



# 88W8688

## Integrated MAC/Baseband/RF WLAN and Bluetooth SoC

### Product Brief

Marvell. Moving Forward Faster

## PRODUCT OVERVIEW

The Marvell® 88W8688 is a low-cost, low-power highly-integrated IEEE 802.11a/g/b MAC/Baseband/RF WLAN and Bluetooth Baseband/RF system-on-chip (SoC). The device is designed to support IEEE 802.11a or 802.11g payload data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mbps, as well as 802.11b data rates of 1, 2, 5.5, and 11 Mbps for WLAN operation. For Bluetooth operation, the device supports Bluetooth 3.0 + High Speed (HS) (also compliant with Bluetooth 2.1 + EDR).

The 88W8688 provides the combined functions of the IEEE Standard 802.11/802.11b Direct Sequence Spread Spectrum (DSSS), 802.11a/g Orthogonal Frequency Division Multiplexing (OFDM) baseband modulation, Medium Access Controller (MAC), CPU, memory, host interfaces, direct-conversion WLAN RF radio, and Bluetooth on a single integrated chip.

The core functional units of the 88W8688 are connected with a high throughput interconnect system, as shown in [Figure 1](#).

The 88W8688 is equipped with a fully integrated RF to baseband radio that operates in both the 2.4 GHz ISM radio band for 802.11g/b WLAN applications and 5 GHz UNII radio band for 802.11a WLAN applications. It also contains all the circuitry to support both transmit and receive for Bluetooth operation.

For optimum performance, the gain adjustment of the integrated LNA and AGC on the receive path is seamlessly controlled by baseband functions.

Integrated transmitters up-convert the quadrature baseband signal, and then deliver the RF signals to external power amplifiers for 2.4 GHz and 5 GHz radio band transmission.

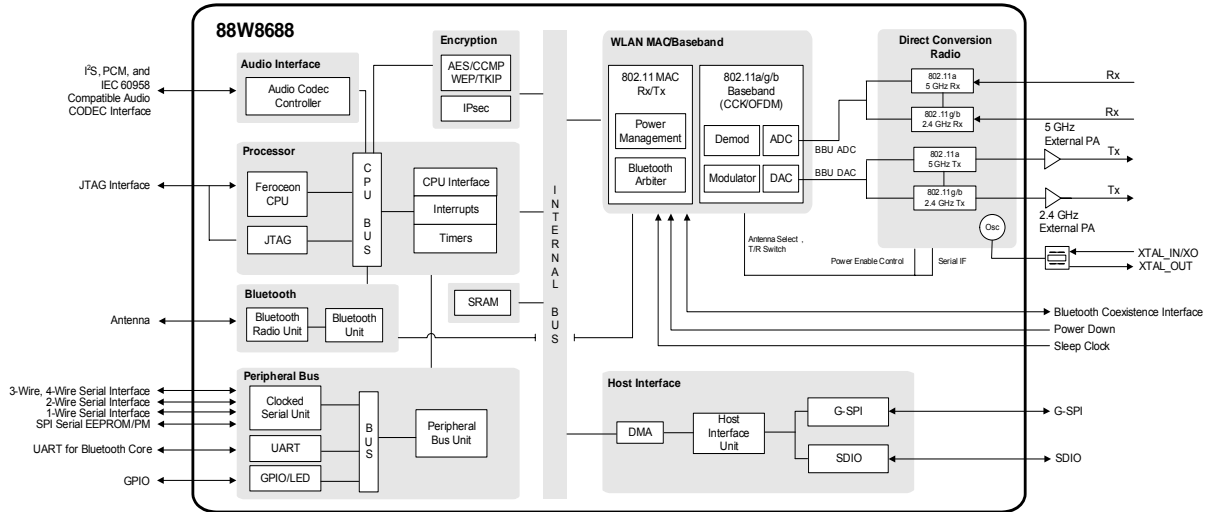
Local oscillator frequencies are generated by a fully integrated programmable frequency synthesizer with no external components. The loop bandwidth is optimized for phase noise and dynamic performance and quadrature signals are generated on-chip.

