

## **RS-SAM3S-220X Datasheet**

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## Overview

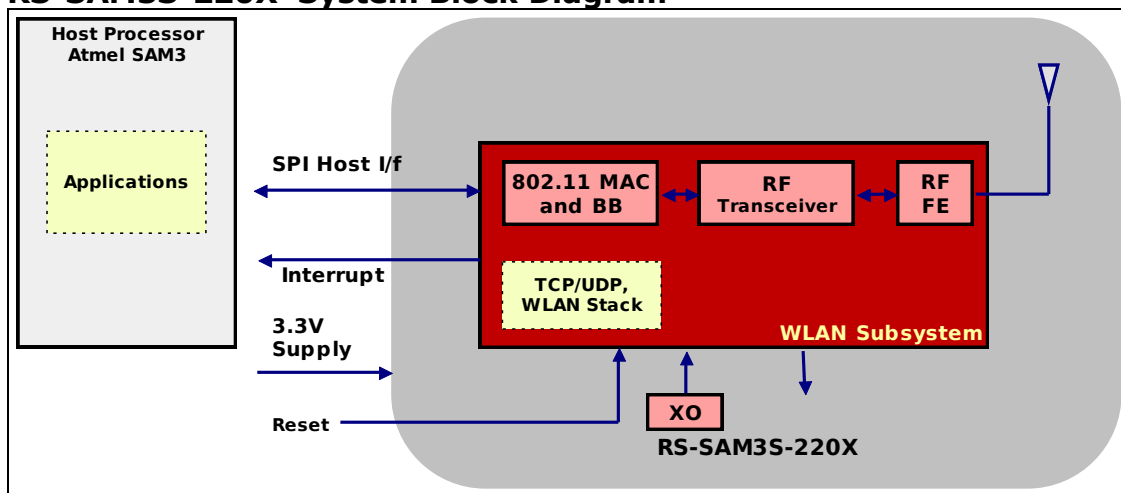
### Overview

The RS-SAM3S-220x is a IEEE 802.11bgn Wi-Fi add-on card that can be interfaced with Atmel's SAM3S-EK Evaluation Kit. It integrates a MAC, baseband processor, RF transceiver with power amplifier, a frequency reference, and an antenna in hardware; and all WLAN protocol and configuration functionality, networking stack in embedded firmware to make a fully self-contained 802.11n WLAN connectivity solution for a variety of applications.

### Device Features:

- Compliant to 802.11b/g and single stream 802.11n
- Fully self-contained serial-to-wireless functionality
- Supports WPA2-PSK, WEP (64 and 128 bit) and TKIP security in infrastructure mode
- Supports WEP (64 and 128 bit) security in ad-hoc mode
- Terminates TCP and UDP connections
- Configuration through SPI
- Integrated antenna, frequency reference.
- Ultra-low-power operation with power-save modes
- Ad-hoc and infrastructure modes for maximum deployment flexibility
- Single supply – 3.1 to 3.6V operation

