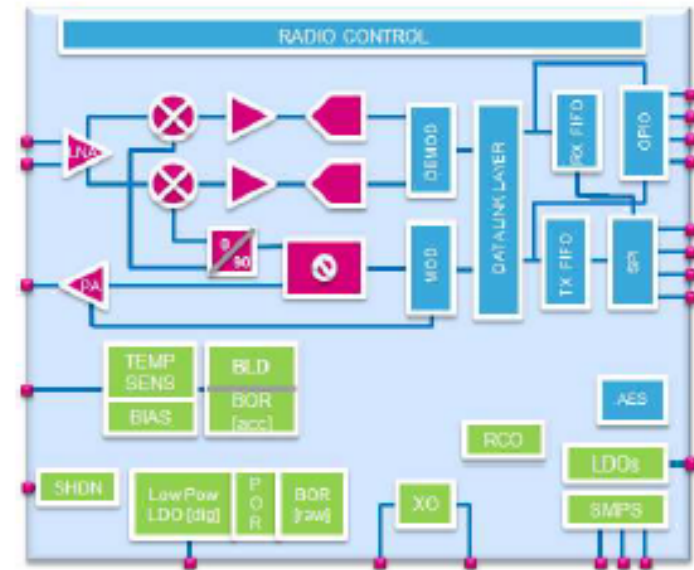
ALARM SYSTEMS



INDUSTRIAL MONITORING & CONTROL

SPIRIT1 – Sub 1-GHz RF Transceiver

- Frequency bands: 150-174MHz, 300-348 MHz, 387-470 MHz, 779-956 MHz
- Modulation schemes: FSK, GFSK, MSK, OOK and ASK
- Air data rate from 1 to 500 kbps
- Programmable output power: from -30dBm to +16dBm (boost mode)
- RX sensitivity: -118dBm @1.2kbps
- Low current consumption
 - Shutdown: 2.5nA
 - Stand-by: 650nA
 - Sleep: 950nA
 - RX: 9mA
 - TX: 21 mA @+11dBm
- Programmable channel spacing (12.5 kHz min).
- Frequency Hopping Antenna diversity algorithm
- AES 128-bit encryption co-processor
- Automatic acknowledgement, retransmission, and timeout protocol engine
- Embedded packet handler
- Wireless M-BUS, 6LoWPAN, 
- EN 300 220, FCC CFR47 15 (15.205, 15.209, 15.231, 15.247, 15.249), and ARIB STD T-67, T-108 compliant



QFN20 4*4

SPIRIT1: key features

Packet handler and Link Layer features

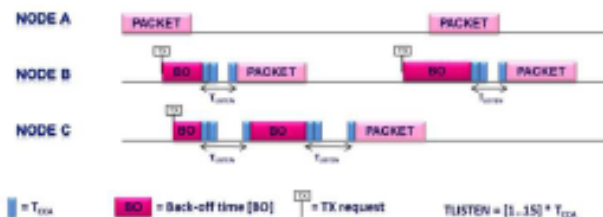
- Integrated **packet handler** supporting:
 - BASIC [general purpose/flexible packet format]
 - Wireless M-BUS
 - STack [ST proprietary stack]
- Support for **Automatic acknowledgment** of received packets, **retransmission** and **time-out** protocol.

Peripherals & Support Functions

- AES 128-bit encryption co-processor** is available for secure data transfer
- Separate **96-byte RX/TX FIFOs**, accessible via the SPI interface for host processing
- Integrated temperature sensor**
- Battery indicator and low battery detector**

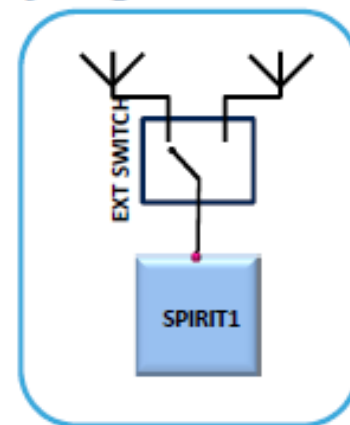
CSMA/CA Engine

- The CSMA/CA engine is a **channel access** mechanism based on the rule of **sensing the channel before transmitting**. This avoids the simultaneous use of the channel by different transmitters.



Antenna Diversity Algorithm

- An external switch is controlled to select the antenna with the highest RSSI
- While receiving the preamble, the antennas are repeatedly switched until the $\text{RSSI} > \text{threshold}$.
- The switch is then disabled and the selected antenna is used.



SPIRIT1 – Product presentation

Available tools and support

- Orderable EVAL KITS

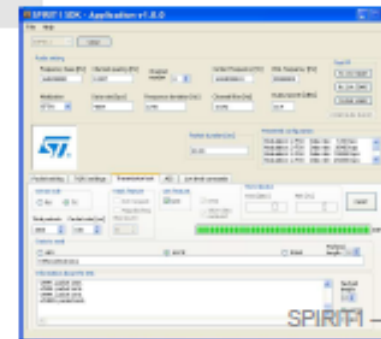
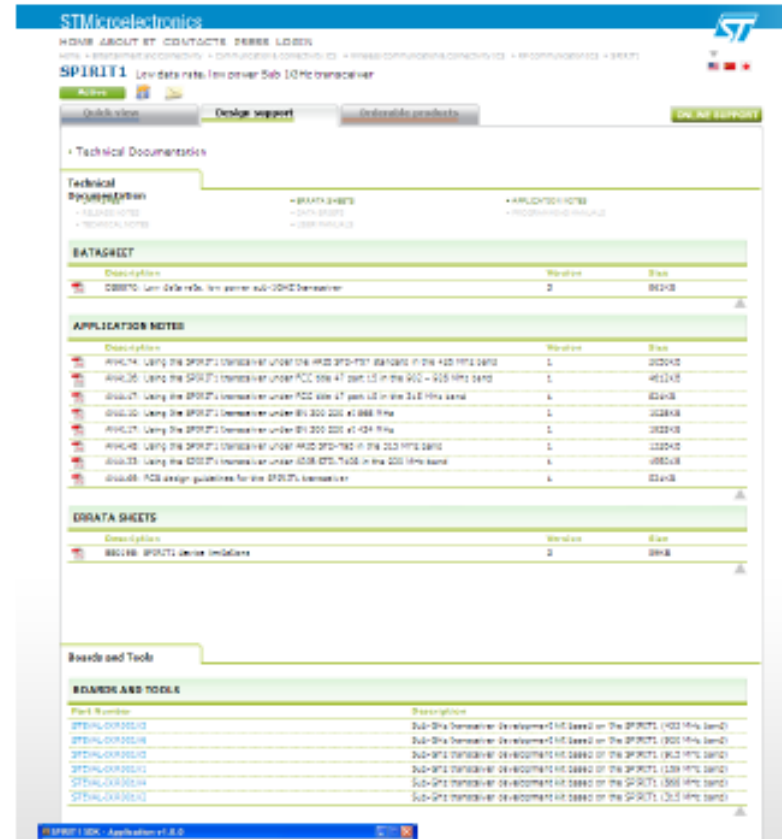
- 169 MHz EVAL KIT [STEVAL-IKR001V1]
- 169 MHz + PA EVAL KIT [STEVAL-IKR001V7D]
- 315 MHz EVAL KIT [STEVAL-IKR001V2]
- 433 MHz EVAL KIT [STEVAL-IKR001V3]
- 868 MHz EVAL KIT [STEVAL-IKR001V4]
- 868 MHz + PA EVAL KIT [STEVAL-IKR001V7D]
- 915 MHz EVAL KIT [STEVAL-IKR001V5]
- 920 MHz EVAL KIT [STEVAL-IKR001V6]

- Easy to use GUI gets users up and running fast

- SPIRIT1 performance can be easily tested
- Packet transmission/reception test with PER evaluation
- AES engine encryption/decryption tests
- Register read/write and dump

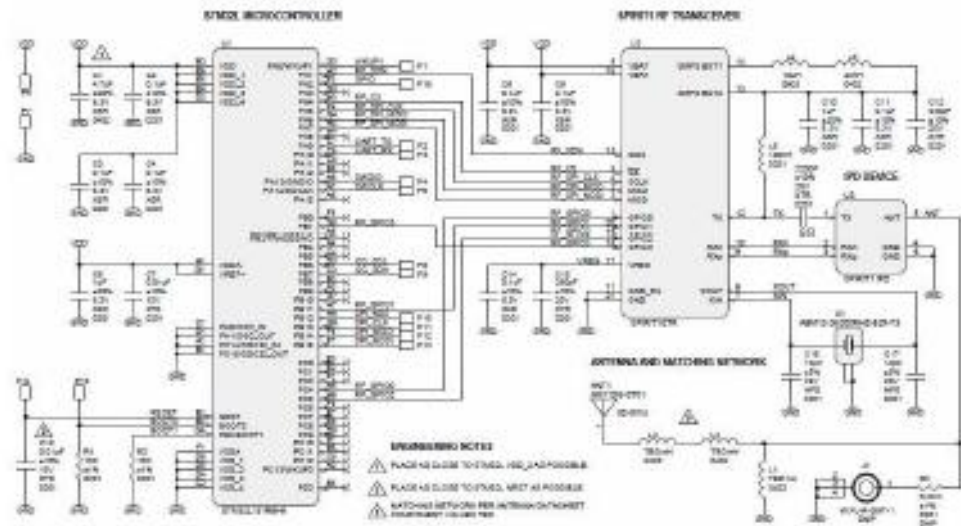
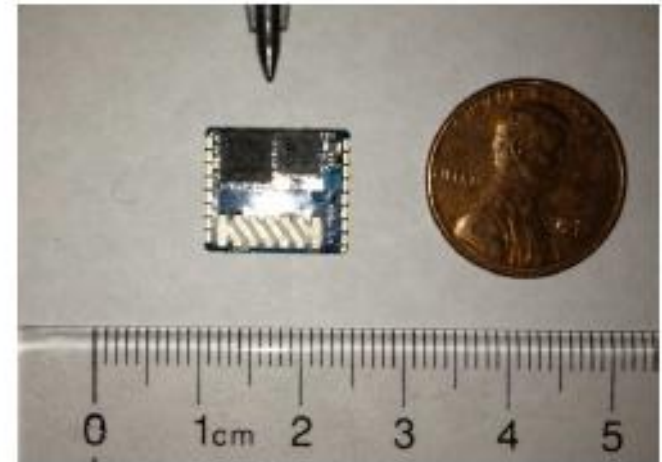
- W-MBUS protocol stack

- Reference design, Application notes, STM32 [Cortex M3] software libraries/drivers



868 and 915MHz SPIRIT1 based module

- SPIRIT1 based Module
 - Supported bands 868MHz and 915MHz
 - Using BALF-SPI-01D3 868/915MHz IPD balun and filter
 - STM32L151RBH6 MCU on board
 - Surface Mount antenna
 - AT Command set interface via UART
- FCC/CE approval: March 2013



Wireless M-BUS suite description

- Key features:

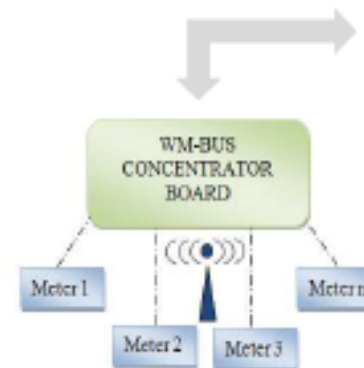
- EN 13757-4:2011
- Modes S1, S1-m, S2, T1, T2, R2, N easily configurable
- Device types supported: meter, collector/reader, both
- Supports AES-128 Encryption.

