



System-on-Chip
solution for
smart devices and
energy applications

NXP® 88MW32X 802.11n Wi-Fi® Dual Band Microcontroller SoC

High integration and low-power operation in the 88MW320/322 WLAN microcontroller system-on-chip (SoC), making it an ideal solution for low-cost, high efficiency smart device, appliance, and energy applications.

PRODUCT OVERVIEW

Several features of the NXP 88MW320/322 SoC enable low system costs and high WLAN protocol processing. For example, the high degree of integration in the SoC requires only one 3.3 V power input, a 38.4 MHz crystal and SPI flash, while the RF path needs only a low-pass filter for antenna connection.

Proven and mature IEEE 802.11n/g/b NXP technology powers a full-featured WLAN subsystem in the SoC. This WLAN subsystem integrates a WLAN MAC, baseband, and direct-conversion RF radio with integrated PA, LINA and transmit/receive switch. It also integrates a CPU subsystem with integrated memory to run NXP WLAN firmware to handle real-time WLAN protocol processing to offload many WLAN functions from the main application CPU.

An Arm® Cortex®-M4F CPU that operates up to 200 MHz powers the 88MW320/322 application subsystem. The device supports an integrated 512 KB SRAM, 128 KB mask ROM and a QSPI interface to external flash. An integrated flash controller with a 32 KB SRAM cache enables execute in place (XIP) support for firmware from flash.

The SoC is designed for low-power operation and includes several low-power states and fast wake-up times. Multiple

power domains and clocks can be individually shut down to save power. The SoC also has a high-efficiency internal PA that can be operated in low-power mode to save power. The microcontroller and WLAN subsystems can be placed into low-power states, independently, supporting a variety of application use cases. An internal DC-DC regulator provides the 1.8 V rail for the WLAN subsystem.

The SoC provides a full array of peripheral interfaces including SSP/SPI/I²S (3x), UART (3x), I²C (2x), general-purpose timers and PWM, ADC, DAC, analog comparator, and GPIOs. It also includes a hardware cryptographic engine, RTC, and watchdog timer.

The 88MW322 SoC includes a high-speed USB On-The-Go (OTG) interface to enable USB audio, video and other applications.

A complete set of digital and analog interfaces enables direct interfacing for I/O and avoids the need for external chips. The application CPU can be used to support custom application development and avoids the need for another microcontroller or processor.