## RS-SAM3S-220X System Block Diagram



## Table of Contents

<b>1</b>	<b>Detailed Feature List.....</b>	<b>6</b>
1.1	Host Interface .....	6
1.2	WLAN .....	6
1.3	Networking Protocols .....	6
1.4	Configuration.....	6
1.5	Software.....	7
<b>2</b>	<b>Package Description .....</b>	<b>8</b>
2.1	Top View .....	8
<b>3</b>	<b>SPI Interface Pin Description .....</b>	<b>9</b>
3.1	Pin Description .....	10
<b>4</b>	<b>Electrical Characteristics .....</b>	<b>11</b>
4.1	Recommended Operating Conditions .....	11
4.2	DC Characteristics – Digital I/O Signals .....	11
4.3	AC Characteristics – Digital I/O Signals.....	11
4.3.1	SPI Interface.....	11
<b>5</b>	<b>Performance Specifications .....</b>	<b>13</b>
5.1	Wireless Specifications .....	13
5.2	Receive Sensitivity.....	13
<b>6</b>	<b>Software Architecture Overview .....</b>	<b>14</b>
6.1	Host .....	15
6.1.1	Host SPI Interface .....	15
6.1.2	Host SPI Driver .....	15
6.1.3	RS-SAM3S-220X SPI Interface .....	15
6.1.4	Host Abstraction Layer (HAL) .....	15
6.1.5	Wireless Control Block (WCB).....	15
6.1.6	Wi-Fi Control Frames .....	15
6.1.7	TCP/IP Control Frames .....	15
6.1.8	Station Management Entity (SME) .....	15
6.1.9	WPA Supplicant.....	16
<b>7</b>	<b>Creating Custom Hardware Designs.....</b>	<b>17</b>
<b>8</b>	<b>Ordering Information .....</b>	<b>18</b>
8.1	Contact Information .....	18
8.2	Resources included with RS-SAM3S-220X.....	18

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## **Table of Figures**

<b>Figure 1:Top View of the Module .....</b>	<b>8</b>
<b>Figure 2: Pinout of the SPI Connector .....</b>	<b>9</b>
<b>Figure 3:Interface Timings – SPI Interface .....</b>	<b>12</b>
<b>Figure 4: Software Architecture Block Diagram.....</b>	<b>14</b>

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## **List of Tables**

<b>Table 1: Pin Description .....</b>	<b>10</b>
<b>Table 2: Recommended Operating Conditions .....</b>	<b>11</b>
<b>Table 3: Input/Output DC Characteristics .....</b>	<b>11</b>
<b>Table 4: AC Characteristics – SPI Interface.....</b>	<b>11</b>
<b>Table 5: Wireless Specifications .....</b>	<b>13</b>
<b>Table 6: Receive Characteristics – Sensitivity .....</b>	<b>13</b>

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## **1 Detailed Feature List**

### **1.1 Host Interface**

- Standard 4-wire SPI
- Operation up to a maximum clock speed of 25MHz<sup>1</sup>

### **1.2 WLAN**

#### MAC

- Conforms to IEEE 802.11b/g/n standards
- Dynamic selection of fragment threshold, data rate, and antenna depending on the channel statistics
- Hardware accelerated implementation of WEP 64/128-bit and AES
- Infrastructure and Ad-hoc modes
- Security - WPA2-PSK, WEP, WPA-TKIP

#### Baseband Processing

- Supports DSSS (1, 2 Mbps) and CCK (5.5, 11 Mbps) modes
- Supports all OFDM data rates (6, 9, 12, 18, 24, 36, 48, and 54 Mbps)
- Supports IEEE 802.11n single-stream modes with data rates up to 65 Mbps
- Supports long, short, and HT preamble modes
- High-performance multipath compensation in OFDM, DSSS, and CCK modes

#### RF

- Highly integrated 2.4 GHz transceiver and Power Amplifier with direct conversion architecture
- Integrated frequency reference and antenna

### **1.3 Networking Protocols**

- TCP
- UDP
- ARP
- ICMP
- DHCP Client

### **1.4 Configuration**

The RS-SAM3S-220X module can be configured by the Host using the SPI interface. The following are some of the commands that can be given to the

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<sup>1</sup> This frequency depends on the external delays also.

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module. A detailed description is available in the software and documentation package downloadable from [www.redpinesignals.com/Atmel/rs-sam3s.html](http://www.redpinesignals.com/Atmel/rs-sam3s.html)

