



ESP8266 SDK API Guide

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Espressif Systems IOT Team

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1. Preambles

ESP8266 WiFi SoC offers a complete and self-contained Wi-Fi networking solution; it can be used to host applications or to offload Wi-Fi networking functions from another application processor. When the ESP8266 hosts application, it boots up directly from an external flash. It has an integrated cache to improve the performance of system's running applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added into any microcontroller-based design with simple connectivity through UART interface or the CPU AHB bridge interface.

ESP8266EX is amongst the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, on top of its Wi-Fi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs. Codes for such applications are provided in examples in the SDK.

Sophisticated system-level features include fast sleep/wake switching for energy-efficient VoIP, adaptive radio biasing for low-power operations, advanced signal processing, spur cancellation and radio co-existence features for common cellular, Bluetooth, DDR, LVDS, LCD interference mitigation.

The SDK based on ESP8266 IoT platform offers users an easy, fast and efficient way to develop IoT devices. This programming guide provides overview of the SDK as well as details on the API. It is written for embedded software developers to help them program on ESP8266 IoT platform.

2. Overview

The SDK provides a set of interfaces for data receive and transmit functions over the Wi-Fi and TCP/IP layers so programmers can focus on application development at a higher level. Users can easily make use of the corresponding interfaces to receive and transmit data.

All networking functions on the ESP8266 IoT platform are realized in the library, and are not transparent to users. Instead, users can initialize the interface in `user_main.c`.

`void user_init(void)` is the default method provided. Users can add functions like firmware initialization, network parameters setting, and timer initialization in the interface.

`void user_rf_pre_init(void)` need to be added in `user_main.c` since SDK_v1.1.0, refers to the IOT_Demo. It is provided for RF initialization. User can call `system_phy_set_rfoption` to set RF option in `user_rf_pre_init`, or call `system_deep_sleep_set_option` before deep-sleep. If RF is disabled, ESP8266 station and soft-AP will both be disabled, so please don't call related APIs, and Wi-Fi function can not be used either.

The SDK provides APIs to handle JSON, and users can also use self-defined data types to handle the them.

Notice:

- Using non-OS SDK which is single-threaded, the CPU should not take long to execute tasks:
 - ▶ If a task occupies the CPU too long, ESP8266 can't feed the dog, it will cause a watchdog reset;
 - ▶ If interrupt is disabled, CPU can only be occupied in us range and the time should not be more than 10 us; if interrupt is not disabled, it is suggested that CPU should not be occupied more than 500 ms.
- We suggest using a timer to check periodically, if users need to call `os_delay_us` or function `while`, or function `for` in timer callback, please do not occupy CPU more than 10 ms.
- Using non-OS SDK, please do not call any function defined with `ICACHE_FLASH_ATTR` in the interrupt handler.
- We suggest using RTOS SDK, RTOS to schedule different tasks.



3. Application Programming Interface (APIs)

3.1. Software Timer

Timer APIs can be found in: `/esp_iot_sdk/include/osapi.h`. Please note that `os_timer` APIs listed below are software timers executed in task, hence timer callbacks may not be precisely executed at the right time; it depends on priority. If you need a precise timer, please use a hardware timer which can be executed in hardware interrupt. Please refer to `hw_timer.c`.

- For the same timer, `os_timer_arm` (or `os_timer_arm_us`) cannot be invoked repeatedly. `os_timer_disarm` should be invoked first.
- `os_timer_setfn` can only be invoked when the timer is not enabled, i.e., after `os_timer_disarm` or before `os_timer_arm` (or `os_timer_arm_us`).

1. `os_timer_arm`

Function:

Enable a millisecond timer.

Prototype:

```
void os_timer_arm (  
    os_timer_t *ptimer,  
    uint32_t milliseconds,  
    bool repeat_flag  
)
```

Parameters:

`os_timer_t *ptimer` : Timer structure

`uint32_t milliseconds` : Timing, Unit: millisecond

- if called `system_timer_reinit`, the maximum value allowed to input is 0x41893
- if didn't call `system_timer_reinit`, the maximum value allowed to input is 0xFFFFFFFF

`bool repeat_flag` : Whether the timer will be invoked repeatedly or not

Return:

null



2. `os_timer_disarm`

Function:

Disarm timer

Prototype:

```
void os_timer_disarm (os_timer_t *ptimer)
```

Parameters:

`os_timer_t *ptimer` : Timer structure

Return:

null

3. `os_timer_setfn`

Function:

Set timer callback function.

For enabled timer, timer callback has to be set.

Prototype:

```
void os_timer_setfn(  
    os_timer_t *ptimer,  
    os_timer_func_t *pfunction,  
    void *parg  
)
```

Parameters:

`os_timer_t *ptimer` : Timer structure

`os_timer_func_t *pfunction` : timer callback function

`void *parg` : callback function parameter

Return:

null

4. `system_timer_reinit`

Function:

Reinitiate the timer when you need to use microsecond timer

Notes:

1. Define `USE_US_TIMER`;
2. Put `system_timer_reinit` at the beginning of `user_init` , in the first sentence.

Prototype:

```
void system_timer_reinit (void)
```


**Parameters:**

null

Return:

null

5. `os_timer_arm_us`

Function:

Enable a microsecond timer.

Notes:

1. Define `USE_US_TIMER`;
2. Put `system_timer_reinit` at the beginning of `user_init` , in the first sentence.

Prototype:

```
void os_timer_arm_us (  
    os_timer_t *ptimer,  
    uint32_t microseconds,  
    bool repeat_flag  
)
```

Parameters:

`os_timer_t *ptimer` : Timer structure
`uint32_t microseconds` : Timing, Unit: microsecond, the minimum value is 0x64, the maximum value allowed to input is 0xFFFFFFFF
`bool repeat_flag` : Whether the timer will be invoked repeatedly or not

Return:

null

3.2. Hardware Timer

Hardware timer APIs can be found in `/esp-iot-sdk/examples/driver_lib/hw_timer.c`. User can use it according to "`readme.txt`" which in folder `driver_lib`.

NOTE:

- if you use NMI source, for autoloader timer , parameter `val` of `hw_timer_arm` can not be less than 100.
- if you use NMI source - this timer has highest priority, it can interrupt other ISRs.
- if you use FRC1 source - this timer can not interrupt other ISRs.
- APIs in `hw_timer.c` can not be called when PWM APIs are in use, because they all use the same hardware timer.



1. hw_timer_init

Function:

Initialize the hardware ISR timer

Prototype:

```
void hw_timer_init (  
    FRC1_TIMER_SOURCE_TYPE source_type,  
    u8 req  
)
```

Parameters:

`FRC1_TIMER_SOURCE_TYPE source_type` : ISR source of timer

`FRC1_SOURCE`, timer use FRC1 ISR as ISR source.

`NMI_SOURCE`, timer use NMI ISR as ISR source.

`u8 req` : 0, not autoloading

1, autoloading mode

Return:

none

2. hw_timer_arm

Function:

Set a trigger timer delay to enable this timer.

Prototype:

```
void hw_timer_arm (uint32 val)
```

Parameters:

`uint32 val` : Timing

- in autoloading mode :

- For `FRC1_SOURCE`, range : 50 ~ 0x7fffff;

- For `NMI_SOURCE`, range : 100 ~ 0x7fffff;

- in non autoloading mode, range : 10 ~ 0x7fffff;

Return:

none

3. hw_timer_set_func

Function:

Set timer callback function.



For enabled timer, timer callback has to be set.