FIGURE 1: 88MW32X BLOCK DIAGRAM

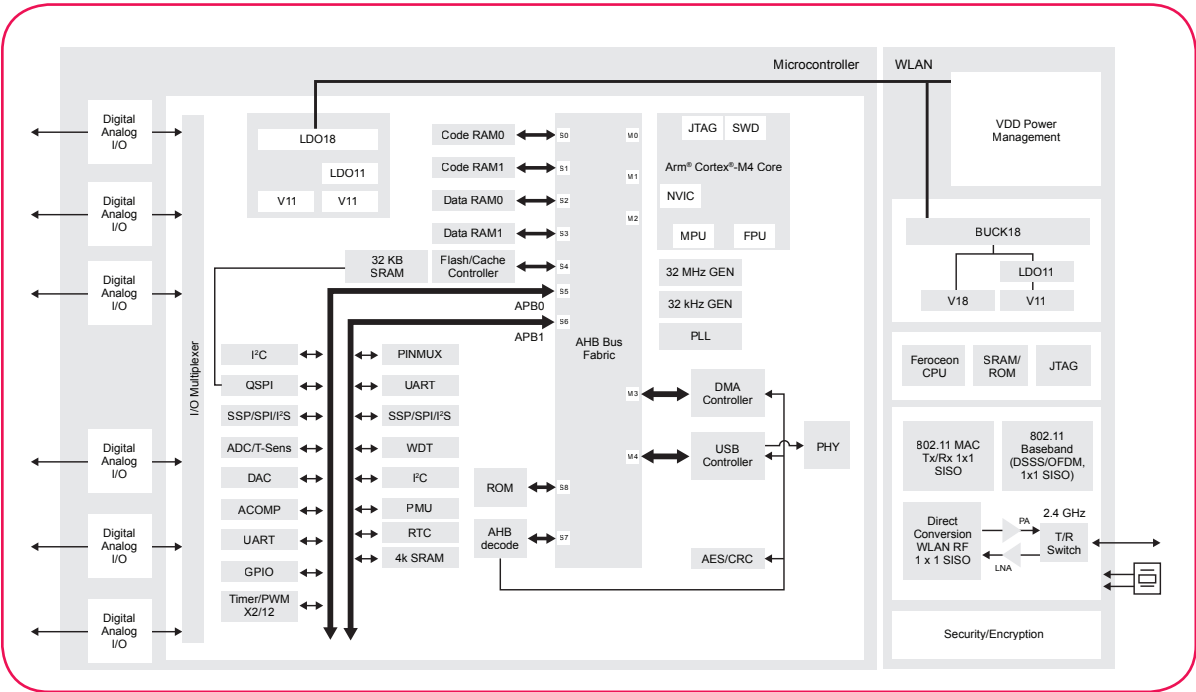


Figure 1 shows an overall block diagram of the device.

APPLICATIONS

- ▶ Smart Home—smart outlet, light switch, security camera, thermostat, sprinkler controller, sensor, door lock, door bell, garage door, security system
- ▶ Industrial—building automation, smart lighting, Wi-Fi to other radio bridge, point of sale (POS) terminals
- ▶ Smart Devices—coffee pot, rice cooker, vacuum cleaner, air purifier, pet monitor, weighing scale, glucometer, blood pressure monitor, fitness equipment
- ▶ Smart Appliances—refrigerator, washer, dryer, oven range, microwave, dishwasher, water heater, air conditioner
- ▶ Smart Accessories—smart speakers, headset, alarm clock, gaming accessory, remote control
- ▶ Gateways—Bluetooth Smart Mesh and other radios to Wi-Fi/IP network

KEY FEATURES

- ▶ Highly integrated SoC requiring very few external components for a full system operation
- ▶ Multiple low-power modes and fast wake-up times
- ▶ Full-featured, single stream 802.11n/g/b WLAN

- ▶ High-efficiency PA with a low-power (10 dB) mode
- ▶ Cortex-M4F application CPU for applications with integrated 512 KB SRAM and 128 KB mask ROM
- ▶ Flash controller with embedded 32 KB SRAM cache to support XIP from external SPI flash
- ▶ Secure boot
- ▶ Full set of digital and analog I/O interfaces

POWER MANAGEMENT

- ▶ Power modes—active, idle, standby, sleep, shutoff, power-down
- ▶ Integrated high-efficiency buck DC-DC converter
- ▶ Independent power domains
- ▶ Brown-out detection
- ▶ Integrated POR
- ▶ Wake-up through dedicated GPIO, IRQ, and RTC

CHIP PACKAGE

- ▶ 88MW320—68-pin QFN, 8 x 8 mm
 - USB OTG not supported
 - 35 GPIOs
 - 2 GPTs

- ▶ 88MW322—88-pin QFN, 10 x 10 mm
 - USB OTG supported
 - 50 GPIOs
 - 4 GPTs

TEMPERATURE

- ▶ Commercial: 0° to 70° C
- ▶ Extended: -30° to 85° C
- ▶ Industrial: -40° to 105° C
- ▶ Storage: -55° to 125° C

WIRELESS

- ▶ IEEE 802.11n/g/b, 1 x 1 SISO 2.4 GHz and HT20
- ▶ Integrated CPU, memory, MAC, DSSS/OFDM baseband, direct conversion RF radio, encryption

TABLE 1: PACKAGE FEATURE DIFFERENCES¹

Features	68-Pin	88-Pin
GPIO	35 total GPIO_0 to GPIO_10 GPIO_16 GPIO_22 to GPIO_33 GPIO_39 to GPIO_49	50 total GPIO_0 to GPIO_49
USB 2.0 OTG	—	1
GPT	2	4

¹ All I/O features are muxed on GPIOs, except WLAN RF TX/RX, USB, reference clock, and reset functionality.