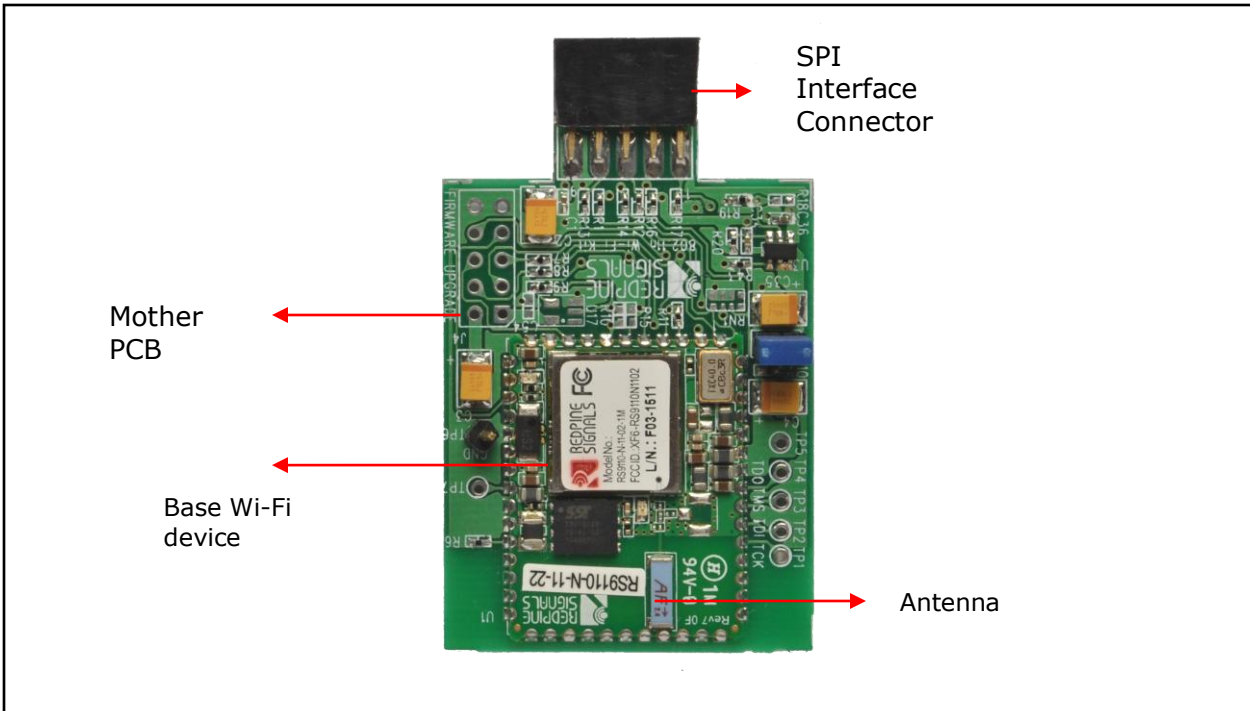
- Scan
- Connect
- Pre-shared Keys
- SSID of hidden WLAN networks
- DHCP Enable/Disable
- Create/Join an IBSS (ad-hoc) network
- Open/Close sockets for TCP, UDP

## **1.5 Software**

- Sample Host driver for SPI interface
- Device configuration and management GUI for Windows XP
- Embedded firmware for complete WLAN functionality including 802.11n aggregation and Block-ACK, auto rate adaptation, security and also complete network stack and applications including TCP, UDP, ARP, ICMP, DHCP client.