Prototype:

```
void hw_timer_set_func (void (* user_hw_timer_cb_set)(void) )
```

Parameters:

```
void (* user_hw_timer_cb_set)(void) : Timer callback function
```

Return:

```
none
```

4. hardware timer example

```
#define REG_READ(_r)      (*(volatile uint32 *) (_r))
#define WDEV_NOW()        REG_READ(0x3ff20c00)
uint32 tick_now2 = 0;
void hw_test_timer_cb(void)
{
    static uint16 j = 0;
    j++;

    if( (WDEV_NOW() - tick_now2) >= 1000000 )
    {
        static u32 idx = 1;
        tick_now2 = WDEV_NOW();
        os_printf("b%u:%d\n", idx++, j);
        j = 0;
    }
}

void ICACHE_FLASH_ATTR user_init(void)
{
    hw_timer_init(FRC1_SOURCE, 1);
    hw_timer_set_func(hw_test_timer_cb);
    hw_timer_arm(100);
}
```



3.3. System APIs

1. system_get_sdk_version

Function:

Get SDK version

Prototype:

```
const char* system_get_sdk_version(void)
```

Parameter:

none

Return:

SDK version

Example:

```
os_printf("SDK version: %s \n", system_get_sdk_version());
```

2. system_restore

Function:

Reset to default settings of following APIs : `wifi_station_set_auto_connect`, `wifi_set_phy_mode`, `wifi_softap_set_config` related, `wifi_station_set_config` related, `wifi_set_opmode`, and APs information recorded by `#define AP_CACHE`

Prototype:

```
void system_restore(void)
```

Parameters:

null

Return:

null

3. system_restart

Function:

Restart

Prototype:

```
void system_restart(void)
```

Parameters:

null



Return:

null

4. **system_init_done_cb**

Function:

Call this API in `user_init` to register a system-init-done callback.

Note:

`wifi_station_scan` has to be called after system init done and station enable.

Prototype:

```
void system_init_done_cb(init_done_cb_t cb)
```

Parameter:

`init_done_cb_t cb` : system-init-done callback

Return:

null

Example:

```
void to_scan(void) { wifi_station_scan(NULL,scan_done); }
void user_init(void) {
    wifi_set_opmode(STATION_MODE);
    system_init_done_cb(to_scan);
}
```

5. **system_get_chip_id**

Function:

Get chip ID

Prototype:

```
uint32 system_get_chip_id (void)
```

Parameters:

null

Return:

Chip ID

6. **system_get_vdd33**

Function:

Measure the power voltage of VDD3P3 pin 3 and 4, unit: 1/1024 V

Note:



- `system_get_vdd33` can only be called when TOUT pin is suspended
- The 107th byte in `esp_init_data_default.bin` (0~127byte) is named as "vdd33_const", when TOUT pin is suspended vdd33_const must be set as 0xFF, that is 255

Prototype:

```
uint16 system_get_vdd33(void)
```

Parameter:

none

Return:

power voltage of VDD33, unit: 1/1024 V

7. `system_adc_read`

Function:

Measure the input voltage of TOUT pin 6, unit: 1/1024 V

Note:

- `system_adc_read` is only available when wire TOUT pin to external circuitry. Input Voltage Range restricted to 0 ~ 1.0V.
- The 107th byte in `esp_init_data_default.bin`(0~127byte) is named as "vdd33_const", and when wire TOUT pin to external circuitry, the vdd33_const must be set as real power voltage of VDD3P3 pin 3 and 4.
- The range of operating voltage of ESP8266 is 1.8V~3.6V, the unit of vdd33_const is 0.1V, so effective value range of vdd33_const is [18, 36]. If vdd33_const is an ineffective value which in [0, 18) or (36, 255), ESP8266 RF calibration will use 3.3V by default.

Prototype:

```
uint16 system_adc_read(void)
```

Parameter:

none

Return:

input voltage of TOUT pin 6, unit: 1/1024 V

8. `system_deep_sleep`

Function:

Configures chip for deep-sleep mode. When the device is in deep-sleep, it automatically wakes up periodically; the period is configurable. Upon waking up, the device boots up from `user_init`.



Note:

- Hardware has to support deep-sleep wake up (`XPD_DCDC` connects to `EXT_RSTB` with 0R).
- `system_deep_sleep(0)`: there is no wake up timer; in order to wakeup, connect a GPIO to pin `RST`, the chip will wake up by a falling-edge on pin `RST`.
- How to short the time it takes to wake up from deep-sleep, please refer to documentation “2A-ESP8266_IOT_SDK_User_Manual” chapter **Appendix**.

Prototype:

```
void system_deep_sleep(uint32 time_in_us)
```

Parameters:

`uint32 time_in_us` : during the time (us) device is in deep-sleep

Return:

null

9. `system_deep_sleep_set_option`

Function:

Call this API before `system_deep_sleep` to set what the chip will do when next deep-sleep wake up. The option is 1 by default

Prototype:

```
bool system_deep_sleep_set_option(uint8 option)
```

Parameter:

`uint8 option` :

0 : Radio calibration after deep-sleep wake up depends on `esp_init_data_default.bin` (0~127byte) byte 108.

1 : Radio calibration is done after deep-sleep wake up; this increases the current consumption.

2 : No radio calibration after deep-sleep wake up; this reduces the current consumption.

4 : Disable RF after deep-sleep wake up, just like modem sleep; this has the least current consumption; the device is not able to transmit or receive data after wake up.

Return:

true : succeed

false : fail



10. system_phy_set_rfoption

Function:

Enable RF or not when wakeup from deep-sleep.

Note:

- This API can only be called in `user_rf_pre_init`.
- Function of this API is similar to `system_deep_sleep_set_option`, if they are both called, it will disregard `system_deep_sleep_set_option` which is called before deep-sleep, and refer to `system_phy_set_rfoption` which is called when deep-sleep wake up.
- Before calling this API, `system_deep_sleep_set_option` should be called once at least.

Prototype:

```
void system_phy_set_rfoption(uint8 option)
```

Parameter:

`uint8 option` :

`system_phy_set_rfoption(0)` : Radio calibration after deep-sleep wake up depends on `esp_init_data_default.bin` (0~127byte) byte 108.

`system_phy_set_rfoption(1)` : Radio calibration is done after deep-sleep wake up; this increases the current consumption.

`system_phy_set_rfoption(2)` : No radio calibration after deep-sleep wake up; this reduces the current consumption.

`system_phy_set_rfoption(4)` : Disable RF after deep-sleep wake up, just like modem sleep; this has the least current consumption; the device is not able to transmit or receive data after wake up.

Return:

none

11. system_phy_set_max_tpw

Function:

Set maximum value of RF TX Power, unit : 0.25dBm

Prototype:

```
void system_phy_set_max_tpw(uint8 max_tpw)
```

Parameter:

`uint8 max_tpw` : maximum value of RF Tx Power, unit : 0.25dBm, range [0, 82]
it can be set refer to the 34th byte (`target_power_qdb_0`) of



`esp_init_data_default.bin`(0~127byte)

Return:

none

12. `system_phy_set_tpw_via_vdd33`

Function:

Adjust RF TX Power according to VDD33, unit : 1/1024 V

Note:

When TOUT pin is suspended, VDD33 can be got by `system_get_vdd33`;

When wire TOUT pin to external circuitry, `system_get_vdd33` can not be used.

Prototype:

`void system_phy_set_tpw_via_vdd33(uint16 vdd33)`

Parameter:

`uint16 vdd33` : VDD33, unit : 1/1024V, range [1900, 3300]

Return:

none

13. `system_set_os_print`

Function:

Turn on/off print logFunction

Prototype:

`void system_set_os_print (uint8 onoff)`

Parameters:

`uint8 onoff`

Note:

`onoff==0`: print function off

`onoff==1`: print function on

Default:

print function on

Return:

null



14. system_print_meminfo

Function:

Print memory information, including data/rodata/bss/heap

Prototype:

```
void system_print_meminfo (void)
```

Parameters:

null

Return:

null

15. system_get_free_heap_size

Function:

Get free heap size

Prototype:

```
uint32 system_get_free_heap_size(void)
```

Parameters:

null

Return:

uint32 : available heap size

16. system_os_task

Function:

Set up tasks

Prototype:

```
bool system_os_task(  
    os_task_t    task,  
    uint8        prio,  
    os_event_t   *queue,  
    uint8        qlen  
)
```



Parameters:

`os_task_t task` : task function
`uint8 prio` : task priority. 3 priorities are supported: 0/1/2; 0 is the lowest priority. This means only 3 tasks is allowed to set up.
`os_event_t *queue` : message queue pointer
`uint8 qlen` : message queue depth