- Wireless M-BUS suite :

- 169MHZ / 868 MHz W M-BUS stacks [binary]
- Application examples
- GUI

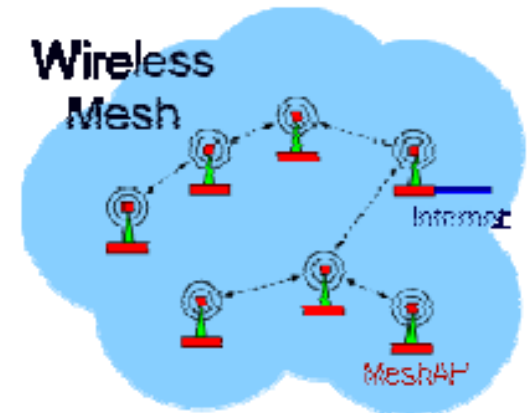


WM-BUS SOFTWARE
APPLICATION



6LoWPAN and Internet of Things

- Spirit1 + STM32L based platform
 - Availability: March 2013
- Developed and provided by Thingsquare
 - A pioneering provider of open-source software
- To connect SPIRIT1 to Internet or any other IP network
 - Adapting the packet size of the two networks
 - Adaptation layer for interoperability and packet form
 - Mesh Routing in the personal area network
 - ...
- Open source based on Contiki OS
 - Modest resources requirements
 - Over-the-air secure software updates



SUMMARY

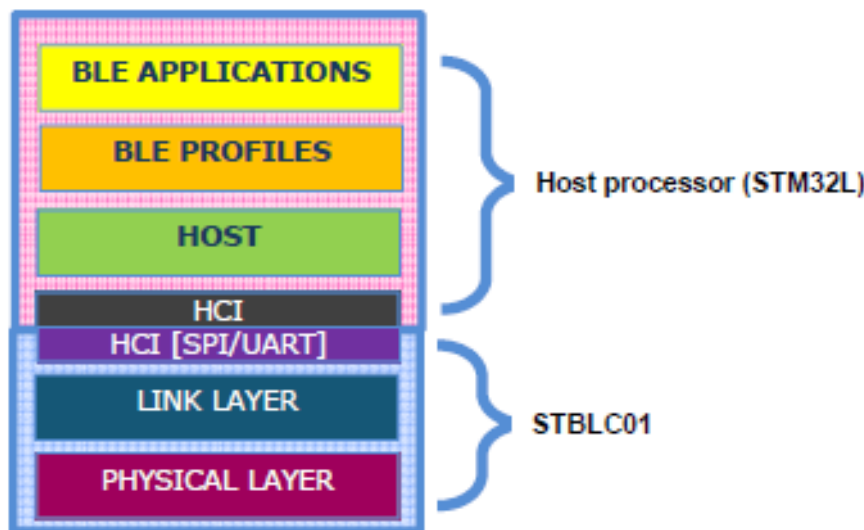
- Best in class solution power consumption without sacrificing RF performances
- Allows long range, reliable and robust RF communication links
- FCC, ETSI, ARIB compliant
- Sub-1GHz Proprietary radio Roadmap
- W-MBUS protocol stack provided
- 6LoWPAN protocol available (March 2013)
- Large availability of development tools and support



Bluetooth Low Energy Transceiver **STBLC01**

STBLC01 Bluetooth® SMART Controller

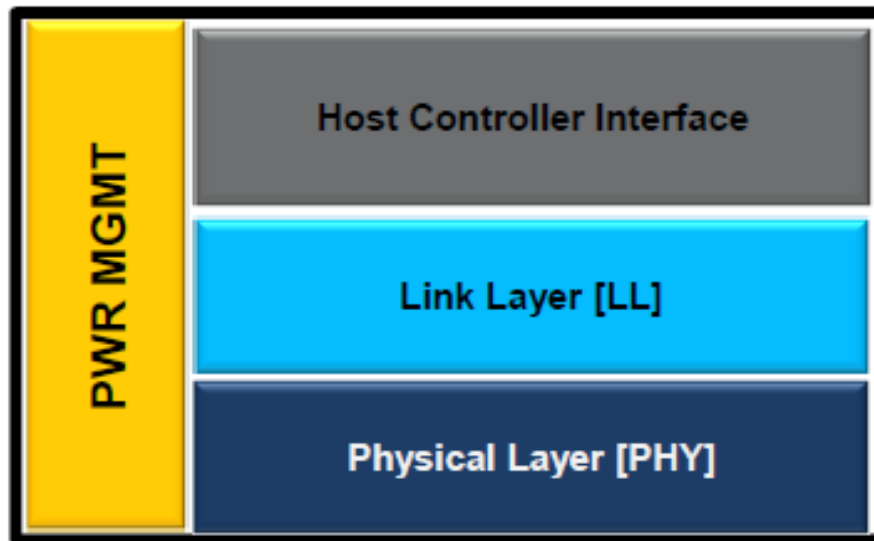
- The STBLC01 is a Bluetooth® SMART controller compliant with **Bluetooth specification 4.0**.
- In the Host processor + Controller implementation, the stack is split in two devices. The application runs in the Host processor.
- The protocol stack running in the host is given separately for free and in the form of static library for STM32L.
- Qualified profiles available separately .



STBLC01

Bluetooth® SMART - Controller

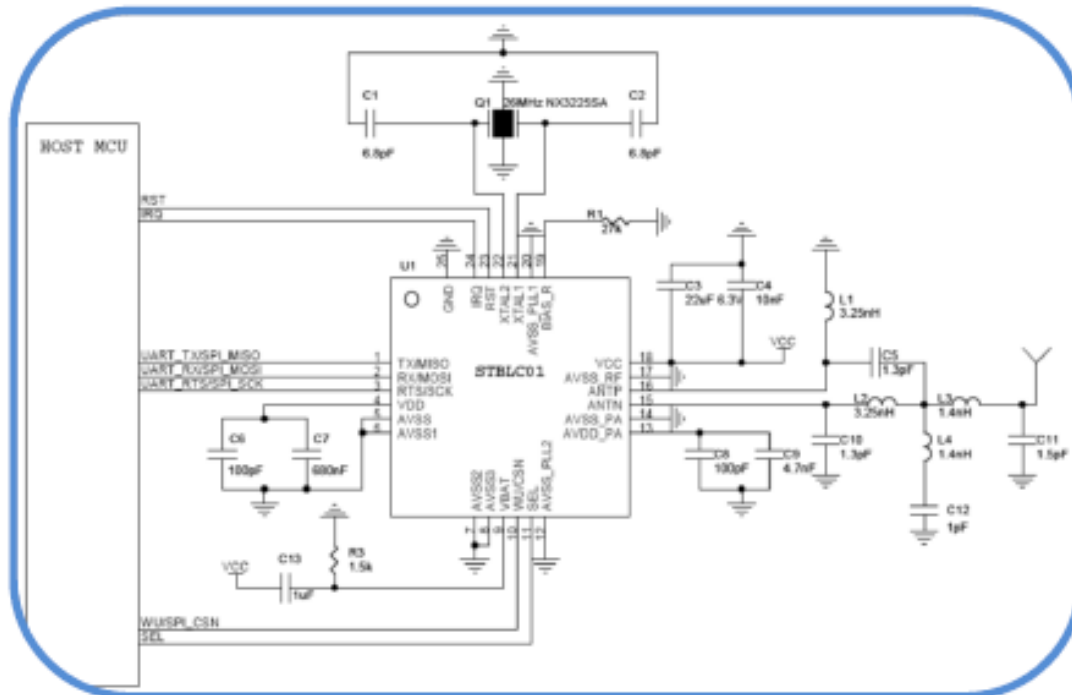
• MAIN CHARACTERISTICS



- Master and slave BLE certified controller
- 1Mbps On air data rate
- 13mA [RX] / 12.1mA [TX@0dBm] maximum peak current allows standard coin cell batteries usage
- Wide spread and low cost 26MHz Xtal are allowed
- Programmable RF output level from -18 dBm to +3dBm
- Battery Level Detector
- QFN 24 5x5 package
- External Microcontroller Interfaces [HCI]: SPI and UART

Qualified Bluetooth Low energy stack and Profiles:
available and provided separately

STBLC01 Application schematic



- Very small number of external discrete components.
- No need of expensive external filters to block undesired frequencies bands.
- Simple matching network to adapt the antenna impedance to the STBLC01 differential 200 Ω real impedance.

STBLC01 main performance

Parameter	Symbol	Typ. value	Unit
Off Mode	I_{off}	9	μA
Sleep Mode	I_{sleep}	19	μA
Idle Mode	I_{idle}	200	μA
TX @0dBm	I_{tx}	12.1	mA
RX	I_{rx}	12.9	mA

Current Consumption
[$V_{\text{in}}=2.5\text{V}$]

Parameter	Typ. value	Unit
Min O/P power	-18	dBm
Max O/P power	+3	dBm
Spurious emission $f \leq 1\text{GHz}$	-47	dBm
Spurious emission $f > 1\text{GHz}$	-43	dBm

