NuttX for ESP32: current status and next developments

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NuttX Online Workshop
Who am I?

- Computer Scientist with hardware experience;
- Embedded System developer (Baremetal, Linux/uClINUX, RTOS, etc);
- Nuttx Contributor/Developer (since 2010);
- Senior Embedded System Eng. at Espressif.
About Espressif (public info only)

• Funded on 2008 as a Startup;
• First very successful device: ESP8266;
• Very innovative and dynamic company;
• Many developers coming from open-source projects;
• Current chips: ESP32 and ESP32-S2 (oh boy, I cannot say too much about new products)
About ESP32 MCU

- Based on Xtensa LX6 Core
- Run up to 240MHz with performance up to 600 DMIPS
- 512 KiB SRAM
- Connectivity: WiFi 802.11 b/g/n and Bluetooth v4.2 BR/EDR
- Many Peripherals: 4 SPIs, 2x I2C, 2x I2S, 12-bit ADC with 18 CH, 2x DACs, 3x UART, Ethernet, SDIO, CAN, PWM, Touch Interface, etc
- Security: Flash Encryption; Secure boot; Crypto HW: AES, SHA-2, RSA, Elliptic Curve, RNG
ESP32 Features:

Espressif ESP32 Wi-Fi & Bluetooth Microcontroller — Function Block Diagram

- **Balun Switch**
  - Radio
  - RF receive
  - Clock generator
  - RF transmit

- **Cryptographic hardware acceleration**
  - RSA
    - Rivest-Shamir-Adleman
  - SHA
    - FIPS PUB 180-4
  - RNG
    - Random number gen.
  - AES
    - FIPS PUB 197

- **Core and memory**
  - Xtensa LX6 microprocessor
    - 32 bit, dual-core or single-core
  - ROM
    - Read-only memory
  - SRAM
    - Static random-access mem.

- **RTC and low-power management subsystem**
  - PMU
    - Power management unit
  - Ultra-low-power co-processor
  - Recovery memory

- **Embedded flash memory**
  - Included in ESP32-PICO-D4 system-in-package QFN module

- **Peripheral interfaces**
  - SPI
    - Serial Peripheral Interface
  - I^2C
    - Inter-Integrated Circuit
  - I^S
    - Inter-IC Sound
  - SDIO
    - Secure Digital Input Output
  - UART
    - Universal asynchronous receiver-transmitter
  - CAN
    - Controller Area Network
  - ETH
    - Ethernet MAC
  - IR
    - Infrared
  - PWM
    - Pulse-width modulation

- **Temperature sensor**
  - Internal, range of -40°C to 125°C

- **Touch sensors**
  - Ten capacitive-sensing inputs

- **DAC**
  - Digital-to-analog converter

- **SAR ADC**
  - Successive approximation, analog-to-digital conv.
NuttX for ESP32 (Out. 2016)

• Port started around Out 2016;

• Basic support to GPIO and UART around that time;

• Development stalled: some HW informations wasn’t available at that time;

• I created a tutorial in my blog https://acassis.wordpress.com showing how to install NuttX.
NuttX for ESP32 (Aug. 2020)

- Added support to SPI;
- Added support to SPI Flash;
- Added support to I2C;
- Added support to Ethernet;

(these driver were ported by Dong Heng and I work with him to fix and submit it)
NuttX for ESP32 (next)

- Add DMA support;
- DMA support for SPI and other drivers;
- Add I2S support;
- Add SDIO support;
- Add CAN and other drivers;
- Add support to security HW;
- Other drivers! ;-)}
And what about WiFi and BT/BLE?

- We are working on it too, some issue:
  - It depends too much of IDF/FreeRTOS functions;
  - We need to reimplement its timer and event layer to work on NuttX;
  - We need to update all the code style to NuttX standard.
Thank you!

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