Return:

true: succeed
false: fail

Example:

```
#define SIG_RX      0
#define TEST_QUEUE_LEN 4
os_event_t *testQueue;
void test_task (os_event_t *e) {
    switch (e->sig) {
        case SIG_RX:
            os_printf(sig_rx %c/n, (char)e->par);
            break;
        default:
            break;
    }
}
void task_init(void) {
    testQueue=(os_event_t *)os_malloc(sizeof(os_event_t)*TEST_QUEUE_LEN);
    system_os_task(test_task,USER_TASK_PRI0_0,testQueue,TEST_QUEUE_LEN);
}
```

17. system_os_post

Function: send message to task

Prototype:

```
bool system_os_post (
    uint8 prio,
    os_signal_t sig,
    os_param_t par
)
```

Parameters:

`uint8 prio` : task priority, corresponding to that you set up
`os_signal_t sig` : message type
`os_param_t par` : message parameters



Return:

true: succeed
false: fail

Referring to the above example:

```
void task_post(void) {  
    system_os_post(USER_TASK_PRI0_0, SIG_RX, 'a');  
}
```

Printout:

```
sig_rx a
```

18. system_get_time

Function:

Get system time (us).

Prototype:

```
uint32 system_get_time(void)
```

Parameter:

null

Return:

System time in microsecond.

19. system_get_rtc_time

Function: Get RTC time, as denoted by the number of RTC clock periods.

Example:

If `system_get_rtc_time` returns 10 (it means 10 RTC cycles), and `system_rtc_clock_cal_proc` returns 5.75 (means 5.75us per RTC cycle), then the real time is $10 \times 5.75 = 57.5$ us.

Note:

System time will return to zero because of `system_restart`, but RTC still goes on.

- reset by pin `EXT_RST` : RTC memory won't change, RTC timer returns to zero
- watchdog reset : RTC memory won't change, RTC timer won't change
- `system_restart` : RTC memory won't change, RTC timer won't change
- power on : RTC memory is random value, RTC timer starts from zero
- reset by pin `CHIP_EN` : RTC memory is random value, RTC timer starts from zero



Prototype:

```
uint32 system_get_rtc_time(void)
```

Parameter:

null

Return:

RTC time

20. system_rtc_clock_cali_proc

Function:

Get RTC clock period.

Note:

RTC clock period has decimal part.

RTC clock period will change according to temperature, so RTC timer is not very precise.

Prototype:

```
uint32 system_rtc_clock_cali_proc(void)
```

Parameter:

null

Return:

RTC clock period (in us), bit11~ bit0 are decimal. ((RTC_CAL * 100)>> 12)

Note:

see RTC demo in Appendix.

21. system_rtc_mem_write

Function:

During deep sleep, only RTC still working, so maybe we need to save some user data in RTC memory. Only user data area can be used by user.

<-----system data----->	<-----user data----->
256 bytes	512 bytes

Note:

RTC memory is 4 bytes aligned for read and write operations. Parameter `des_addr` means block number(4 bytes per block). So, if we want to save some data at the beginning of user data area, `des_addr` will be $256/4 = 64$, `save_size` will be data length.

**Prototype:**

```
bool system_rtc_mem_write (  
    uint32 des_addr,  
    void * src_addr,  
    uint32 save_size  
)
```

Parameter:

`uint32 des_addr` : destination address (block number) in RTC memory,
`des_addr >= 64`
`void * src_addr` : data pointer.
`uint32 save_size` : data length (byte)

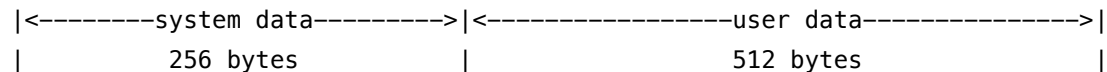
Return:

true: succeed
false: fail

22. system_rtc_mem_read

Function:

Read user data from RTC memory. Only user data area should be accessed by the user.

**Note:**

RTC memory is 4 bytes aligned for read and write operations. Parameter `src_addr` means block number(4 bytes per block). So, to read data from the beginning of user data area, `src_addr` will be $256/4=64$, `save_size` will be data length.

Prototype:

```
bool system_rtc_mem_read (  
    uint32 src_addr,  
    void * des_addr,  
    uint32 save_size  
)
```

Parameter:

`uint32 src_addr` : source address (block number) in rtc memory, `src_addr >= 64`
`void * des_addr` : data pointer
`uint32 save_size` : data length, byte



Return:

true: succeed
false: fail

23. system_uart_swap

Function:

UART0 swap. Use MTCK as UART0 RX, MTDO as UART0 TX, so ROM log will not output from this new UART0. We also need to use MTDO (U0CTS) and MTCK (U0RTS) as UART0 in hardware.

Prototype:

```
void system_uart_swap (void)
```

Parameter:

null

Return:

null

24. system_uart_de_swap

Function:

Disable UART0 swap. Use original UART0, not MTCK and MTDO.

Prototype:

```
void system_uart_de_swap (void)
```

Parameter:

null

Return:

null

25. system_get_boot_version

Function:

Get version info of boot

Prototype:

```
uint8 system_get_boot_version (void)
```

Parameter:

null

Return:

Version info of boot.



Note:

If boot version ≥ 3 , you could enable boot enhance mode (refer to [system_restart_enhance](#))

26. `system_get_userbin_addr`

Function: Get address of the current running user bin (user1.bin or user2.bin).

Prototype:

```
uint32 system_get_userbin_addr (void)
```

Parameter:

null

Return:

Start address info of the current running user bin.

27. `system_get_boot_mode`

Function: Get boot mode.

Prototype:

```
uint8 system_get_boot_mode (void)
```

Parameter:

null

Return:

```
#define SYS_BOOT_ENHANCE_MODE 0
#define SYS_BOOT_NORMAL_MODE 1
```

Note:

Enhance boot mode: can load and run FW at any address;

Normal boot mode: can only load and run normal user1.bin (or user2.bin).

28. `system_restart_enhance`

Function:

Restarts system, and enters enhance boot mode.

Prototype:

```
bool system_restart_enhance(
    uint8 bin_type,
    uint32 bin_addr
)
```




Parameter:

```
uint8 bin_type : type of bin
#define SYS_BOOT_NORMAL_BIN 0 // user1.bin or user2.bin
#define SYS_BOOT_TEST_BIN 1 // can only be Espressif test bin
uint32 bin_addr : start address of bin file
```

Return:

```
true: succeed
false: Fail
```

Note:

`SYS_BOOT_TEST_BIN` is for factory test during production; you can apply for the test bin from Espressif Systems.

29. `system_update_cpu_freq`

Function:

Set CPU frequency. Default is 80MHz.

Note:

System bus frequency is 80MHz, will not be affected by CPU frequency. The frequency of UART, SPI, or other peripheral devices, are divided from system bus frequency, so they will not be affected by CPU frequency either.

Prototype:

```
bool system_update_cpu_freq(uint8 freq)
```

Parameter:

```
uint8 freq : CPU frequency
#define SYS_CPU_80MHz 80
#define SYS_CPU_160MHz 160
```

Return:

```
true: succeed
false: fail
```

30. `system_get_cpu_freq`

Function:

Get CPU frequency.

Prototype:

```
uint8 system_get_cpu_freq(void)
```

Parameter:

```
null
```



Return:

CPU frequency, unit : MHz.

31. system_get_flash_size_map

Function:

Get current flash size and flash map.

Flash map depends on the selection when compiling, more details in document “2A-ESP8266__IOT_SDK_User_Manual”

Structure:

```
enum flash_size_map {  
    FLASH_SIZE_4M_MAP_256_256 = 0,  
    FLASH_SIZE_2M,  
    FLASH_SIZE_8M_MAP_512_512,  
    FLASH_SIZE_16M_MAP_512_512,  
    FLASH_SIZE_32M_MAP_512_512,  
    FLASH_SIZE_16M_MAP_1024_1024,  
    FLASH_SIZE_32M_MAP_1024_1024  
};
```

Prototype:

```
enum flash_size_map system_get_flash_size_map(void)
```

Parameter:

none

Return:

flash map

32. system_get_rst_info

Function:

Get information about current startup.