TX performance

STBLC01: a fully qualified Bluetooth® SMART solution

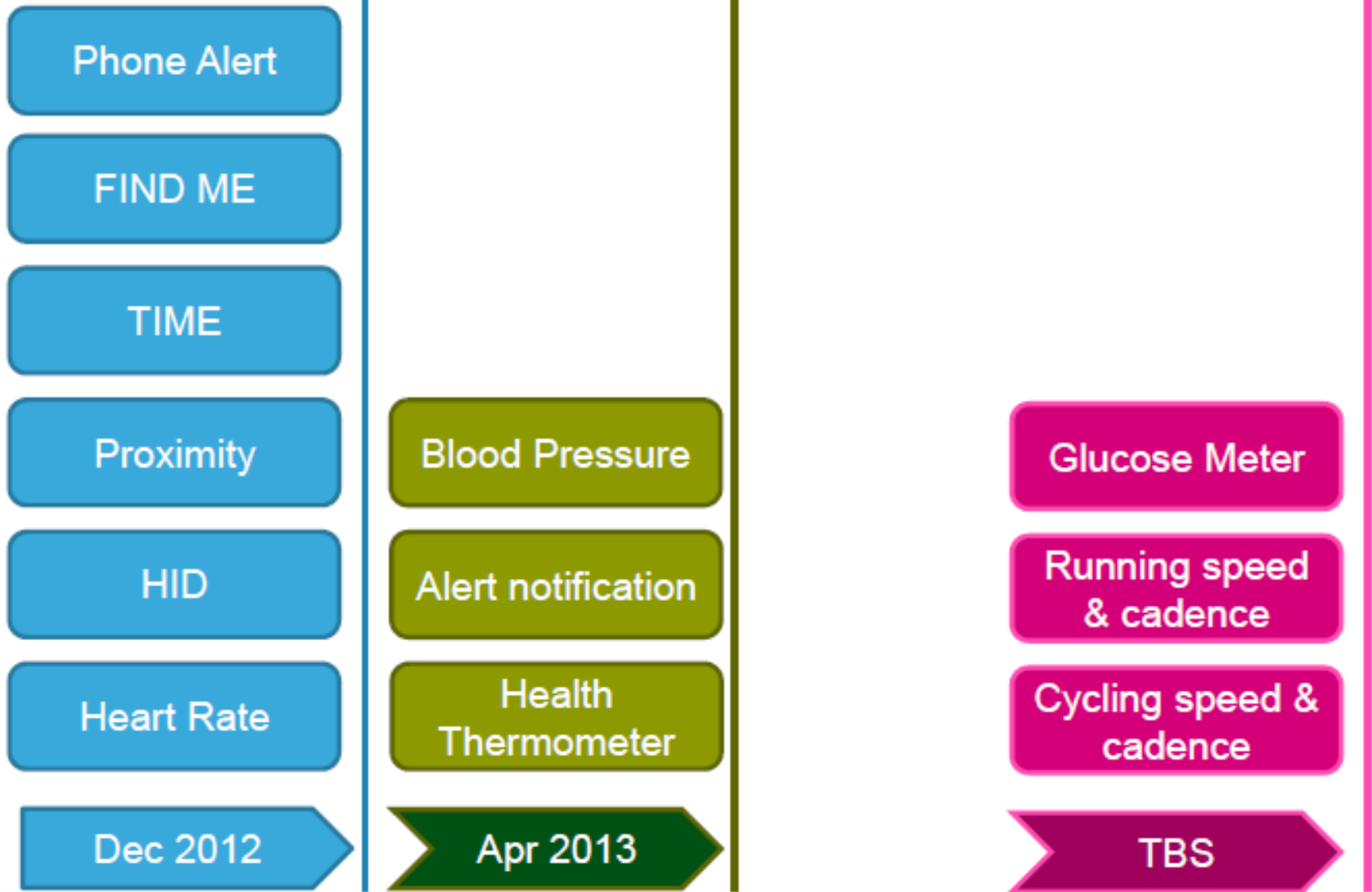


Hardware [July 4, 2012]



Bluetooth Host Stack [Sept 24, 2012]

ST Bluetooth® SMART profiles roadmap



STBLC01 Eval kit

- Hardware

- 2 STM32L Discovery Boards
- 2 STBLC01 RF modules
- 2 Adapter Boards
- 2 Antennas

- Programmable through GUI

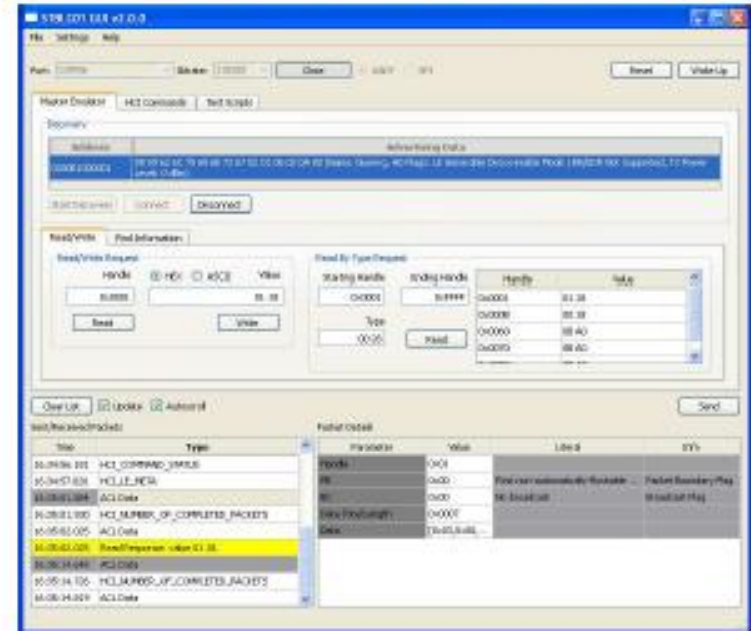
- STBLC01 performance can be easily checked/tested

- HOST STACK

- Qualified Bluetooth Low Energy Stack provided

- PC Demo application

- Example of Bluetooth Low Energy application





STM32W+ 2.4GHz 802.15.4 and Zigbee IP

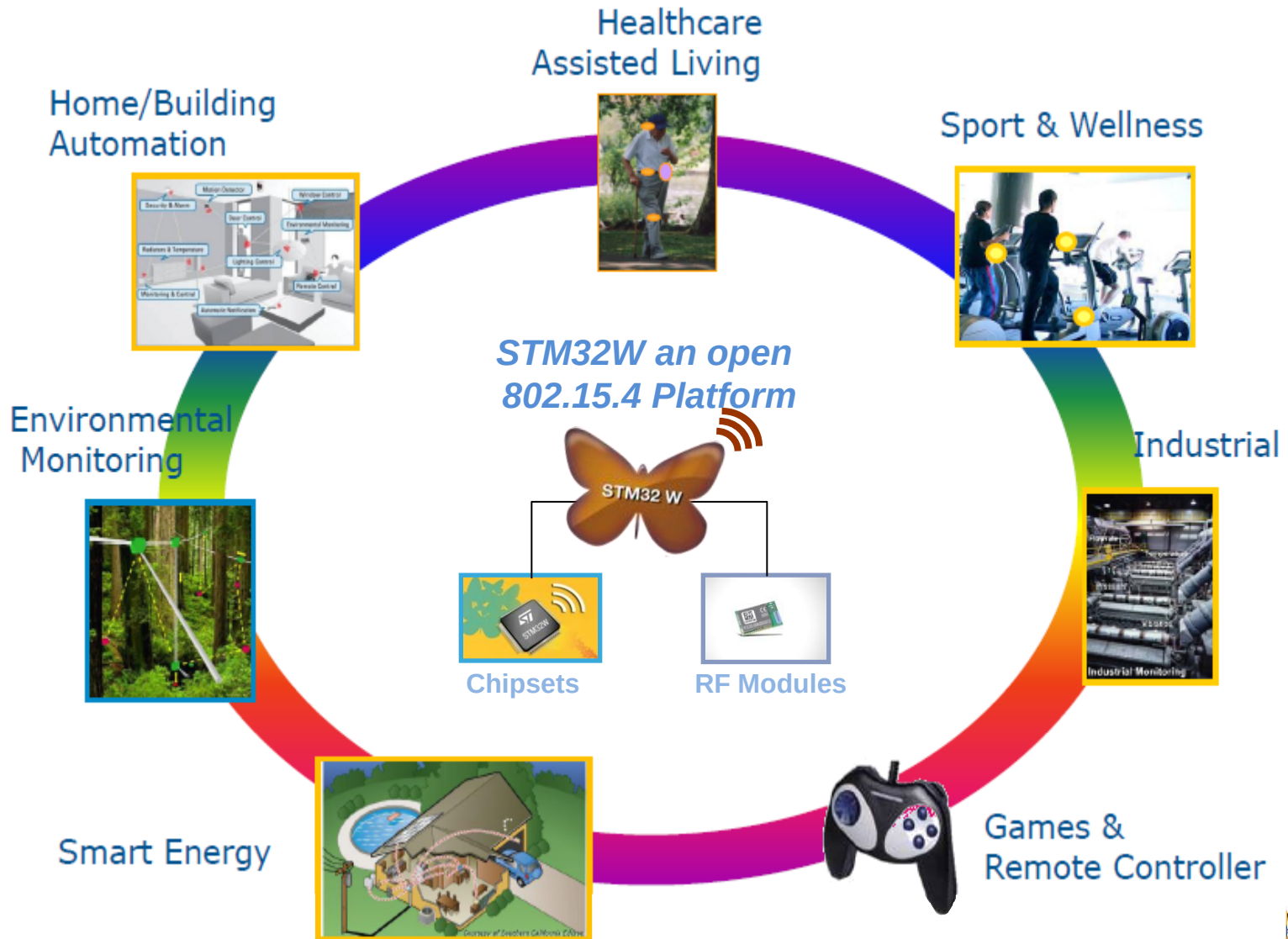


**SPZB32W Series of
IEEE 802.15.4 RF Modules**

<http://www.emcu.it/STM32/STM32Wxx/STM32Wxx.html>

<http://www.emcu.it/Wireless/ZigBee/ZigBee.html>

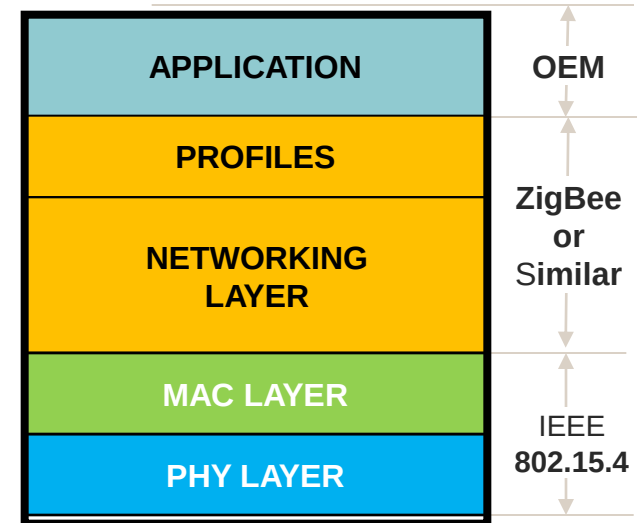
Targeting Wireless Sensor Networks Market



IEEE 802.15.4 Highlights

- IEEE 802.15.4 defines the physical layer (PHY) and medium access control (MAC) sublayers for a low-rate WPAN (LR-WPAN)
- IEEE 802.15.4 targets
 - Low Power Consumption Devices
 - Low Data Rate Communication
 - Dynamic and Scalable Ad Hoc Networks
- IEEE 802.15.4 operates in license-free bands
- Few stacks are defined by std committees on top of IEEE 802.15.4 for use in multiple domains
 - Stack Examples: Zigbee PRO, Zigbee IP, 6LoWPan, RF4CE

BAND	COVERAGE	DATA RATE	CHANNEL NUMBERS
2,4 GHz	ISM Worldwide	250 kbps	11-26
868 MHz	Europe	20 kbps	0
915 MHz	ISM Americas	40 kbps	1-10

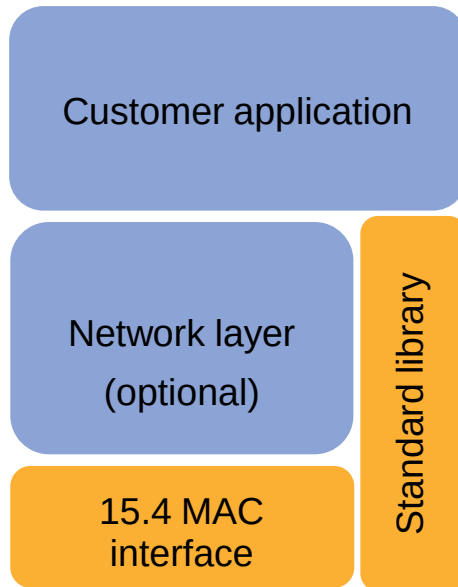


STM32W F/W combinations/portfolio

(for all versions)