## 2 Package Description

### 2.1 Top View

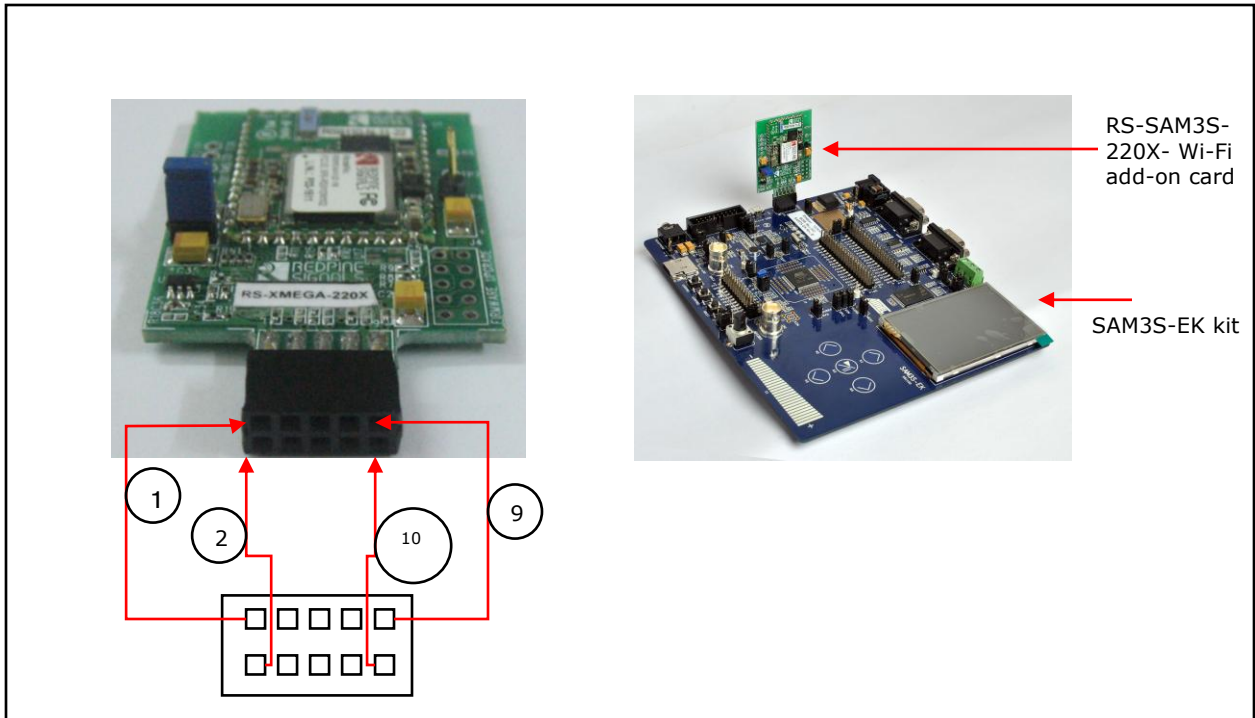


**Figure 1:Top View of the Module**

Note: The base Wi-Fi device is a Redpine Signals 802.11n module (RS9110-N-11-22-01, [http://redpinesignals.com/Products/Modules/Connect-io-n/Wireless\\_Device\\_Server/RS9110-N-11-22.html](http://redpinesignals.com/Products/Modules/Connect-io-n/Wireless_Device_Server/RS9110-N-11-22.html) ) that is put on the mother PCB above to create the Wi-Fi add-on card.



### 3 SPI Interface Pin Description



**Figure 2: Pinout of the SPI Connector**

Note: For detailed description of the SAM3S-EK platform, please check [http://www.atmel.com/dyn/products/tools\\_card.asp?tool\\_id=4678](http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4678)

### 3.1 Pin Description

Pin No.	Pin Name	Direction	Description
1	RESET_n	Input	Active Low reset input driving the reset of the Wi-Fi module
2	POWER_EN	Input	Driven from the SAM3S-EK, enables power to the Wi-Fi add-on card.
3	SPI_INTR	Output	Interrupt generated by the module
4	Reserved	Output	No connect
5	SPI_CS	Input	Active low SPI Slave select signal
6	SPI_MOSI	Input	SPI data input
7	SPI_MISO	Output	SPI data output
8	SPI_CLK	Input	SPI clock input
9	GND	Input	Should be connected to Ground
10	VCC	Input	Should be connected to 3.3V Supply

**Table 1: Pin Description**

## 4 Electrical Characteristics

### 4.1 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Supply voltage	V <sub>IN</sub>	3.1	3.3	3.6	V
Ambient temperature	T <sub>a</sub>	-40	25	85	°C