Structure:

```
enum rst_reason {  
    REANSON_DEFAULT_RST        = 0,    // normal startup by power on  
    REANSON_WDT_RST            = 1,    // hardware watch dog reset  
    // exception reset, GPIO status won't change  
    REANSON_EXCEPTION_RST      = 2,
```



```
// software watch dog reset, GPIO status won't change
REANSON_SOFT_WDT_RST      = 3,
// software restart ,system_restart , GPIO status won't change
REANSON_SOFT_RESTART      = 4,
REANSON_DEEP_SLEEP_AWAKE  = 5,  // wake up from deep-sleep
REANSON_EXT_SYS_RST = 6,  // external system reset
};

struct rst_info {
    uint32 reason;  // enum rst_reason
    uint32 exccause;
    uint32 epc1; // the address that error occurred
    uint32 epc2;
    uint32 epc3;
    uint32 excvaddr;
    uint32 depc;
};
```

Prototype:

```
struct rst_info* system_get_rst_info(void)
```

Parameter:

none

Return:

Information about startup.

33. system_soft_wdt_stop

Function:

Stop software watchdog

Note:

Please don't stop software watchdog for too long (less than 6 seconds), otherwise it will trigger hardware watchdog reset.

Prototype:

```
void system_soft_wdt_stop(void)
```

Parameter:

none

Return:

none



34. `system_soft_wdt_restart`

Function:

Restart software watchdog

Note:

This API can only be called if software watchdog is stopped
(`system_soft_wdt_stop`)

Prototype:

```
void system_soft_wdt_restart(void)
```

Parameter:

none

Return:

none

35. `system_soft_wdt_feed`

Function:

Feed software watchdog

Note:

This API can only be called if software watchdog is enabled.

Prototype:

```
void system_soft_wdt_feed(void)
```

Parameter:

none

Return:

none

36. `os_memset`

Function:

Set value of memory

Prototype:

```
os_memset(void *s, int ch, size_t n)
```

Parameter:

`void *s` – pointer of memory

`int ch` – set value

`size_t n` – size



Return:

none

Example:

```
uint8 buffer[32];  
os_memset(buffer, 0, sizeof(buffer));
```

37. os_memcpy

Function:

copy memory

Prototype:

```
os_memcpy(void *des, void *src, size_t n)
```

Parameter:

`void *des` – pointer of destination

`void *src` – pointer of source

`size_t n` – memory size

Return:

none

Example:

```
uint8 buffer[4] = {0};  
os_memcpy(buffer, "abcd", 4);
```

38. os_strlen

Function:

Get string length

Prototype:

```
os_strlen(char *s)
```

Parameter:

`char *s` – string

Return:

string length

Example:

```
char *ssid = "ESP8266";  
os_memcpy(softAP_config.ssid, ssid, os_strlen(ssid));
```



39. `os_printf`

Function:

print format

Note:

Default to be output from UART 0. `uart_init` in `IOT_Demo` can set baud rate of UART, and `os_install_putc1((void *)uart1_write_char)` in it will set `os_printf` to be output from UART 1.

Prototype:

```
os_printf(const char *s)
```

Parameter:

`const char *s` – string

Return:

none

Example:

```
os_printf("SDK version: %s \n", system_get_sdk_version());
```

40. `os_bzero`

Function:

Set the first `n` bytes of string `p` to be 0, include `'\0'`

Prototype:

```
void os_bzero(void *p, size_t n)
```

Parameter:

`void *p` – pointer of memory need to be set 0

`size_t n` – length

Return:

none

41. `os_delay_us`

Function:

Time delay, max : 65535 us

Prototype:

```
void os_delay_us(uint16 us)
```

Parameter:

`uint16 us` – time, unit: us



Return:

none

42. `os_install_putc1`

Function:

Register print output function.

Prototype:

```
void os_install_putc1(void(*p)(char c))
```

Parameter:

`void(*p)(char c)` – pointer of print function

Return:

none

Example:

`os_install_putc1((void *)uart1_write_char)` in `uart_init` will set `os_printf` to be output from UART 1, otherwise, `os_printf` default output from UART 0.

3.4. SPI Flash Related APIs

More details about flash read/write operation in documentation “99A-SDK-Espressif IOT Flash RW Operation” <http://bbs.espressif.com/viewtopic.php?f=21&t=413>

1. `spi_flash_get_id`

Function:

Get ID info of spi flash

Prototype:

```
uint32 spi_flash_get_id (void)
```

Parameters:

null

Return:

SPI flash ID

2. `spi_flash_erase_sector`

Function:

Erase sector in flash



Prototype:

```
SpiFlashOpResult spi_flash_erase_sector (uint16 sec)
```

Parameters:

`uint16 sec` : Sector number, the count starts at sector 0, 4KB per sector.

Return:

```
typedef enum{
    SPI_FLASH_RESULT_OK,
    SPI_FLASH_RESULT_ERR,
    SPI_FLASH_RESULT_TIMEOUT
} SpiFlashOpResult;
```

3. spi_flash_write

Function:

Write data to flash. Flash read/write has to be 4-bytes aligned.

Prototype:

```
SpiFlashOpResult spi_flash_write (
    uint32 des_addr,
    uint32 *src_addr,
    uint32 size
)
```

Parameters:

`uint32 des_addr` : destination address in flash.
`uint32 *src_addr` : source address of the data.
`uint32 size` : length of data

Return:

```
typedef enum{
    SPI_FLASH_RESULT_OK,
    SPI_FLASH_RESULT_ERR,
    SPI_FLASH_RESULT_TIMEOUT
} SpiFlashOpResult;
```

4. spi_flash_read

Function:

Read data from flash. Flash read/write has to be 4-bytes aligned.

**Prototype:**

```
SpiFlashOpResult spi_flash_read(  
    uint32 src_addr,  
    uint32 * des_addr,  
    uint32 size  
)
```

Parameters:

```
uint32  src_addr: source address in flash  
uint32 *des_addr: destination address to keep data.  
uint32  size:     length of data
```

Return:

```
typedef enum {  
    SPI_FLASH_RESULT_OK,  
    SPI_FLASH_RESULT_ERR,  
    SPI_FLASH_RESULT_TIMEOUT  
} SpiFlashOpResult;
```

Example:

```
uint32 value;  
  
uint8 *addr = (uint8 *)&value;  
  
spi_flash_read(0x3E * SPI_FLASH_SEC_SIZE, (uint32 *)addr, 4);  
  
os_printf("0x3E sec:%02x%02x%02x%02x\r\n", addr[0], addr[1], addr[2],  
addr[3]);
```

5. system_param_save_with_protect

Function:

Write data into flash with protection. Flash read/write has to be 4-bytes aligned.

Protection of flash read/write : use 3 sectors (4KBytes per sector) to save 4KB data with protect, sector 0 and sector 1 are data sectors, back up each other, save data alternately, sector 2 is flag sector, point out which sector is keeping the latest data, sector 0 or sector 1.

Note:

More details about protection of flash read/write in documentation “99A-SDK-Espressif IOT Flash RW Operation” <http://bbs.espressif.com/viewtopic.php?f=21&t=413>



Prototype:

```
bool system_param_save_with_protect (
    uint16 start_sec,
    void *param,
    uint16 len
)
```

Parameter:

uint16 start_sec : start sector (sector 0) of the 3 sectors which used for flash read/write protection.

For example, in IOT_Demo we could use the 3 sectors (3 * 4KB) starts from flash 0x3D000 for flash read/write protection, so the parameter **start_sec** should be 0x3D

void *param : pointer of data need to save

uint16 len : data length, should less than a sector which is 4 * 1024

Return:

true, succeed;

false, fail

6. system_param_load

Function:

Read data which saved into flash with protection. Flash read/write has to be 4-bytes aligned.