For security, the 88W8688 supports the IEEE 802.11i security standard through implementation of the Advanced Encryption Standard (AES)/Counter Mode CBC-MAC Protocol (CCMP), and Wired Equivalent Privacy (WEP) with Temporal Key Integrity Protocol (TKIP) security mechanisms. The device also supports Internet Protocol Security (IPsec) with DES/3DES/AES encryption and MD5/SHA-1 authentication.

For video, voice, and multimedia applications, the 88W8688 supports 802.11e Quality of Service (QoS). The device also supports 802.11h Dynamic Frequency Selection (DFS) for detecting radar pulses when operating in the 5 GHz range.

The 88W8688 supports a generic SPI (G-SPI) and SDIO host interface for connecting the WLAN to the host processor. High-speed UART, PCM/Inter-IC Sound (I<sup>2</sup>S), and SDIO interfaces are available to connect the Bluetooth core to the host processor. A Bluetooth coexistence interface is also supported for external, co-located Bluetooth devices.

**Figure 1: Top Block Diagram<sup>1</sup>**



1. Antenna can be used as an option to enhance performance.

Marvell reference designs are highly-integrated low cost, production quality designs that provide a quick time-to-market solution for customers developing single chip IEEE 802.11a/g/b WLAN and Bluetooth solutions.

## Applications

- WLAN/Bluetooth enabled cellular handsets
- WLAN/Bluetooth headsets
- Portable audio/video devices and accessories
- Gaming platforms
- WLAN/Bluetooth enabled digital still cameras and printers

## General Features

- Single-chip integration of 802.11a/g/b wireless direct conversion radio, baseband, MAC, CPU, memory, host interfaces, and Bluetooth
- Integrates all 802.11a/g/b RF to baseband transmit and receive operations, with support for external power amplifiers
- Fully integrated frequency synthesizers with optimized phase noise performance for OFDM applications
- Ultra low-power dissipation
- Supports 12, 13, 19.2, 20, 24, 26, 38.4, 40, or 52 MHz oscillator clock source
- Supports Marvell Bluetooth coexistence

## Standards

### IEEE 802.11 WLAN

- 802.11 data rates of 1 and 2 Mbps
- 802.11b data rates of 5.5 and 11 Mbps
- 802.11a/g data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mbps for multimedia content transmission
- 802.11e Quality of Service (QoS)
- 802.11h DFS statistics processing
- 802.11h transmit power control
- 802.11j channels (Japan)
- 802.11s mesh networking

### Bluetooth

- Bluetooth 3.0 + High Speed (HS) (also compliant with Bluetooth 2.1 + EDR)
- Bluetooth Class 1 (up to 10 dBm without external PA) (Class 1.5)
- Bluetooth Class 1 (greater than 10 dBm with external PA)

## Packaging

- 6 x 10 mm 152-pin TFBGA
- Flip chip package (400  $\mu$ m)

## Processor

### CPU

- Integrated Marvell Feroceon® CPU (ARMv5TE-compliant)
- Offloads wireless protocol stack processing from host CPU
- 106 MHz operating frequency

### DMA

- Independent 2-channel Direct Memory Access (DMA)

## Memory

- Internal SRAM for Tx frame queues and Rx data buffers
- Boot ROM

## Networking Functions

### WLAN MAC

- Ad-Hoc and Infrastructure modes
- Request-to-Send (RTS)/Clear-to-Send (CTS) for operation under Distributed Coordination Function (DCF)
- Hardware filtering of 64 multicast and 96 unicast addresses and additional firmware options
- On-chip Tx and Rx FIFOs for maximum throughput
- Open System and Shared Key Authentication services
- Managed information base counters
- Quality of Service (QoS)
- DFS statistics processing
- Mesh networking
- Power management
- External sleep clock control
- Transmit rate adaptation
- Transmit power control
- Long and short preamble generation on a frame-by-frame basis for 802.11b frames