- ▶ Antenna diversity
- ▶ CMOS and low-swing sine wave input clock
- ▶ Low-power with deep sleep and standby modes
- ▶ Pre-regulated supplies
- ▶ Integrated T/R switch, PA, and LNA
- ▶ Optional 802.11n features
- ▶ One-time programmable (OTP) memory to eliminate need for external EEPROM

WLAN Rx Path

- ▶ Direct conversion architecture eliminates need for external SAW filter
- ▶ On-chip gain selectable LNA with optimized noise figure and power consumption
- ▶ High dynamic range AGC function in receive mode

WLAN Tx Path

- ▶ Integrated PA with power control
- ▶ Optimized Tx gain distribution for linearity and noise performance

WLAN Local Oscillator

- ▶ Fractional-N for multiple reference clock support
- ▶ Fine channel step

WLAN Encryption

- ▶ WEP 64- and 128-bit encryption with hardware TKIP processing (WPA)
- ▶ AES-CCMP hardware implementation as part of 802.11i security standard (WPA2)
- ▶ Enhanced AES engine performance
- ▶ AES-Cipher-Based Message Authentication Code (CMAC) as part of the 802.11w security standard

- ▶ WLAN Authentication and Privacy Infrastructure (WAPI)

IEEE 802.11 Standards

- ▶ 802.11 data rates of 1 and 2 Mbit/s
- ▶ 802.11b data rates of 5.5 and 11 Mbit/s
- ▶ 802.11g data rates 6, 9, 12, 18, 24, 36, 48, and 54 Mbit/s for multimedia content transmission
- ▶ 802.11g/b performance enhancements
- ▶ 802.11n compliant with maximum data rates up to 72.2 Mbit/s (20 MHz channel)
- ▶ 802.11d international roaming
- ▶ 802.11e quality of service
- ▶ 802.11h transmit power control
- ▶ 802.11i enhanced security
- ▶ 802.11k radio resource measurement
- ▶ 802.11n block acknowledgment extension
- ▶ 802.11r fast hand-off for AP roaming
- ▶ 802.11w protected management frames
- ▶ Fully supports clients (stations) implementing IEEE Power Save mode
- ▶ Wi-Fi direct connectivity

MICROPROCESSOR

Processor

- ▶ Arm Cortex-M4F, 32-bit
- ▶ 200 MHz main bus clock

Memory

- ▶ 128 KB ROM
- ▶ 512 KB RAM

Flash Controller

- ▶ Supports QSPI flash devices
- ▶ Memory-mapped access to QSPI flash devices
- ▶ 32 KB SRAM cache

Digital Interfaces

- ▶ 3 x I²S stereo
- ▶ 3 x SPI master/slave
- ▶ 2 x I²C master/slave
- ▶ 3 x UART
- ▶ 1 x USB OTG 2.0, high-speed
- ▶ 1 x QSPI
- ▶ Up to 50 GPIOs
- ▶ 2 x wake-up pins

Analog

- ▶ 2-step ADC with integrated PGA and configurable resolution/speed
 - 12-bit/2 MHz sample(s) for fast conversion
 - 16-bit/16 kHz sample/s with voice quality
 - 8 single channels or 4 differential channels
- ▶ 2-channel or 1 differential channel DAC, 10-bit/500 ksps
- ▶ 2 analog comparators with programmable speed/current
- ▶ On-die/off-chip temperature sensing and battery monitor

Counters/Timers/PWM

- ▶ General-purpose timers (GPT) with LED PWM support
- ▶ Real-time clock (RTC)
- ▶ CM4 system tick
- ▶ Watchdog timer