Protection of flash read/write : use 3 sectors (4KBytes per sector) to save 4KB data with protect, sector 0 and sector 1 are data sectors, back up each other, save data alternately, sector 2 is flag sector, point out which sector is keeping the latest data, sector 0 or sector 1.

Note:

More details about protection of flash read/write in documentation “99A-SDK-Espressif IOT Flash RW Operation” <http://bbs.espressif.com/viewtopic.php?f=21&t=413>

Prototype:

```
bool system_param_load (
    uint16 start_sec,
    uint16 offset,
    void *param,
    uint16 len
)
```

**Parameter:**

`uint16 start_sec` : start sector (sector 0) of the 3 sectors which used for flash read/write protection. It can not sector 1 or sector 2.

For example, in IOT_Demo we could use the 3 sectors (3 * 4KB) starts from flash 0x3D000 for flash read/write protection, so the parameter `start_sec` is 0x3D, can not be 0x3E or 0x3F.

`uint16 offset` : offset of data saved in sector

`void *param` : data pointer

`uint16 len` : data length, $\text{offset} + \text{len} \leq 4 * 1024$

Return:

true, succeed;

false, fail

7. spi_flash_set_read_func

Function:

Register user-define SPI flash read API.

Note:

This API can be only used in SPI overlap mode, please refer to `esp_iot_sdk\examples\driver_lib\driver\spi_overlap.c`

Prototype:

```
void spi_flash_set_read_func (user_spi_flash_read read)
```

Parameter:

`user_spi_flash_read read` : user-define SPI flash read API

Parameter Definition:

```
typedef SpiFlashOpResult (*user_spi_flash_read)(  
    SpiFlashChip *spi,  
    uint32 src_addr,  
    uint32 * des_addr,  
    uint32 size  
)
```

Return:

none





3.5. Wi-Fi Related APIs

`wifi_station` APIs and other APIs which set/get configurations of the ESP8266 station can only be called if the ESP8266 station is enabled.

`wifi_softap` APIs and other APIs which set/get configurations of the ESP8266 soft-AP can only be called if the ESP8266 soft-AP is enabled.

Flash system parameter area is the last 16KB of flash.

1. `wifi_get_opmode`

Function:

get WiFi current operating mode

Prototype:

```
uint8 wifi_get_opmode (void)
```

Parameters:

null

Return:

WiFi working modes:

0x01: station mode

0x02: soft-AP mode

0x03: station+soft-AP

2. `wifi_get_opmode_default`

Function:

get WiFi operating mode that saved in flash

Prototype:

```
uint8 wifi_get_opmode_default (void)
```

Parameters:

null

Return:

WiFi working modes:

0x01: station mode

0x02: soft-AP mode

0x03: station+soft-AP



3. `wifi_set_opmode`

Function:

Sets WiFi working mode as station, soft-AP or station+soft-AP, and save it to flash. Default is soft-AP mode.

Note:

Versions before `esp-iot-sdk_v0.9.2`, need to call `system_restart()` after this api; after `esp-iot-sdk_v0.9.2`, need not to restart.

This configuration will be saved in flash system parameter area if changed.

Prototype:

```
bool wifi_set_opmode (uint8 opmode)
```

Parameters:

`uint8 opmode`: WiFi operating modes:

0x01: station mode

0x02: soft-AP mode

0x03: station+soft-AP

Return:

true: succeed

false: fail

4. `wifi_set_opmode_current`

Function:

Sets WiFi working mode as station, soft-AP or station+soft-AP, and won't save to flash

Prototype:

```
bool wifi_set_opmode_current (uint8 opmode)
```

Parameters:

`uint8 opmode`: WiFi operating modes:

0x01: station mode

0x02: soft-AP mode

0x03: station+soft-AP

Return:

true: succeed

false: fail

5. `wifi_station_get_config`

Function:

Get WiFi station current configuration



Prototype:

```
bool wifi_station_get_config (struct station_config *config)
```

Parameters:

```
struct station_config *config : WiFi station configuration pointer
```

Return:

```
true:  succeed  
false: fail
```

6. `wifi_station_get_config_default`

Function:

Get WiFi station configuration that saved in flash

Prototype:

```
bool wifi_station_get_config_default (struct station_config *config)
```

Parameters:

```
struct station_config *config : WiFi station configuration pointer
```

Return:

```
true:  succeed  
false: fail
```

7. `wifi_station_set_config`

Function:

Set WiFi station configuration, and save it to flash

Note:

- This API can be called only if ESP8266 station is enabled.
- If `wifi_station_set_config` is called in `user_init`, there is no need to call `wifi_station_connect` after that, ESP8266 will connect to router automatically; otherwise, need `wifi_station_connect` to connect.
- In general, `station_config.bssid_set` need to be 0, otherwise it will check bssid which is the MAC address of AP.
- This configuration will be saved in flash system parameter area if changed.

Prototype:

```
bool wifi_station_set_config (struct station_config *config)
```



Parameters:

`struct station_config *config`: WiFi station configuration pointer

Return:

true: succeed

false: fail

Example:

```
void ICACHE_FLASH_ATTR
user_set_station_config(void)
{
    char ssid[32] = SSID;
    char password[64] = PASSWORD;
    struct station_config stationConf;

    stationConf.bssid_set = 0; //need not check MAC address of AP

    os_memcpy(&stationConf.ssid, ssid, 32);
    os_memcpy(&stationConf.password, password, 64);
    wifi_station_set_config(&stationConf);
}

void user_init(void)
{
    wifi_set_opmode(STATIONAP_MODE); //Set softAP + station mode
    user_set_station_config();
}
```

8. `wifi_station_set_config_current`

Function:

Set WiFi station configuration, won't save to flash

Note:

- This API can be called only if ESP8266 station is enabled.
- If `wifi_station_set_config_current` is called in `user_init`, there is no need to call `wifi_station_connect` after that, ESP8266 will connect to router automatically; otherwise, need `wifi_station_connect` to connect.
- In general, `station_config.bssid_set` need to be 0, otherwise it will check bssid which is the MAC address of AP.

Prototype:

```
bool wifi_station_set_config_current (struct station_config *config)
```




Parameters:

`struct station_config *config`: WiFi station configuration pointer

Return:

true: succeed
false: fail

9. `wifi_station_connect`

Function:

To connect WiFi station to AP

Note:

- If the ESP8266 is already connected to a router, we need to call `wifi_station_disconnect` first, before calling `wifi_station_connect`.
- Do not call this API in `user_init`. This API need to be called after system initializes and the ESP8266 station enabled.

Prototype:

`bool wifi_station_connect (void)`

Parameters:

null

Return:

true: succeed
false: fail

10. `wifi_station_disconnect`

Function:

Disconnects WiFi station from AP

Note:

Do not call this API in `user_init`. This API need to be called after system initializes and the ESP8266 station enabled.

Prototype:

`bool wifi_station_disconnect (void)`

Parameters:

null

Return:

true: succeed
false: fail



11. wifi_station_get_connect_status

Function:

Get connection status of WiFi station to AP

Prototype:

```
uint8 wifi_station_get_connect_status (void)
```

Parameters:

null

Return:

```
enum{
    STATION_IDLE = 0,
    STATION_CONNECTING,
    STATION_WRONG_PASSWORD,
    STATION_NO_AP_FOUND,
    STATION_CONNECT_FAIL,
    STATION_GOT_IP
};
```

12. wifi_station_scan

Function:

Scan all available APs

Note:

Do not call this API in `user_init`. This API need to be called after system initializes and the ESP8266 station enabled.