SimpleMAC

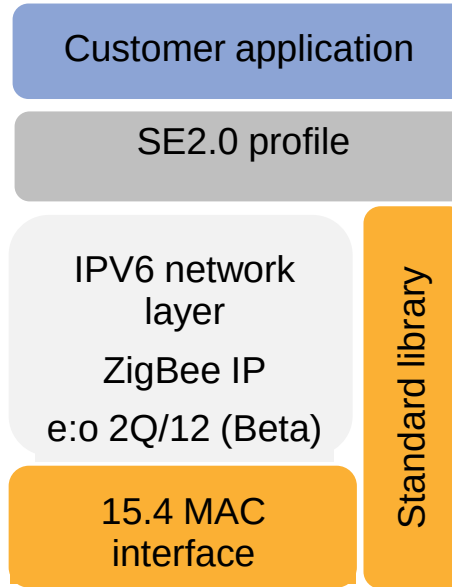
Full design freedom
RF control



4

ZigBee IP

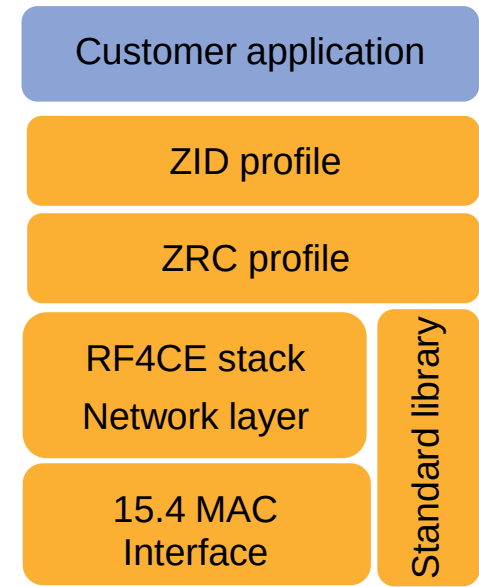
SmartGrid



5

RF4CE

Consumer, remote controls



3

Part Number last digit mapping



Customer code



Libraries available

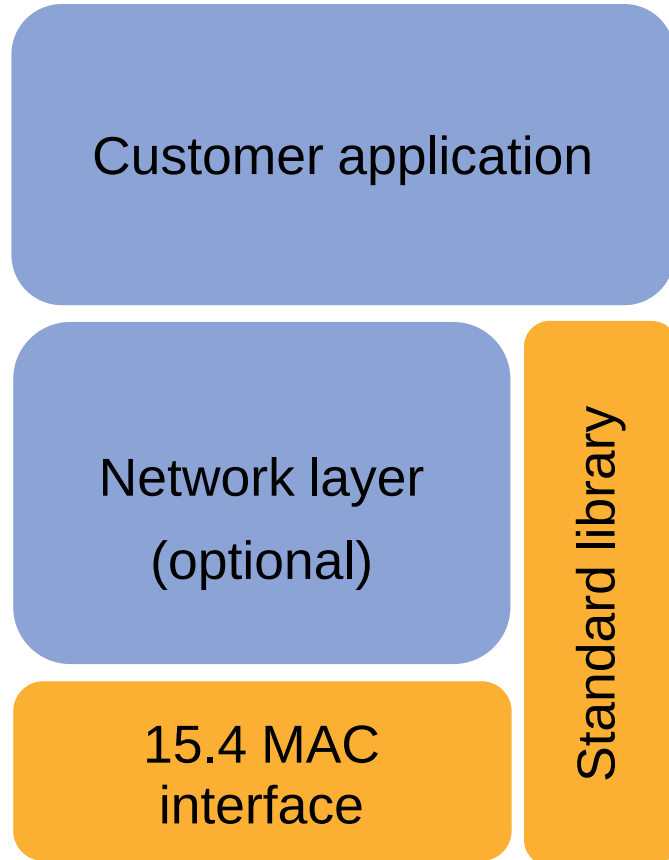


Alpha released, Beta planned in June 2012 (depends on Zigbee Alliance specification ratification)



Alpha released, Beta planned Q4 2012 (depends on CSEP specification ratification)

IEEE 802.15.4 Simple MAC Library



- The ST **IEEE 802.15.4** Simple MAC Library provides a set of APIs allowing access to the **PHY** and **lower-MAC** functionality of the STM32W SoC:
 - RX/TX functionalities
 - Radio channel selection
 - **Transmit power level** control
 - Boost mode control
 - Radio **sleep** and **wakeup** control
 - LQI and RSSI for received packets
 - Implements Unslotted CSMA transmit support including CCA
 - Ability to enable/disable receiver
 - Automatic acknowledgement management

SPZB32W Approvals

- SPZB32Wxyz.t are **RoHS** compliant
- SPZB32Wxyz.t modules are **CE** certified
 - Radio: EN 300 328
 - EMC: EN 301 489-17
 - Safety: EN60950-1
- The SPZB32Wxyz.t modules are compliant with Part 15 of the **FCC**
 - **modular approval** applies to devices that are not stand-alone products and are designed to always be included in other (end) products
 - The **FCC ID** of the module must be used on the label for the end host product
 - Modules with U.fl. Connectors have been also certified with the following external antenna



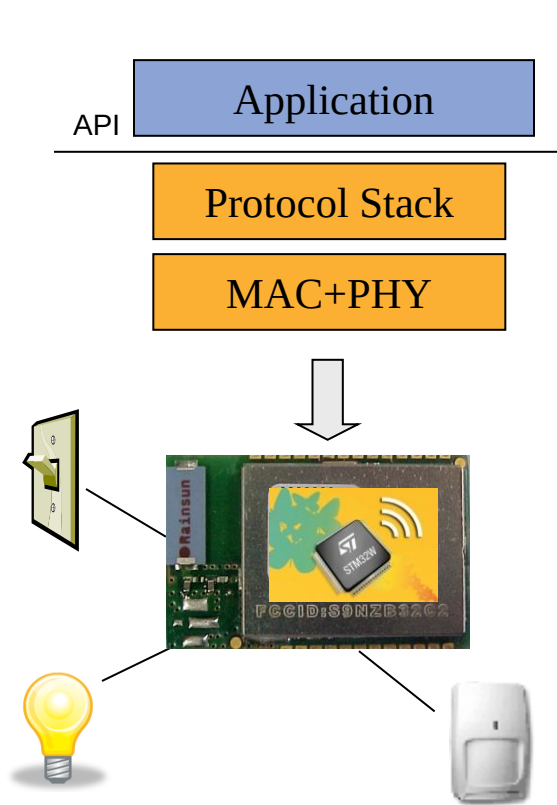
Table 8. FCC approvals

ITEM	Part No.	Manufacturer
1	2010B4844-01 (Titanis Antenna)	Antenova

Integration Modes

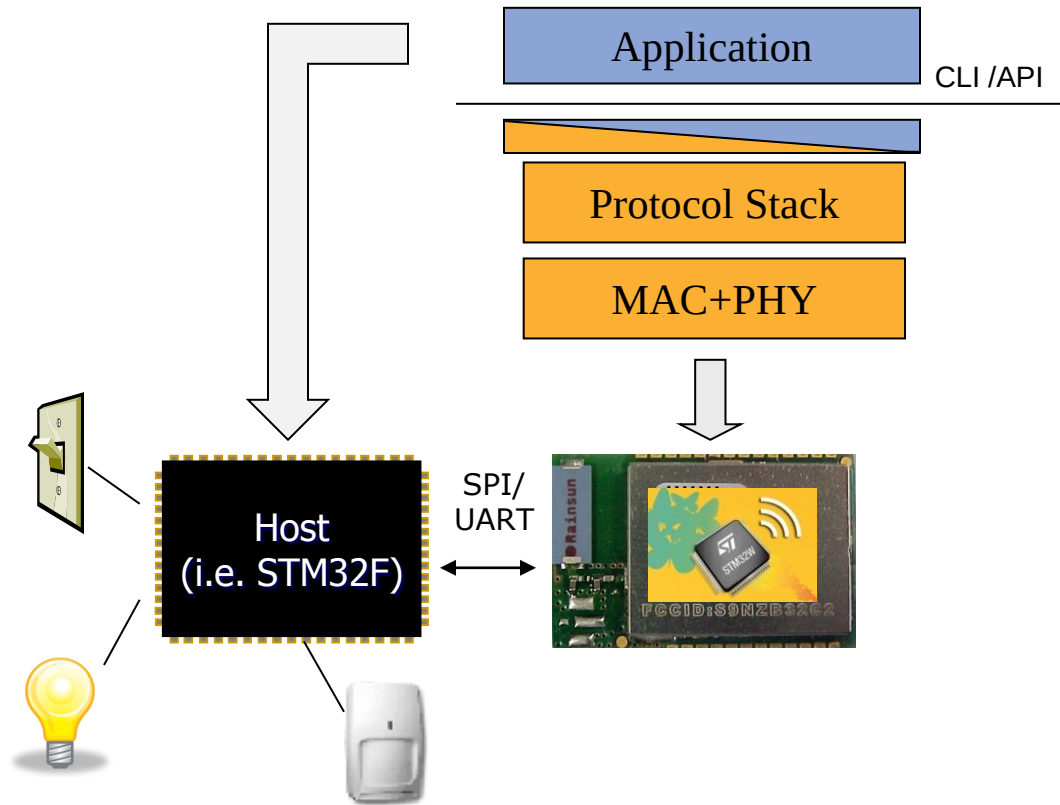
SOC Use Mode:

STM32W runs both the protocol and the application both stored in the integrated Flash



Network Coprocessor Use Mode:

STM32W runs the protocol while an host processor runs and store the application



SPZB32W Series Options

Part Number Schema

Product Family

802.15.4/ZigBee
RF Modules

Memory Options (integrated micro)

32Wx → 32W1: 8/128 kB STM32W108CBU6

32Wx → 32W2: 16/256 kB STM32W108CCU7

Antenna Options

y→A: Integrated Antenna

y→C: Integrated UFL Connector

Power Transmission Options

z→1: Long Range (Integrated PA) (up to +20 dBm/100 mW)

z→2: Normal Range (+3 dBm /2 mW typical)

Stack Options

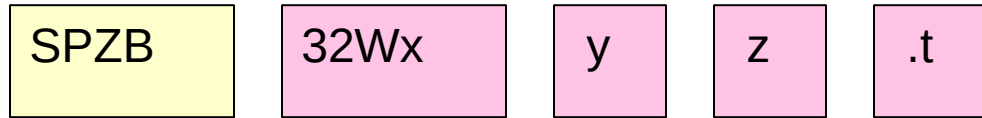
Blank: Open (only for evaluation boards)