**Table 2: Recommended Operating Conditions**

### 4.2 DC Characteristics – Digital I/O Signals

Parameter	Min.	Typ.	Max.	Units
Input high voltage	2	-	3.6	V
Input low voltage	-0.3	-	0.8	V
Output low voltage	-	-	0.4	V
Output high voltage	3.0	-	-	V
Input leakage current (at 3.3V or 0V)	-	-	±10	μA
Tristate output leakage current (at 3.3V or 0V)	-	-	±10	μA

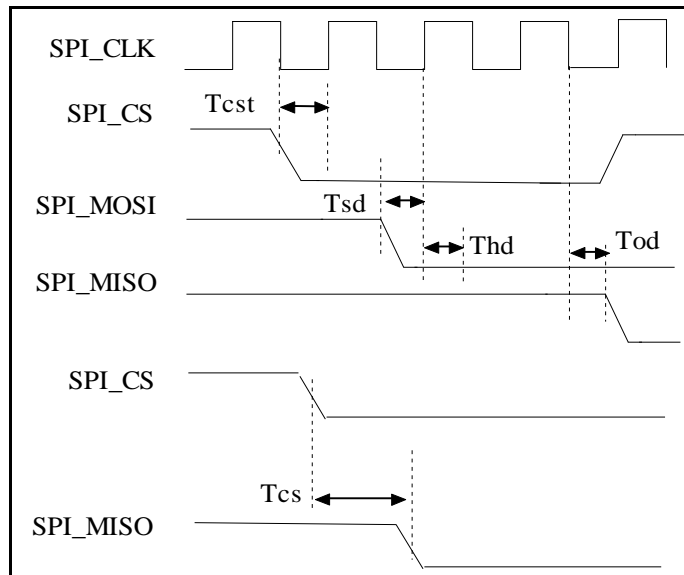
**Table 3: Input/Output DC Characteristics**

### 4.3 AC Characteristics – Digital I/O Signals

#### 4.3.1 SPI Interface

Parameter	Symbol	Min.	Typ.	Max.	Units
SPI_CLK Frequency	F <sub>spi</sub>	0		25	MHz
SPI_CS to output valid	T <sub>cs</sub>	3.5	-	7.5	ns
SPI_CS setup time	T <sub>cst</sub>	2	-		ns
SPI_MOSI setup time	T <sub>sd</sub>	1	-		ns
SPI_MOSI hold time	T <sub>hd</sub>	1.5	-		ns
SPI_MISO clock to output valid	T <sub>od</sub>	4	-	9.25	ns

**Table 4: AC Characteristics – SPI Interface**



**Figure 3: Interface Timings – SPI Interface**

## 5 Performance Specifications

### 5.1 Wireless Specifications

Feature	Description
Frequency Band	2.400 – 2.500 GHz (2.4 GHz ISM band)
Modulation	OFDM with BPSK, QPSK, 16-QAM, and 64-QAM 802.11b with CCK and DSSS
Supported Data Rates	802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11b: 1, 2, 5.5, 11 Mbps
802.11n Features	MCS 0-7, STBC, RIFS, Greenfield Protection A-MPDU, A-MSDU Aggregation with Block-ack
Typical Transmit Power (+/- 2 dBm)	17 dBm for 802.11b DSSS 17 dBm for 802.11b CCK 15 dBm for 802.11g/n OFDM