Prototype:

```
bool wifi_station_scan (struct scan_config *config, scan_done_cb_t cb);
```

Structure:

```
struct scan_config {
    uint8 *ssid;        // AP's ssid
    uint8 *bssid;       // AP's bssid
    uint8 channel;      //scan a specific channel
    uint8 show_hidden;  //scan APs of which ssid is hidden.
};
```

Parameters:

```
struct scan_config *config: AP config for scan
if config==null: scan all APs
if config.ssid==null && config.bssid==null && config.channel!=null:
    ESP8266 will scan the specific channel.
scan_done_cb_t cb: callback function after scan
```



Return:

true: succeed
false: fail

13. scan_done_cb_t

Function:

Callback function for wifi_station_scan

Prototype:

```
void scan_done_cb_t (void *arg, STATUS status)
```

Parameters:

void *arg: information of APs that be found, refer to struct `bss_info`
STATUS status: get status

Return:

null

Example:

```
wifi_station_scan(&config, scan_done);  
static void ICACHE_FLASH_ATTR scan_done(void *arg, STATUS status) {  
    if (status == OK) {  
        struct bss_info *bss_link = (struct bss_info *)arg;  
        bss_link = bss_link->next.stqe_next; //ignore first  
        ...  
    }  
}
```

14. wifi_station_ap_number_set

Function:

Sets the number of APs that will be cached for ESP8266 station mode.
Whenever ESP8266 station connects to an AP, it keeps caches a record of this AP's SSID and password. The cached ID index starts from 0.

Note:

This configuration will be saved in flash system parameter area if changed.

Prototype:

```
bool wifi_station_ap_number_set (uint8 ap_number)
```

Parameters:

uint8 ap_number: the number of APs can be recorded (MAX: 5)



Return:

true: succeed
false: fail

15. wifi_station_get_ap_info

Function:

Get information of APs recorded by ESP8266 station.

Prototype:

```
uint8 wifi_station_get_ap_info(struct station_config config[])
```

Parameters:

`struct station_config config[]`: information of APs, array size has to be 5.

Return:

The number of APs recorded.

Example:

```
struct station_config config[5];  
int i = wifi_station_get_ap_info(config);
```

16. wifi_station_ap_change

Function:

Switch ESP8266 station connection to AP as specified

Prototype:

```
bool wifi_station_ap_change (uint8 new_ap_id)
```

Parameters:

`uint8 new_ap_id` : AP's record id, start counting from 0.

Return:

true: succeed
false: fail

17. wifi_station_get_current_ap_id

Function:

Get the current record id of AP.

Prototype:

```
uint8 wifi_station_get_current_ap_id ();
```

Parameter:

null



Return:

The index of the AP, which ESP8266 is currently connected to, in the cached AP list.

18. `wifi_station_get_auto_connect`

Function:

Checks if ESP8266 station mode will connect to AP (which is cached) automatically or not when it is powered on.

Prototype:

```
uint8 wifi_station_get_auto_connect(void)
```

Parameter:

null

Return:

0: will not connect to AP automatically;
Non-0: will connect to AP automatically.

19. `wifi_station_set_auto_connect`

Function:

Setting the ESP8266 station to connect to the AP (which is recorded) automatically or not when powered on. Enable auto-connect by default.

Note:

Call this API in `user_init`, it is effective in this current power on; call it in other place, it will be effective in next power on.

This configuration will be saved in flash system parameter area if changed.

Prototype:

```
bool wifi_station_set_auto_connect(uint8 set)
```

Parameter:

`uint8 set`: Automatically connect or not:
0: will not connect automatically
1: to connect automatically

Return:

true: succeed
false: fail

20. `wifi_station_dhcpc_start`

Function:

Enable ESP8266 station DHCP client.



Note:

DHCP is enabled by default.

This configuration interacts with static IP API ([wifi_set_ip_info](#)):

If DHCP is enabled,, static IP will be disabled;

If static IP is enabled,, DHCP will be disabled;

These settings depend on the last configuration.

Prototype:

```
bool wifi_station_dhcpc_start(void)
```

Parameter:

null

Return:

true: succeed

false: fail

21. [wifi_station_dhcpc_stop](#)

Function:

Disable ESP8266 station DHCP client.

Note:

DHCP default enable.

Prototype:

```
bool wifi_station_dhcpc_stop(void)
```

Parameter:

null

Return:

true: succeed

false: fail

22. [wifi_station_dhcpc_status](#)

Function: Get ESP8266 station DHCP client status.

Prototype:

```
enum dhcpc_status wifi_station_dhcpc_status(void)
```

Parameter:

null



Return:

```
enum dhcp_status {  
    DHCP_STOPPED,  
    DHCP_STARTED  
};
```

23. wifi_station_set_reconnect_policy

Function:

Set whether reconnect or not when the ESP8266 station is disconnected from AP

Note:

We suggest to call this API in `user_init`

This API can only be called when the ESP8266 station is enabled.

Prototype:

```
bool wifi_station_set_reconnect_policy(bool set)
```

Parameter:

`bool set` - true, enable reconnect; false, disable reconnect

Return:

true: succeed

false: fail

24. wifi_station_get_rssi

Function:

Get rssi of the AP which ESP8266 station connected to

Prototype:

```
sint8 wifi_station_get_rssi(void)
```

Parameter:

none

Return:

< 0 : succeed, return rssi

31 : fail, return error code



25. wifi_station_set_hostname

Function:

Set ESP8266 station DHCP hostname

Prototype:

```
bool wifi_station_set_hostname(char* hostname)
```

Parameter:

`char* hostname` : hostname, max length: 32

Return:

true: succeed

false: fail

26. wifi_station_get_hostname

Function:

Get ESP8266 station DHCP hostname

Prototype:

```
char* wifi_station_get_hostname(void)
```

Parameter:

none

Return:

hostname

27. wifi_softap_get_config

Function:

Get WiFi soft-AP current configuration

Prototype:

```
bool wifi_softap_get_config(struct softap_config *config)
```

Parameter:

`struct softap_config *config` : ESP8266 soft-AP config

Return:

true: succeed

false: fail



28. wifi_softap_get_config_default

Function:

Get WiFi soft-AP configurations saved in flash

Prototype:

```
bool wifi_softap_get_config_default(struct softap_config *config)
```

Parameter:

`struct softap_config *config` : ESP8266 soft-AP config

Return:

true: succeed
false: fail

29. wifi_softap_set_config

Function:

Set WiFi soft-AP configuration and save it to flash

Note:

- This API can be called only if the ESP8266 soft-AP is enabled.
- This configuration will be saved in flash system parameter area if changed.
- In soft-AP + station mode, the ESP8266 soft-AP will adjust its channel configuration to be the as same as the ESP8266. More details in appendix or BBS <http://bbs.espressif.com/viewtopic.php?f=10&t=324>

Prototype:

```
bool wifi_softap_set_config (struct softap_config *config)
```

Parameter:

`struct softap_config *config` : WiFi soft-AP configuration pointer

Return:

true: succeed
false: fail

30. wifi_softap_set_config_current

Function:

Set WiFi soft-AP configuration, won't save it to flash

Note:

- This API can be called only if the ESP8266 soft-AP is enabled.



- In the soft-AP + station mode, ESP8266 soft-AP will adjust its channel configuration to be as same as the ESP8266. More details in appendix or BBS <http://bbs.espressif.com/viewtopic.php?f=10&t=324>

Prototype:

```
bool wifi_softap_set_config_current (struct softap_config *config)
```

Parameter:

```
struct softap_config *config : WiFi soft-AP configuration pointer
```

Return:

```
true: succeed  
false: fail
```

31. wifi_softap_get_station_num

Function:

count the number of stations connected to the ESP8266 soft-AP

Prototype:

```
uint8 wifi_softap_get_station_num(void)
```

Parameter:

```
none
```

Return:

```
how many stations connected to ESP8266 soft-AP
```

32. wifi_softap_get_station_info

Function:

Get connected station devices under soft-AP mode, including MAC and IP

Note:

This API can not get static IP. It can only be used when DHCP enabled.