t→1: ZigBee PRO (EmberZNet) *_{NRD}

t→3: RF4CE

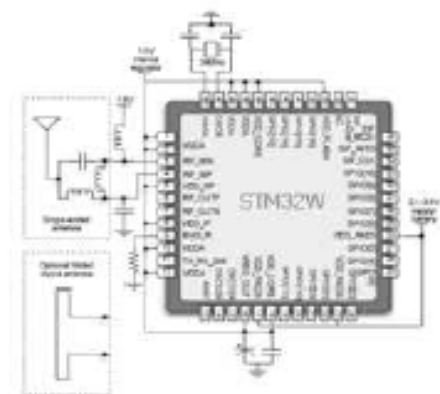
t→4: SimpleMAC

t→ 5: ZigBee IP

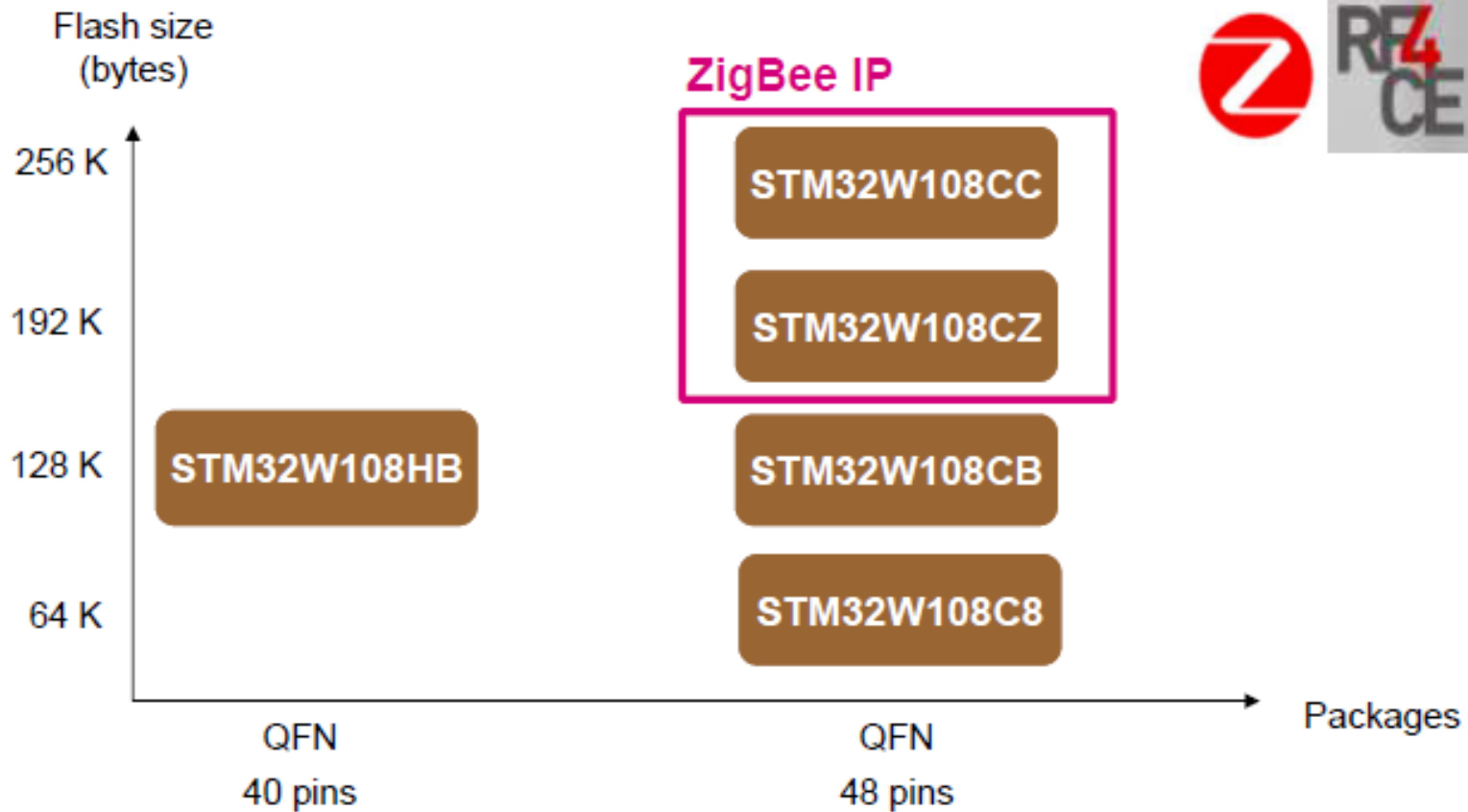


STM32W – IEEE 802.15.4 system on chip

- **Microcontroller**
 - ARM Cortex-M3 core architecture
 - Embedded memory
 - eFlash: from 64 to 256 Kbytes
 - SRAM: from 8 to 16 Kbytes
- **IEEE 802.15.4 2.4 GHz radio**
 - Transmitter: 2-point direct synthesizer modulation
 - Receiver: low IF super heterodyne architecture
 - Digital baseband DSP and MAC support
 - -100 dBm sensitivity and up to 7 dBm output power
- **Networking**
 - ZigBee compliant IP and RF4CE stacks
 - IEEE 802.15.4 optimized MAC library
- **Peripherals**
 - AES-128 encryption HW accelerator
 - Debug channel via JTAG
 - USART, SPI, I²C, 24 GPIOs
- **Other**
 - QFN48 and QFN40 packages available



STM32W – PORTFOLIO



STM32W development tools



- **STM32WC-SK** : evaluation kit
 - 2 x MB851
 - 1 x MB951 (USB stick)



- **STM32WC-KEXT** : extension kit
 - 2 x MB851
 - 2 x MB954 (with external PA)

C: With 256kbytes version used

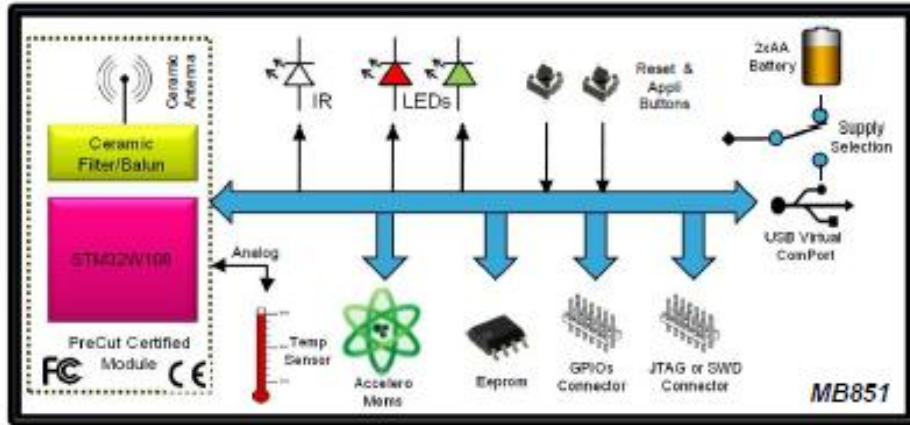
STM32W RF Control kit

- Entry-level RF evaluation and development tool
- Low cost
- Plug-and-play RF control
- Fully compatible with STM32W standard tools series
- STM32WC-RFCKIT (C: 256kbytes version used)



STM32W – Reference Design

2.4GHz Wireless SmartGrid Connectivity



Features / Benefits

- Development board including STM32W programming through USB and JTAG. The later brings full debugging during customer design phase
- Versatile implementation allows to easily experiment various applications types by enabling: Analog or digital Sensor/Mems but also IR communication, LEDs or switches control
- Pre-cut module with ceramic balun and antenna. CE and FCC certified significantly reduce customer RF development efforts.

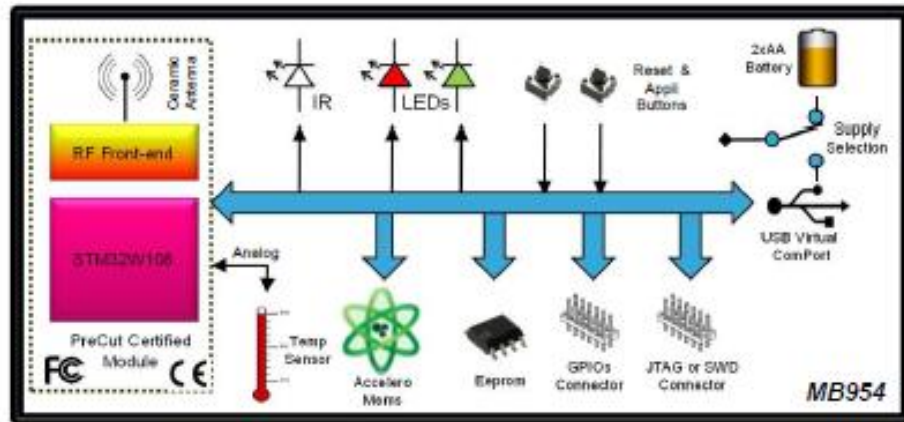
Type	Reference
 PCB	MB851
 KIT	STM32W108C-SK STM32W108C-KEXT
 AN  Software	www.st.com/internet/evalboard/product/247094.jsp

Applications

- Building & Home Automation, Smart Meter, Appliances, Security and Monitoring

STM32W – Reference Design

2.4GHz Extended Range Wireless Connectivity



Features / Benefits (Add-on to MB851)

- RF Front-end boost up to +20dBm output power capability. RF front-end is inclusive of 2 baluns, a filter and a low noise amplifier.
- >128dBm Link budget.
- Pre-cut module keep same form factor as version w/o Front-end IC
- Pre-cut module with RF Front-end and ceramic antenna. CE and FCC certified significantly reduce customer RF development efforts.

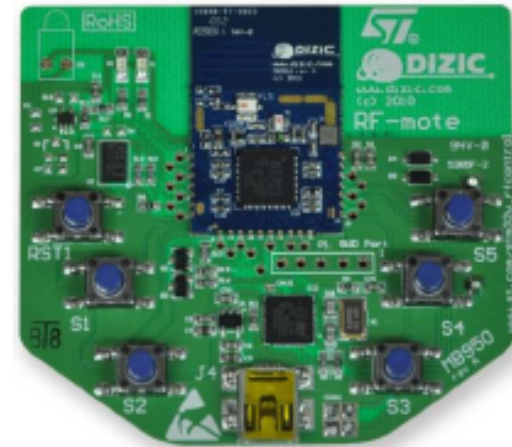
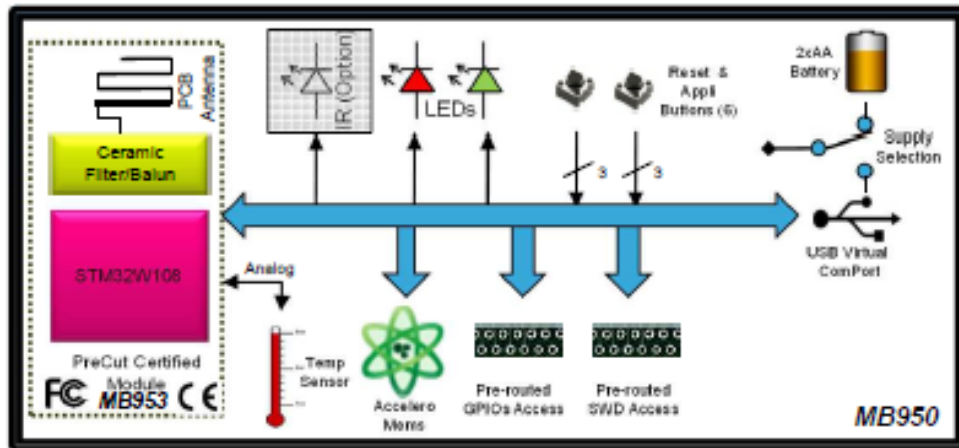
Type	Reference
	MB954
	STM32W108C-KEXT
 	www.st.com/internet/evalboard/product/247100.jsp

Applications

- Building & Home Automation, Smart Meter, Appliances, Security and Monitoring

STM32W – Reference Design

2.4GHz Wireless Consumer Connectivity



Features / Benefits

- Development board including STM32W programming through USB and SWD. The later brings full debugging during customer design phase
- Versatile implementation allows to easily experiment various applications such as RF remote control, pointing device
- Pre-cut low cost module (MB953) with ceramic balun and PCB antenna (2 layers implementation). CE and FCC certified significantly reduce customer RF development efforts.