**Table 5: Wireless Specifications**

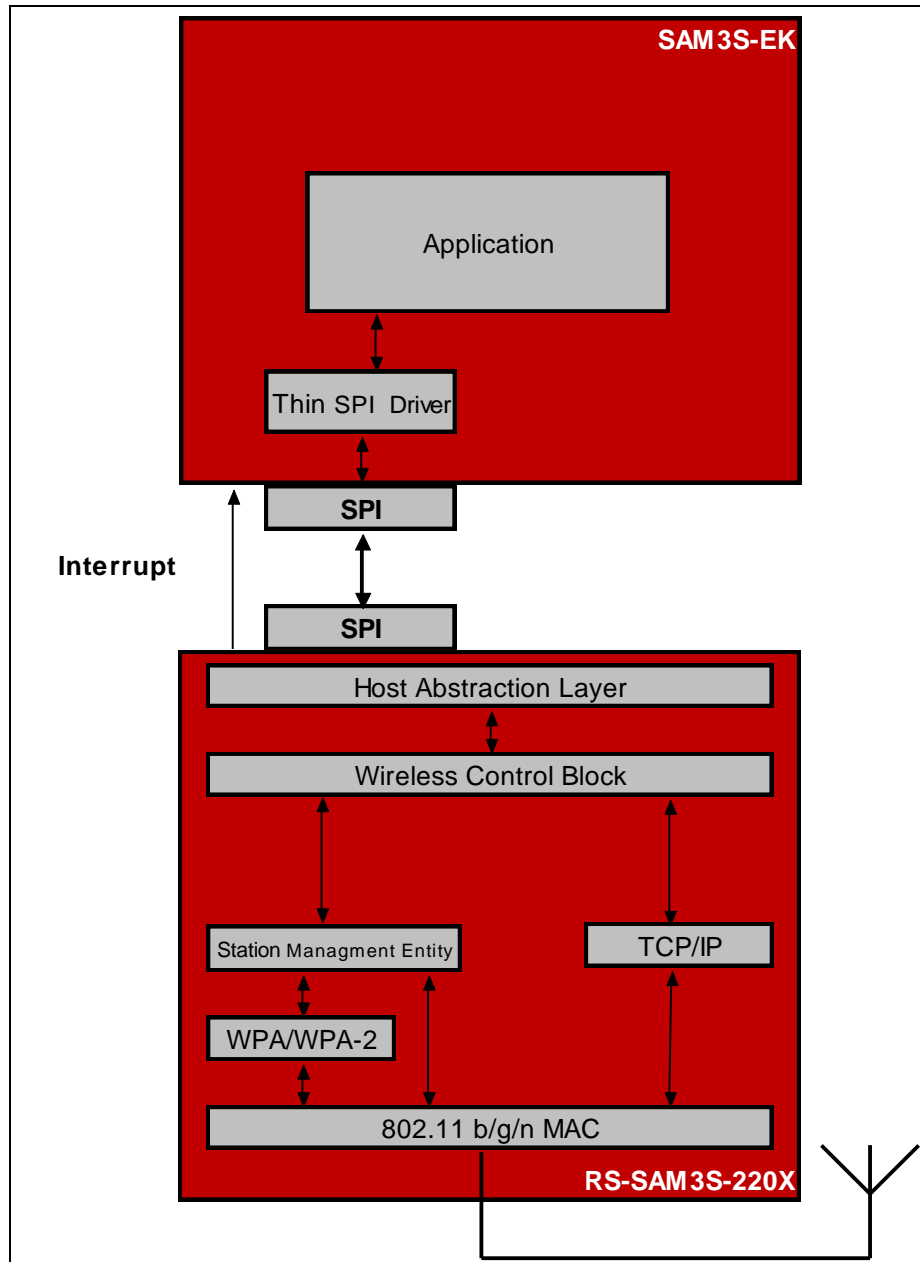
### 5.2 Receive Sensitivity

Data Rate	Typical Sensitivity (+/- 1.5 dBm)	Sweep – PER Floor
1 Mbps	-97.0 dBm	< 0.1%
2 Mbps	-93.0 dBm	< 0.1%
11 Mbps	-88.0 dBm	< 0.1%
6 Mbps	-91.0 dBm	< 0.1%
54 Mbps	-75.0 dBm	< 0.1%
65 Mbps	-71.0 dBm	< 0.1%

**Table 6: Receive Characteristics – Sensitivity**

## 6 Software Architecture Overview

The following figure depicts the software architecture of the RS-SAM3S-220X module.



**Figure 4: Software Architecture Block Diagram**

The Host communicates with RS-SAM3S-220X using the SPI interface. A driver on the Host takes care of the interaction with the Wi-Fi module through the SPI Host interface.