Prototype:

```
struct station_info * wifi_softap_get_station_info(void)
```

Input Parameters:

```
null
```

Return:

```
struct station_info* : station information structure
```



33. wifi_softap_free_station_info

Function:

Frees the struct `station_info` by calling the `wifi_softap_get_station_info` function

Prototype:

```
void wifi_softap_free_station_info(void)
```

Input Parameters:

null

Return:

null

Examples 1 (Getting MAC and IP information):

```
struct station_info * station = wifi_softap_get_station_info();
struct station_info * next_station;
while(station) {
    os_printf(bssid : MACSTR, ip : IPSTR/n,
              MAC2STR(station->bssid), IP2STR(&station->ip));
    next_station = STAILQ_NEXT(station, next);
    os_free(station);    // Free it directly
    station = next_station;
}
```

Examples 2 (Getting MAC and IP information):

```
struct station_info * station = wifi_softap_get_station_info();
while(station){
    os_printf(bssid : MACSTR, ip : IPSTR/n,
              MAC2STR(station->bssid), IP2STR(&station->ip));
    station = STAILQ_NEXT(station, next);
}
wifi_softap_free_station_info();    // Free it by calling functions
```

34. wifi_softap_dhcps_start

Function: Enable ESP8266 soft-AP DHCP server.

Note:

DHCP default enable.

This configuration interacts with static IP API (`wifi_set_ip_info`):

If enable DHCP, static IP will be disabled;

If enable static IP, DHCP will be disabled;

This will depend on the last configuration.



Prototype:

```
bool wifi_softap_dhcps_start(void)
```

Parameter:

null

Return:

true: succeed

false: fail

35. `wifi_softap_dhcps_stop`

Function: Disable ESP8266 soft-AP DHCP server.

Note: DHCP default enable.

Prototype:

```
bool wifi_softap_dhcps_stop(void)
```

Parameter:

null

Return:

true: succeed

false: fail

36. `wifi_softap_set_dhcps_lease`

Function:

Set the IP range that can be got from the ESP8266 soft-AP DHCP server.

Note:

- IP range has to be in the same sub-net with the ESP8266 soft-AP IP address
- This API can only be called during DHCP server disable (`wifi_softap_dhcps_stop`)
- This configuration only takes effect on next `wifi_soft-AP_dhcps_start`; if then `wifi_softap_dhcps_stop` is called, user needs to call this API to set IP range again if needed, and then call `wifi_softap_dhcps_start` for the configuration to take effect.

Prototype:

```
bool wifi_softap_set_dhcps_lease(struct dhcps_lease *please)
```



Parameter:

```
struct dhcps_lease {
    struct ip_addr start_ip;
    struct ip_addr end_ip;
};
```

Return:

```
true:  succeed
false: fail
```

Example:

```
void dhcps_lease_test(void)
{
    struct dhcps_lease dhcp_lease;
    const char* start_ip = "192.168.5.100";
    const char* end_ip = "192.168.5.105";

    dhcp_lease.start_ip.addr = ipaddr_addr(start_ip);
    dhcp_lease.end_ip.addr = ipaddr_addr(end_ip);
    wifi_softap_set_dhcps_lease(&dhcp_lease);
}
```

or

```
void dhcps_lease_test(void)
{
    struct dhcps_lease dhcp_lease;
    IP4_ADDR(&dhcp_lease.start_ip, 192, 168, 5, 100);
    IP4_ADDR(&dhcp_lease.end_ip, 192, 168, 5, 105);
    wifi_softap_set_dhcps_lease(&dhcp_lease);
}

void user_init(void)
{
    struct ip_info info;
    wifi_set_opmode(STATIONAP_MODE); //Set softAP + station mode
    wifi_softap_dhcps_stop();

    IP4_ADDR(&info.ip, 192, 168, 5, 1);
    IP4_ADDR(&info.gw, 192, 168, 5, 1);
    IP4_ADDR(&info.netmask, 255, 255, 255, 0);
    wifi_set_ip_info(SOFTAP_IF, &info);

    dhcps_lease_test();
    wifi_softap_dhcps_start();
}
```



37. wifi_softap_get_dhcps_lease

Function:

Query the IP range that can be got from the ESP8266 soft-AP DHCP server.

Note:

This API can only be called during ESP8266 soft-AP DHCP server enabled.

Prototype:

```
bool wifi_softap_get_dhcps_lease(struct dhcps_lease *please)
```

Return:

true: succeed
false: fail

38. wifi_softap_dhcps_status

Function: Get ESP8266 soft-AP DHCP server status.

Prototype:

```
enum dhcp_status wifi_softap_dhcps_status(void)
```

Parameter:

null

Return:

```
enum dhcp_status {  
    DHCP_STOPPED,  
    DHCP_STARTED  
};
```

39. wifi_softap_set_dhcps_offer_option

Function:

Set ESP8266 soft-AP DHCP server option.

Structure:

```
enum dhcps_offer_option{  
    OFFER_START = 0x00,  
    OFFER_ROUTER = 0x01,  
    OFFER_END  
};
```

Prototype:

```
bool wifi_softap_set_dhcps_offer_option(uint8 level, void* optarg)
```



Parameter:

`uint8 level` – `OFFER_ROUTER` set router option
`void* optarg` – default to be enable
`bit0, 0` disable router information from ESP8266 softAP DHCP server;
`bit0, 1` enable router information from ESP8266 softAP DHCP server;

Return:

`true` : succeed
`false` : fail

Example:

```
uint8 mode = 0;
wifi_softap_set_dhcps_offer_option(OFFER_ROUTER, &mode);
```

40. `wifi_set_phy_mode`

Fuction: Set ESP8266 physical mode (802.11b/g/n).

Note: ESP8266 soft-AP only support bg.

Prototype:

```
bool wifi_set_phy_mode(enum phy_mode mode)
```

Parameter:

`enum phy_mode mode` : physical mode
`enum phy_mode` {
 `PHY_MODE_11B` = 1,
 `PHY_MODE_11G` = 2,
 `PHY_MODE_11N` = 3
};

Return:

`true` : succeed
`false` : fail

41. `wifi_get_phy_mode`

Function:

Get ESP8266 physical mode (802.11b/g/n)

Prototype:

```
enum phy_mode wifi_get_phy_mode(void)
```



Parameter:

null

Return:

```
enum phy_mode{
    PHY_MODE_11B = 1,
    PHY_MODE_11G = 2,
    PHY_MODE_11N = 3
};
```

42. `wifi_get_ip_info`

Function:

Get IP info of WiFi station or soft-AP interface

Prototype:

```
bool wifi_get_ip_info(
    uint8 if_index,
    struct ip_info *info
)
```

Parameters:

`uint8 if_index` : the interface to get IP info: `0x00` for `STATION_IF`, `0x01` for `SOFTAP_IF`.
`struct ip_info *info` : pointer to get IP info of a certain interface

Return:

true: succeed
false: fail

43. `wifi_set_ip_info`

Function:

Set IP address of ESP8266 station or soft-AP

Note:

To set static IP, please disable DHCP first (`wifi_station_dhcpc_stop` or `wifi_softap_dhcps_stop`):

If enable static IP, DHCP will be disabled;

If enable DHCP, static IP will be disabled;



Prototype:

```
bool wifi_set_ip_info(
    uint8 if_index,
    struct ip_info *info
)
```

Prototype:

```
uint8 if_index : set station IP or soft-AP IP
#define STATION_IF    0x00
#define SOFTAP_IF     0x01
struct ip_info *info : IP information
```

Example:

```
struct ip_info info;

wifi_station_dhcpc_stop();

wifi_softap_dhcps_stop();

IP4_ADDR(&info.ip, 192, 168, 3, 200);
IP4_ADDR(&info.gw, 192, 168, 3, 1);
IP4_ADDR(&info.netmask, 255, 255, 255, 0);
wifi_set_ip_info(STATION_IF, &info);

IP4_ADDR(&info.ip, 10, 10, 10, 1);
IP4_ADDR(&info.gw, 10, 10, 10, 1);
IP4_ADDR(&info.netmask, 255, 255, 255, 0);
wifi_set_ip_info(SOFTAP_IF, &info);

wifi_softap_dhcps_start();
```

Return:

```
true: succeed
false: fail
```

44. **wifi_set_macaddr**

Function:

Sets MAC address

Note:

- This API can only be called in `user_init`.
- ESP8266 soft-AP and station have different MAC addresses, please do not set them to be the same.