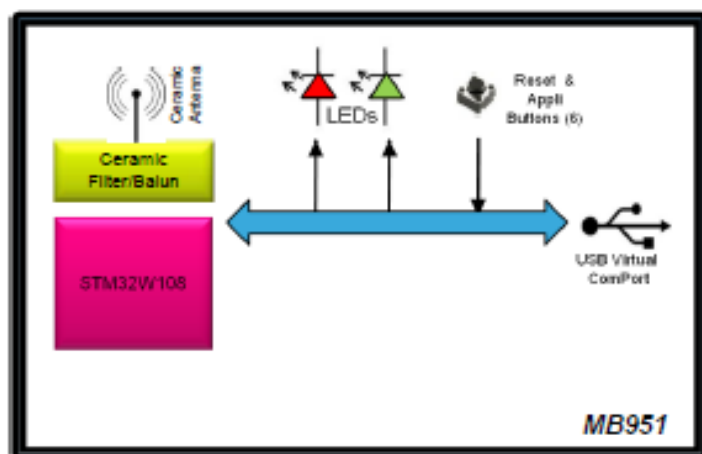
Type	Reference
	MB950 (with embedded MB953)
	STM32WC-RFCKIT
 	www.st.com/internet/evalboard/product/251361.jsp

Applications

- Remote control, Set top box, Pointer

STM32W – Reference Design

2.4GHz Wireless USB Dongle



Features / Benefits

- 2.4GHz to USB converter dongle.
- “No brainer” link to Set top Box, PC or development tools.
- RF network sniffer
- Versatile implementation enables “pairing” process for RF4CE based system using on-board micro-switch.
- Re-programming through USB capable

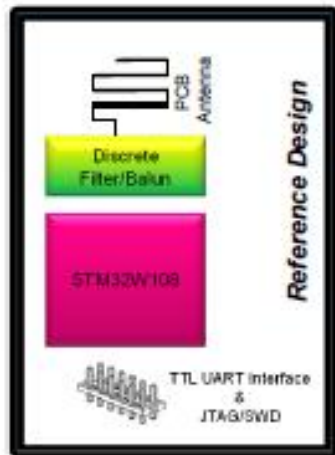
Type	Reference
	MB951
	STM32WC-RFCKIT STM32W108C-SK
 	www.st.com/internet/evalboard/product/251361.jsp

Applications

- Remote control, Set top Box, RF sniffer

STM32W – Reference Design

2.4GHz Wireless ultimate low cost implementation



Features / Benefits

- Ultra low cost STM32W reference design
 - Single layer PCB implementation
 - PCB antenna
 - Discret balun and filter
- Programming and debugging through JTAG.
- Small form factor compatible with target applications
- Excellent RF performances

Type	Reference
	Schematic and Gerber files

Applications

- Remote control, toys, gaming, security sensors

STM32W An open 802.15.4 Platform



Integrated 2.4 GHz radio MCU enables efficient and low-cost wireless network implementation



STM32W is a ZigBee IP SEP 2.0 platform

STM32W is a ZigBee RF4CE certified platform

STM32W is an IEEE 802.15.4 certified platform



ST32L1W 2.4GHz triple Front end Radio

Zigbee IP / Bluetooth Low Energy / ANT



STM32 L1W series

Wide range of application

Consumer



Digital cameras



Gaming



Bar-code scanners



Tablet PC

Healthcare and fitness



Health care



Medical devices, ECG and sports/fitness equipment

Industrial



Water meters



Fire & Motion Sensors



Home automation



Security Sensors



Electricity meters



Cortex

Low-Power Leadership from ARM

STM32L1 + Wireless

- An ultra-low-power Quad protocol radio



Feature	STM32L1x 256kB	Radio	STM32L1W
ID card	Cortex-M3 @ 32MHz 256kB Flash / 32kB RAM / 8kB EE RTC2V2, USB, ADC LCD, DAC, AES, Op-amp, Comp, timers (16-bit), USART, SPI, I2C, Touch Sensing ...	2.4 GHz Radio ZigBee IP / RF4CE BT LowEnergy ANT/ANT+	Cortex-M3 + 2.4GHz Radio 256kB Flash / 32kB RAM / 8kB EE RTC2V2, USB, ADC LCD, DAC, AES, Touch Sensing ... Flash and EEPROM write and read protection available. Zigbee, BLE, RF4CE, ANT
Package	UQFN48 LQFP48/64/100 BGA100	No stand alone version	BGA 132/80/44 pins 7x7mm 0.6 thickness (BGA80/44 to emulate QFN)

STM32 L1W block diagram

Wireless (2.4 GHz)



RF package

- BGA 7x7mm in
 - 132 pins
 - 80 pins
 - 44 pins



STM32 L1W - Fact sheet

Radio 2.4 GHz (BLE – ZigBee – ANT – RF4CE)

- **ARM 32-bit Cortex-M3 core**
 - 32 MHz CPU frequency
 - 256 Kbytes Flash / 8 Kbytes data EEPROM
 - 32 Kbyte SRAM
- **1.65 to 3.6 V supply**
- **Communication peripherals**
 - Up to 3x USART, 3x SPI, 2x I²C
 - **I2C fast mode**
 - **SPI (16Mbit/s)** with 8 to 16 bits programmable bit frame,
 - **USART (4 Mbits/s)** supporting LIN master, IrDa and modem control support
 - USB FS 2.0
 - **EnergyLite Radio 2.4GHz**
 - Integrated Balun
 - 802.15.4 (ZigBee/RF4CE)
 - Bluetooth Low-Energy
 - ANT, ANT+
- **Up to 9x timers**
 - 3x 16-bit timer with 4 IC/OC/PWM
 - 1x 16-bit timer with 2 IC/OC/PWM
 - 2x 16-bit timer with 1 IC/OC/PWM
 - 2x 16-bit basic timers
 - 1x 32-bit timer each with 4 IC/OC/PWM
- **Encryption**
 - AES 128-bit
- **Display**
 - LCD 8x40/4x44 segments
- **RTC with H/W calendar and alarm functions**
- **I/O ports**
 - 16-bit Fast I/O ports
 - Charge transfer support with CT lib capacitive sensing software
- **Analog features**
 - 1x 12-bit ADC 1 MSPS/24 channels with analog supply from 1.8 to 3.6V.
 - 2x 12-bit DAC
 - 2x Analog comparators
 - 2xOpamp
- **Debug mode**
 - Serial wire debug (SWD) and JTAG interfaces
- **Power consumption (TYP)**
 - RUN: 270 μ A/MHz (Flash) and 220 μ A/MHz (Ram)
 - STOP: 0.6 μ A w/o RTC and 1.7 μ A w/ RTC
 - 6 x Ultra-low power modes

STM32L1W Current Consumption

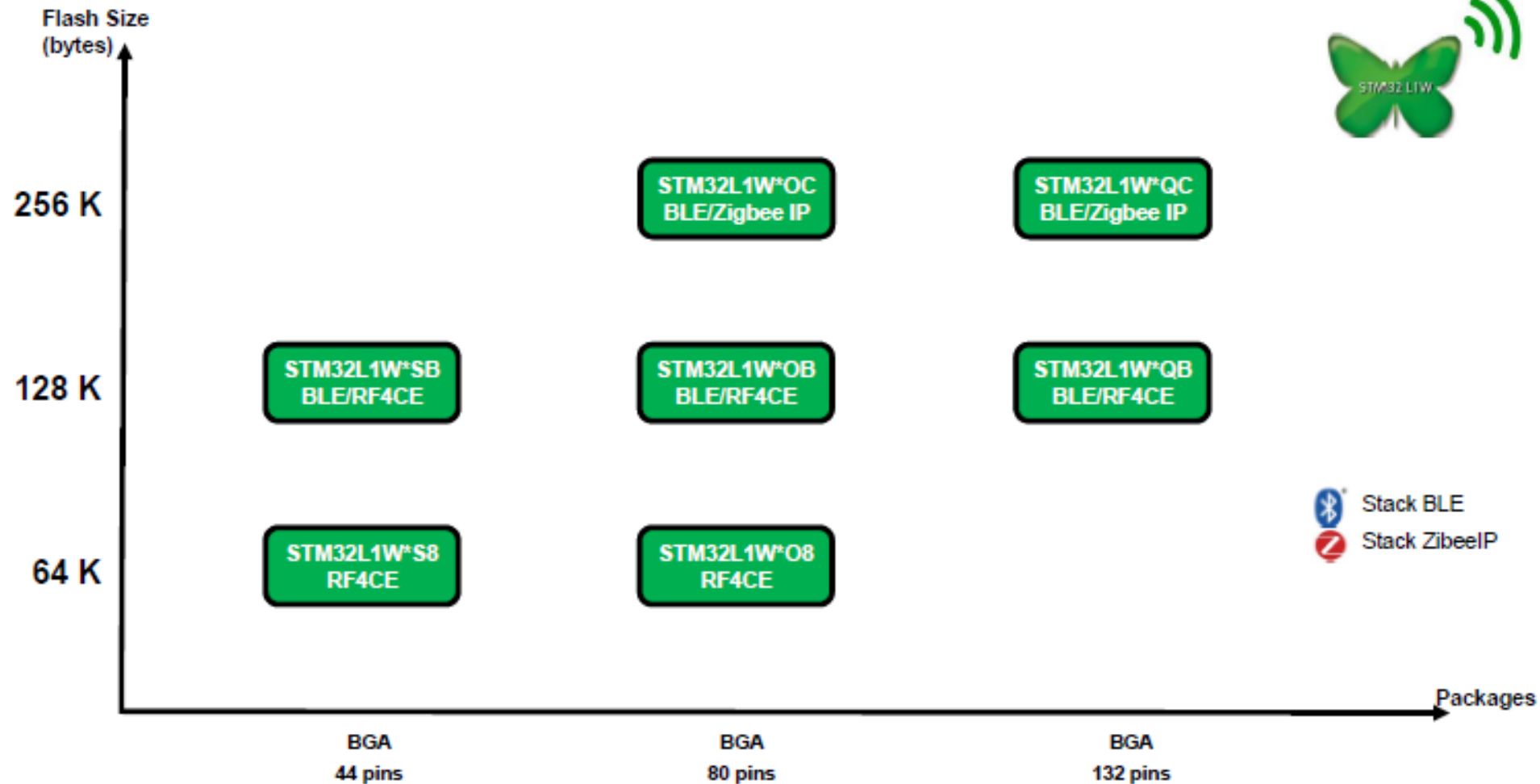
- Current Consumption @ 3.0 V

Parameter	Typ. Value	Unit
Power save mode 4 (no RAM retention, external wake-up)	0.4	μA
Power save mode 3 (RAM retention, external wake-up)	0.6	μA
Power save mode 2 (RAM retention, Radio timer running)	1.3	μA
Power save mode 1 (RAM retention, Radio timer and RTC running)	1.8	μA
TX @0dBm	6	mA
RX	4	mA