The following sections explain in brief the various components.

## **6.1 Host**

The Host is any system that has applications being executed on it.

### **6.1.1 Host SPI Interface**

The SPI on the Host side provides an interface for the host to access the Wi-Fi module. SPI on the Host acts as the master.

### **6.1.2 Host SPI Driver**

The SPI driver on the Host is a thin driver through which the applications interact with the Wi-Fi module. The SPI driver uses the SPI host controller driver on the Host to send/receive the data to/from the RS-SAM3S-220X module and also to configure the same over the SPI interface.

### **6.1.3 RS-SAM3S-220X SPI Interface**

The SPI on the RS-SAM3S-220X acts the SPI slave. It is a standard 4-wire SPI and can support a maximum frequency of 25MHz.

### **6.1.4 Host Abstraction Layer (HAL)**

The HAL abstracts the lower layers in the host interface with which the RS-SAM3S-220X module is connected. The HAL interacts with the Wireless Control Block layer for the processing of the frames obtained from or destined to the Host.

### **6.1.5 Wireless Control Block (WCB)**

The data from/to the Host is classified as Wi-Fi specific frames and TCP/IP specific frames. The WCB layer processes the frame obtained and acts accordingly. The functionality of the WCB module depends on the type of the frame and the direction of the frame (in case of TCP/IP) as described below.

### **6.1.6 Wi-Fi Control Frames**

The WCB interprets the Wi-Fi control information from the Host and interacts with the SME (Station Management Entity). Configuration of the RS-SAM3S-220X module from the Host for Wi-Fi access is through SPI commands, provided as an API set.

### **6.1.7 TCP/IP Control Frames**

If the frames from the host are interpreted as TCP/IP specific frames then the WCB interacts with the TCP/IP stack.

### **6.1.8 Station Management Entity (SME)**

The SME is the core layer which manages the Wi-Fi connectivity. The SME maintains the state machine to detect the activity on the Wi-Fi network and indicates to the user accordingly. It also performs re-association to the

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configured access point in Infrastructure mode. It interacts with the WPA supplicant if Security is enabled in the Wi-Fi network.

### **6.1.9 WPA Supplicant**

The WPA supplicant is used to initiate the 802.1x/E Access Point authentication if WPA/WPA2-PSK is used as the security parameter. It also plays a major part in performing the 4-way handshake to derive the PTK in WPA/WPA2-PSK modes.



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## 7 Creating Custom Hardware Designs

The base Wi-Fi device shown in the figure [Top View of the Module](#) is a Redpine Signals 802.11n module (Part no. RS9110-N-11-22-01, [http://redpinesignals.com/Products/Modules/Connect-io-n/Wireless\\_Device\\_Server/RS9110-N-11-22.html](http://redpinesignals.com/Products/Modules/Connect-io-n/Wireless_Device_Server/RS9110-N-11-22.html) ). The Wi-Fi module is put on the mother PCB above to create the Wi-Fi add-on card. This module can be added as a Wi-Fi component in any other custom designs using the RS9110-N-11-22-01 module and the Atmel SAM3 Host processor. For guidance on integration of the module on an application board, please visit <http://www.redpinesignals.com/Products/Modules/Connect-io-n/index.html>

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## **8 Ordering Information**

### **8.1 Contact Information**

For additional information, please contact Sales at Redpine Signals, Inc.

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Website: <http://www.redpinesignals.com/atmel>

### **8.2 Resources included with RS-SAM3S-220X**

The following documentation and software are available along with the RS-SAM3S-220X, downloadable from [www.redpinesignals.com/atmel](http://www.redpinesignals.com/atmel) ).

Documentation

- Wi-Fi add-on card datasheet
- Getting Started Guide
- Programming Reference Manual
- Application notes for example applications

Software

- GUI for demonstration application
- Binary image for demonstration application
- API Source Code
- Source code for example applications



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