## WLAN Baseband

- DSSS and OFDM modulation
- Advanced Equalizer for Complementary Code Keying (CCK) modes
- Differential Binary Phase Shift Keying (DBPSK), Differential Quadrature Phase Shift Keying (DQPSK), and CCK modulation modes
- 16-QAM and 64-QAM modulation
- On-chip A/D and D/A converters for Inphase/Quadrature (I/Q) channels
- Targeted for multi-path delay spreads up to 680 ns in 11 Mbps mode and 150 ns in 54 Mbps mode
- DFS statistics gathering
- 802.11j channels (Japan)

## WLAN RF

### Rx Path

- On-chip gain selectable LNA with optimized noise figure and power consumption
- Highly integrated architecture eliminates need for external SAW filter
- High dynamic range AGC function in receive mode
- Immune to high power cellular phone transmission signals
- Supports antenna diversity

### Tx Path

- Supports external PA with power control for both 2.4 GHz and 5 GHz operation
- Image-reject transmitter to reduce external RF filter count for 2.4 GHz radio transmit
- Supports closed and open loop power control in increments of 0.5 dB
- Very low spectral emissions in the cellular phone receive band

## WLAN Encryption

- AES-CCMP hardware implementation as part of 802.11i security standard
- WPA (Wi-Fi Protected Access) encryption
- WEP 64- and 128-bit encryption with hardware TKIP processing
- IPsec security acceleration in hardware

## Bluetooth

- Digital Audio interfaces including PCM interface for voice application and I<sup>2</sup>S for digital stereo applications
- Baseband and radio basic data rate and EDR packet types—1 Mbps (GFSK), 2 Mbps (p/4-DQPSK), and 3 Mbps (8DPSK)
- Fully functional Bluetooth baseband—AFH, forward error correction, header error control, access code correlation, CRC, encryption bit stream generation, and whitening
- Adaptive Frequency Hopping (AFH), including Packet Loss Rate (PLR)
- Interlaced Scan for faster connection setup
- Simultaneous active ACL connection support
- Full master and slave piconet support
- Scatternet support
- Standard UART and SDIO Type-A HCI transport layer
- HCI layer verified to function with major profile stack vendors
- SCO/eSCO links with hardware accelerated audio signal processing and hardware supported PPEC algorithm for speech quality improvement
- All standard SCO/eSCO voice coding
- All standard pairing, authentication, link key, and encryption operations
- Standard Bluetooth power saving mechanisms (i.e., hold, sniff modes)
- Dynamic Transmit Power Control (TPC)
- Channel Quality Driven (CQD) data rate

## Networking Coexistence

- Supports Marvell 2-Wire Bluetooth Coexistence Arbitration (2WBCA) scheme
- Supports Marvell 3-Wire Bluetooth Coexistence Arbitration (3WBCA) scheme
- Supports Marvell 4-Wire Bluetooth Coexistence Arbitration (4WBCA) scheme

## Host Interfaces

- G-SPI device interface
- SDIO device interface
  - Supports SPI, 1-bit SDIO, and 4-bit SDIO transfer modes at the full clock range up to 50 MHz
- Universal Asynchronous Receiver/Transmitter (UART) interface

## Peripheral Bus Interfaces

- Clocked serial unit
  - 3-Wire, 4-Wire (3W4W) Serial Interface
  - 2-Wire Serial Interface (TWSI)
  - 1-Wire Serial Interface
  - SPI serial (EEPROM)
- Universal Asynchronous Receiver/Transmitter (UART)
- General Purpose Input Output (GPIO)
- Flexible GPIO interface with Light Emitting Diode (LED) driver to indicate Tx/Rx activities

## Audio Interfaces

### Audio Codec Interface

- Marvell Class D Audio Amplifier
- TWSI interface for Audio Codec programming
- IEC60958 compatible Audio Codec interface
- I<sup>2</sup>S (Inter-IC Sound) interface for audio data connection to Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC)
- Master and slave mode for I<sup>2</sup>S, MSB, and LSB audio interfaces
- Tri-state output capability

### PCM Interface

- Master or slave mode
- PCM bit width size of 8 bits or 16 bits
- Up to 4 slots with configurable bit width and start positions
- Short frame and long frame synchronization
- Tri-state output capability



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