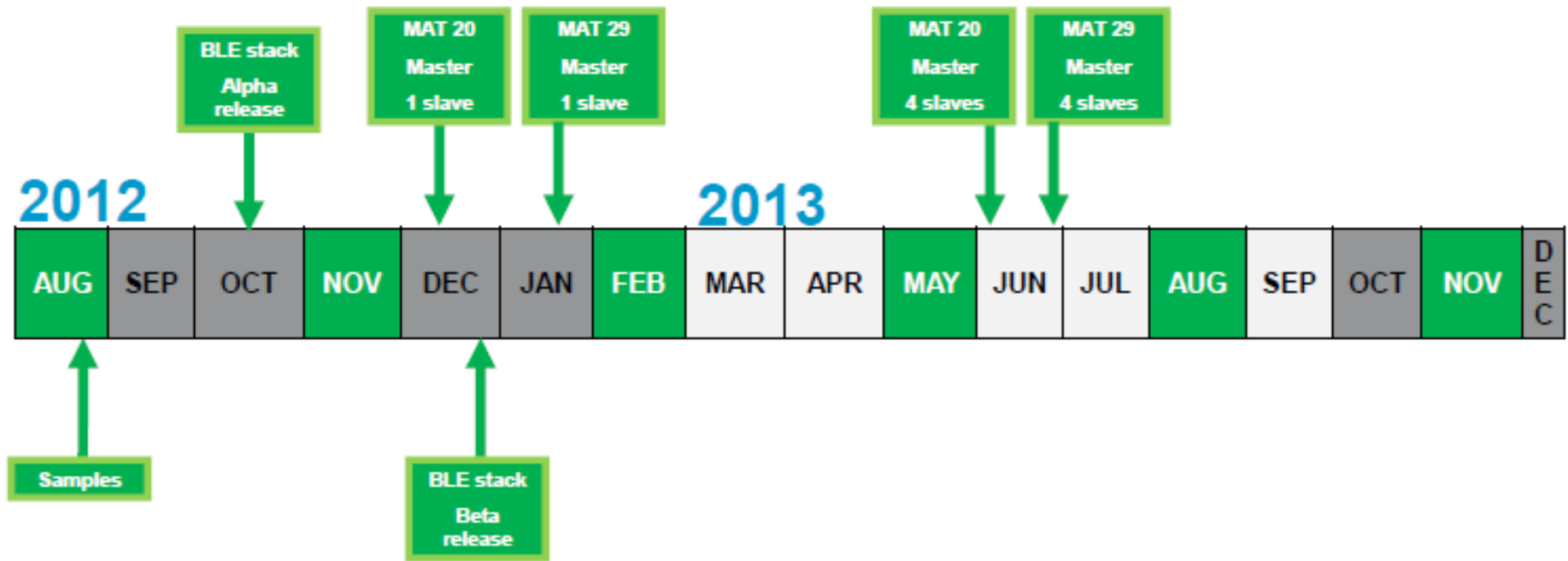
STM32L1W Stack size

Stack	Size (bytes)
BLE (Master and slave)	61k Flash 15k RAM
BLE (Slave only)	57k Flash 15k RAM
BLE (Master only)	58k Flash 15k RAM
ZigBee IP with SEP 2.0	125k Flash 10k RAM
RF4CE	18k-24k Flash 2.5k RAM
ANT/ANT+ (Master and slave)	20k Flash 2k RAM

STM32L1W – ZigBee IP/ BLE / RF4CE Portfolio



STM32 L1W series schedule



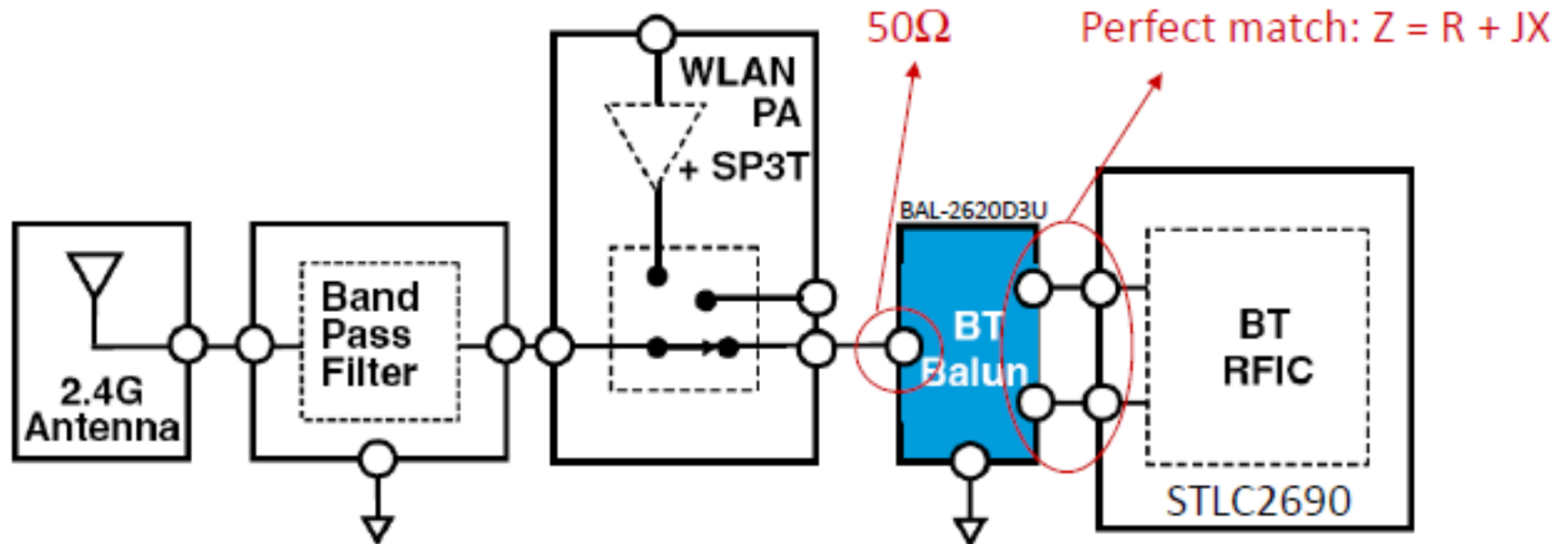
STM32 L1W – Cortex-M3 @ 32 MHz
BLE/Zigbee/ANT/RF4CE



BALF-xxx

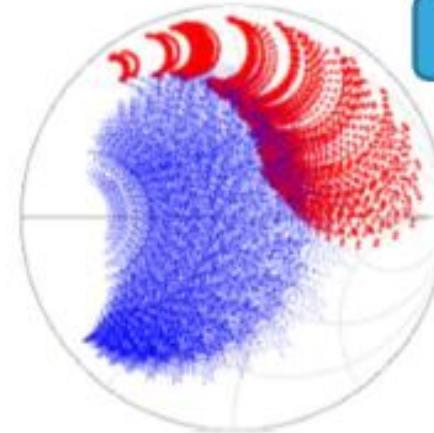
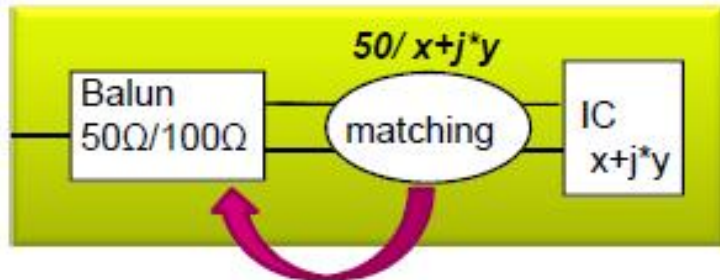
Balun and filters

Balun example



- ▶ BAL-2690D3U has been designed to **fit with FM/BT combo STLC2690 output impedance**
- ▶ It is **used when both WLAN and BT are coexisting**

Balun with integrated matching

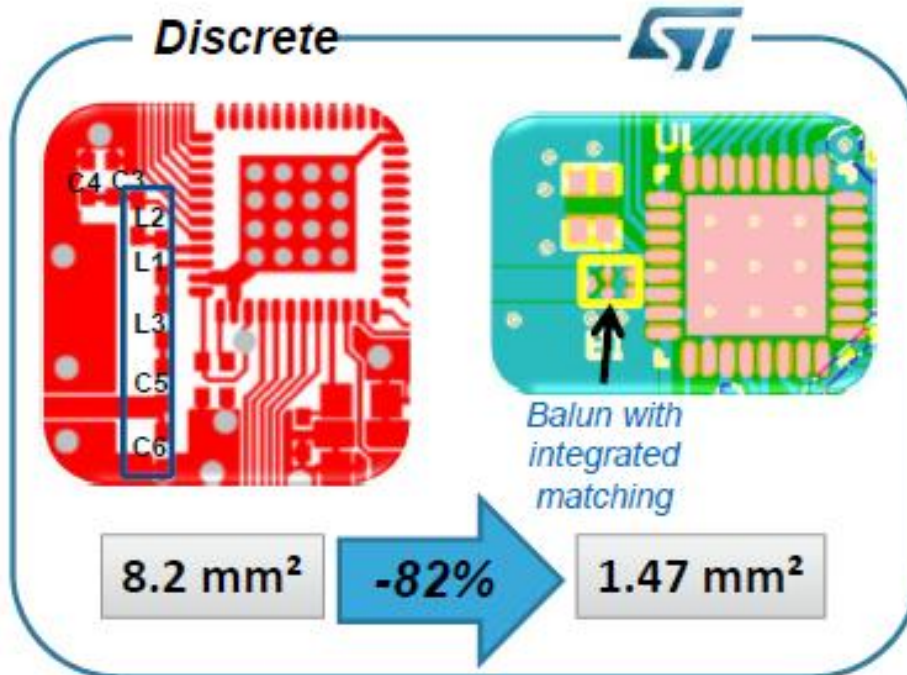


Perfect Match

Continuous Impedance Matching



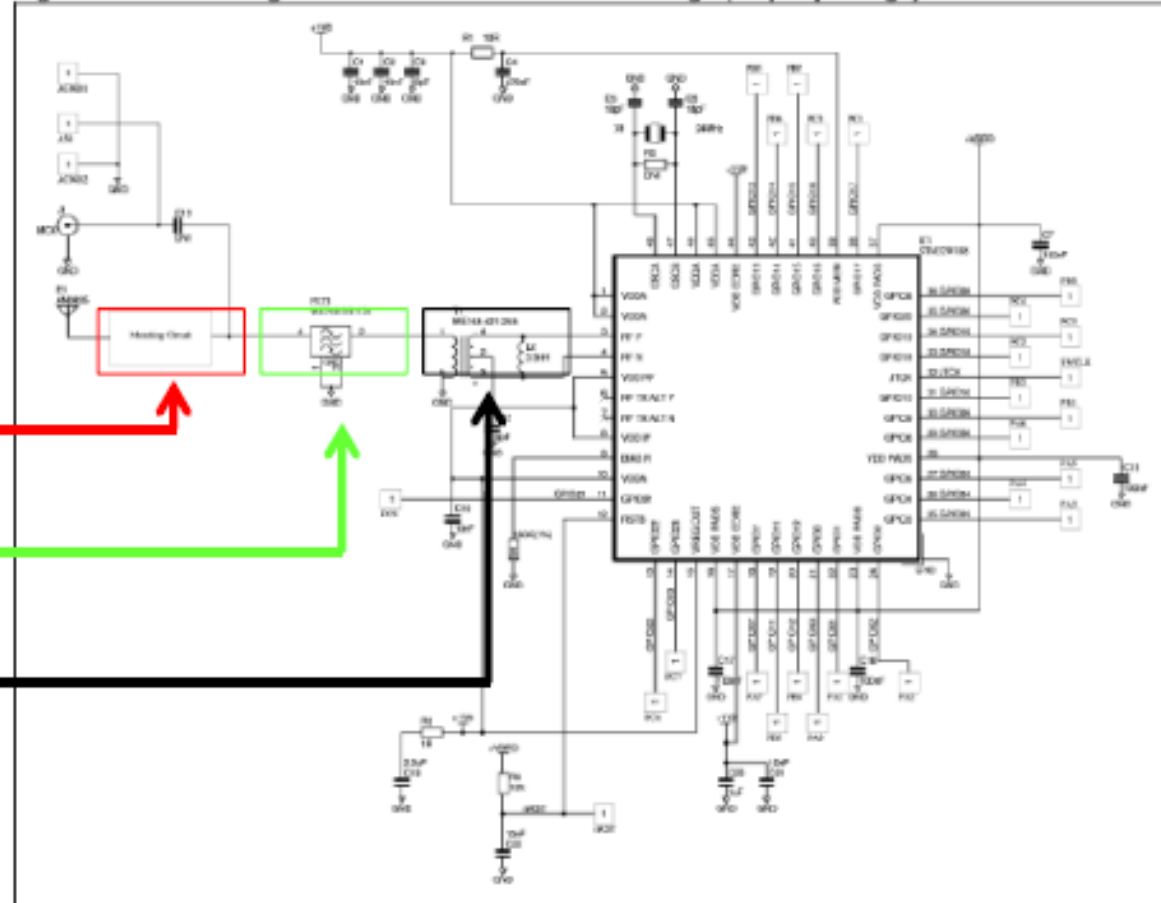
ST Balun
= zero SMD components



STM32W108 Antenna Connection

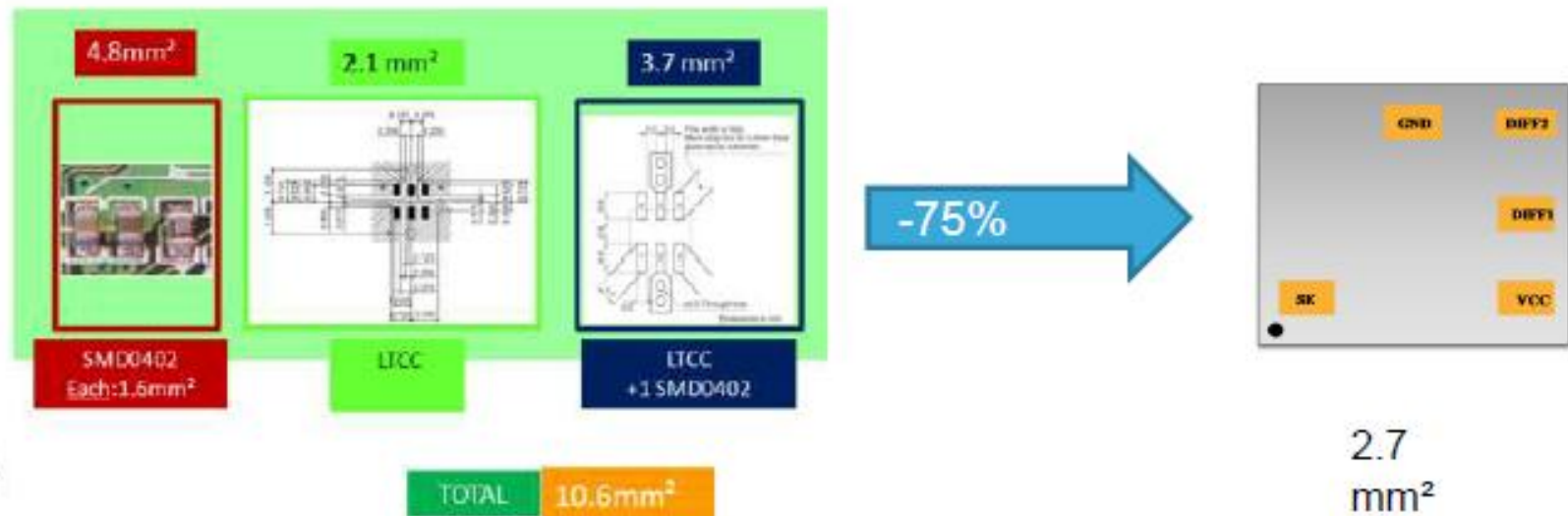
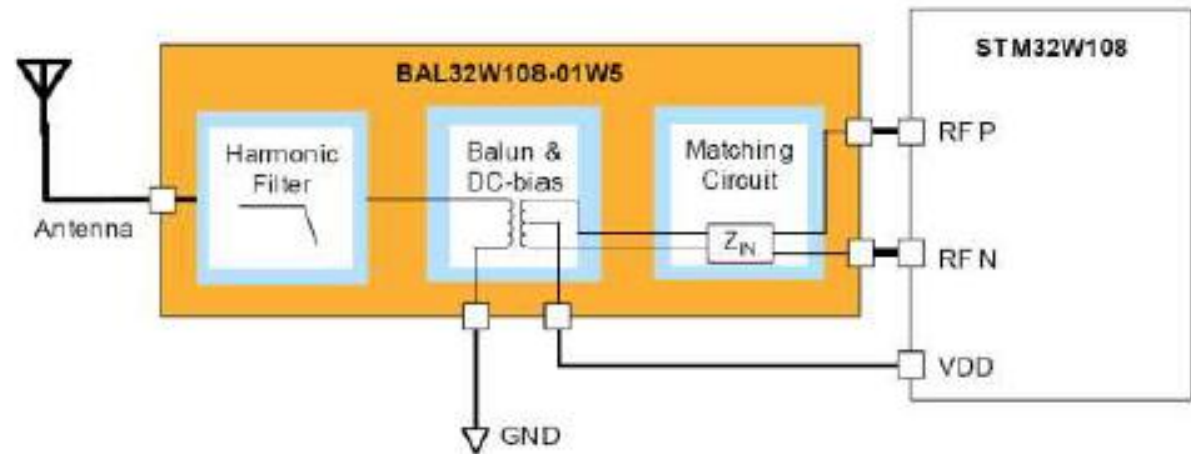
Figure 1. Block diagram of STM32W108 reference design (48-pin package)

- Antenna Matching
- Harmonic Filter
- Balun + STM32W Matching

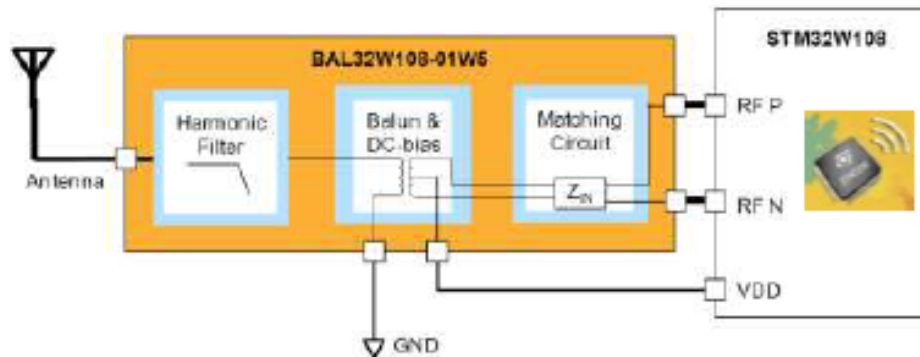


ANTENNA CONNECTION FUNCTIONS ARE REQUIRED BY STM32W

ST RF IPD FOR STM32W108



BAL32W108-01E3: one-slide benefits



• FEATURES (target data)

Direct connection to STM32W
1 device integrating 6 discretes

Insertion Loss < 3.1dB max

Coated Glass Die
(Ceramic-like soldering)

PCB footprint area: 2.7 mm²

• BENEFITS

EASIER DESIGN: faster time to market
LOWER BOM: less assembly cost

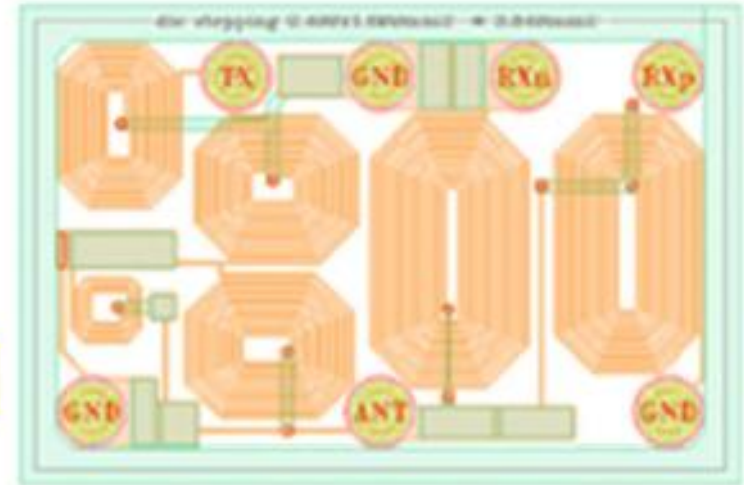
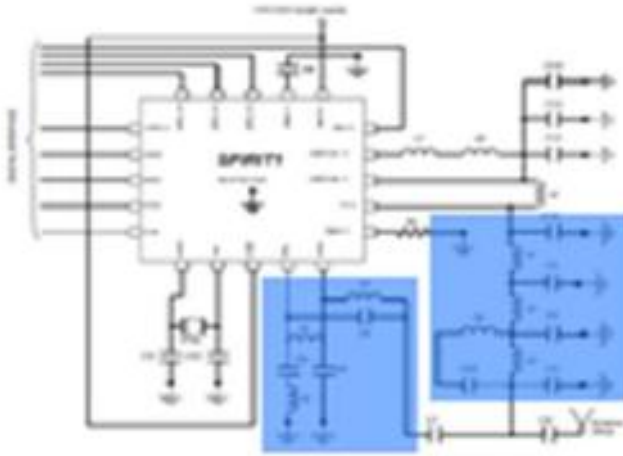
HIGHER Rx SENSITIVITY:
lower power consumption

HIGHER RELIABILITY
5 solder joints vs 20 in discrete

LOWER PCB AREA
- 75% vs discrete

BALF-SPI868-01D3

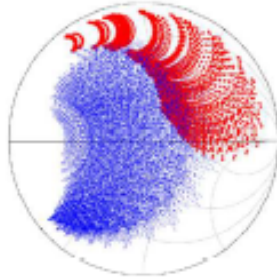
SPIRIT1 companion chip



Design : September 2012
Demo board : March 2013
MAT 30: March 2013

Balun + Filter into 1 die

- ST IPD **technology on glass** : already in use by main RF players
- Cover all ETSI, FCC & ARIB recommendation : **868 to 920MHz** frequency range
- 3mm² : Reduce **size** (up to 70% vs discrete solution) and **cost** (-60% from BOM + PCB)
- Dedicated companion chip : No validation needed at customer for **faster design** time.
 - Will be validated in SPIRIT1 evaluation board
- No components dispersion or temperature dispersion : **function is guaranteed**
- Integrated solution : Higher **reliability**, better **performances** (IL) thanks to no parasitic elements, greatly **reduce PCB sensibility**



Standalone Matched Balun

Production

Sampling

Development

Investigation

169-915MHz



BALF-SPIxxxE3



2.45GHz



BAL-2690D3



TEXAS INSTRUMENTS

BAL-C2531-01D3



BAL-NRF01-D3



TEXAS INSTRUMENTS

BAL-C2540-01D3



BALF-2690-01D3



BAL-32W108-01E3

2,1GHz

2,1GHz

Transfer Jet

4.48GHz

SONY

BAL-4480-01D3

*No limitation on frequency range and impedance
Can work with all ICs makers*

For more info contact:
enrico.marinoni@silica.com FAE
roberto.rossetti@silica.com BDM