Prototype:

```
bool wifi_set_macaddr(  
    uint8 if_index,  
    uint8 *macaddr  
)
```

Parameter:

```
uint8 if_index : set station MAC or soft-AP mac  
#define STATION_IF    0x00  
#define SOFTAP_IF     0x01  
uint8 *macaddr : MAC address
```

Example:

```
wifi_set_opmode(STATIONAP_MODE);  
  
char sofap_mac[6] = {0x16, 0x34, 0x56, 0x78, 0x90, 0xab};  
char sta_mac[6] = {0x12, 0x34, 0x56, 0x78, 0x90, 0xab};  
wifi_set_macaddr(SOFTAP_IF, sofap_mac);  
wifi_set_macaddr(STATION_IF, sta_mac);
```

Return:

```
true:  succeed  
false: fail
```

45. wifi_get_macaddr

Function: get MAC address

Prototype:

```
bool wifi_get_macaddr(  
    uint8 if_index,  
    uint8 *macaddr  
)
```

Parameter:

```
uint8 if_index : set station MAC or soft-AP mac  
#define STATION_IF    0x00  
#define SOFTAP_IF     0x01  
uint8 *macaddr : MAC address
```

Return:

```
true:  succeed  
false: fail
```



46. `wifi_set_sleep_type`

Function:

Sets sleep type for power saving. Set `NONE_SLEEP_T` to disable power saving.

Note: Default to be Modem sleep.

Prototype:

```
bool wifi_set_sleep_type(enum sleep_type type)
```

Parameters:

```
enum sleep_type type : sleep type
```

Return:

```
true: succeed  
false: fail
```

47. `wifi_get_sleep_type`

Function:

Gets sleep type.

Prototype:

```
enum sleep_type wifi_get_sleep_type(void)
```

Parameters:

```
null
```

Return:

```
enum sleep_type {  
    NONE_SLEEP_T = 0;  
    LIGHT_SLEEP_T,  
    MODEM_SLEEP_T  
};
```

48. `wifi_status_led_install`

Function:

Installs WiFi status LED

Prototype:

```
void wifi_status_led_install (  
    uint8 gpio_id,  
    uint32 gpio_name,  
    uint8 gpio_func  
)
```



Parameter:

`uint8 gpio_id` : GPIO number
`uint8 gpio_name` : GPIO mux name
`uint8 gpio_func` : GPIO function

Return:

null

Example:

Use GPIO0 as WiFi status LED

```
#define HUMITURE_WIFI_LED_IO_MUX    PERIPHS_IO_MUX_GPIO0_U
#define HUMITURE_WIFI_LED_IO_NUM    0
#define HUMITURE_WIFI_LED_IO_FUNC    FUNC_GPIO0
wifi_status_led_install(HUMITURE_WIFI_LED_IO_NUM,
                        HUMITURE_WIFI_LED_IO_MUX, HUMITURE_WIFI_LED_IO_FUNC)
```

49. wifi_status_led_uninstall

Function: Uninstall WiFi status LED

Prototype:

```
void wifi_status_led_uninstall ()
```

Parameter:

null

Return:

null

50. wifi_set_broadcast_if

Function:

Set ESP8266 send UDP broadcast from station interface or soft-AP interface, or both station and soft-AP interfaces. Default to be soft-AP.

Note:

If set broadcast interface to be station only, ESP8266 softAP DHCP server will be disable.

Prototype:

```
bool wifi_set_broadcast_if (uint8 interface)
```

Parameter:

`uint8 interface` : 1:station; 2:soft-AP, 3:station+soft-AP



Return:

true: succeed
false: fail

51. `wifi_get_broadcast_if`

Function:

Get interface which ESP8266 sent UDP broadcast from. This is usually used when you have STA + soft-AP mode to avoid ambiguity.

Prototype:

```
uint8 wifi_get_broadcast_if (void)
```

Parameter:

none

Return:

1: station
2: soft-AP
3: both station and soft-AP

52. `wifi_set_event_handler_cb`

Function:

Register Wi-Fi event handler

Prototype:

```
void wifi_set_event_handler_cb(wifi_event_handler_cb_t cb)
```

Parameter:

`wifi_event_handler_cb_t cb` : callback

Return:

none

Example:

```
void wifi_handle_event_cb(System_Event_t *evt)
{
    os_printf("event %x\n", evt->event);
    switch (evt->event) {
        case EVENT_STAMODE_CONNECTED:
            os_printf("connect to ssid %s, channel %d\n",
                evt->event_info.connected.ssid,
                evt->event_info.connected.channel);
            break;
        case EVENT_STAMODE_DISCONNECTED:
```



```
        os_printf("disconnect from ssid %s, reason %d\n",
                  evt->event_info.disconnected.ssid,
                  evt->event_info.disconnected.reason);

        break;
case EVENT_STAMODE_AUTHMODE_CHANGE:
    os_printf("mode: %d -> %d\n",
              evt->event_info.auth_change.old_mode,
              evt->event_info.auth_change.new_mode);

    break;
case EVENT_STAMODE_GOT_IP:
    os_printf("ip:" IPSTR ",mask:" IPSTR ",gw:" IPSTR,
              IP2STR(&evt->event_info.got_ip.ip),
              IP2STR(&evt->event_info.got_ip.mask),
              IP2STR(&evt->event_info.got_ip.gw));

    os_printf("\n");
    break;
case EVENT_SOFTAPMODE_STACONNECTED:
    os_printf("station: " MACSTR "join, AID = %d\n",
              MAC2STR(evt->event_info.sta_connected.mac),
              evt->event_info.sta_connected.aid);

    break;
case EVENT_SOFTAPMODE_STADISCONNECTED:
    os_printf("station: " MACSTR "leave, AID = %d\n",
              MAC2STR(evt->event_info.sta_disconnected.mac),
              evt->event_info.sta_disconnected.aid);

    break;
default:
    break;
    }
}

void user_init(void)
{
    // TODO: add your own code here....
    wifi_set_event_handler_cb(wifi_handle_event_cb);
}
```

53. wifi_get_channel

Function:

Get Wi-Fi channel



Prototype:

```
uint8 wifi_get_channel(void)
```

Parameters:

null

Return:

Channel number

54. wifi_set_channel

Function:

Set Wi-Fi channel

NOTE:

- If set channel to be different with router's channel, ESP8266 station may disconnect from router
- Set channel in soft-AP + station mode please pay attention on appendix ["ESP8266 soft-AP and station channel configuration"](#)

Prototype:

```
bool wifi_set_channel (uint8 channel)
```

Parameters:

uint8 channel : channel number

Return:

true: succeed

false: fail

55. wifi_wps_enable

Function:

Enable Wi-Fi WPS function

Note:

WPS can only be used when ESP8266 station is enabled.

Structure:

```
typedef enum wps_type {  
    WPS_TYPE_DISABLE=0,  
    WPS_TYPE_PBC,  
    WPS_TYPE_PIN,  
    WPS_TYPE_DISPLAY,  
    WPS_TYPE_MAX,  
}
```



```
}WPS_TYPE_t;
```

Prototype:

```
bool wifi_wps_enable(WPS_TYPE_t wps_type)
```

Parameter:

`WPS_TYPE_t wps_type` : WPS type, so far only `WPS_TYPE_PBC` is supported

Return:

true: succeed
false: fail

56. wifi_wps_disable

Function:

Disable Wi-Fi WPS function and release resource it taken

Prototype:

```
bool wifi_wps_disable(void)
```

Parameter:

none

Return:

true: succeed
false: fail

57. wifi_wps_start

Function:

WPS starts to work

Note:

WPS can only be used when ESP8266 station is enabled.

Prototype:

```
bool wifi_wps_start(void)
```

Parameter:

none

Return:

true: means that WPS starts to work successfully, does not mean WPS succeed.
false: fail



58. `wifi_set_wps_cb`

Function:

Set WPS callback, parameter of the callback is the status of WPS.

Callback and parameter structure:

```
typedef void (*wps_st_cb_t)(int status);

enum wps_cb_status {
    WPS_CB_ST_SUCCESS = 0,
    WPS_CB_ST_FAILED,
    WPS_CB_ST_TIMEOUT,
    WPS_CB_ST_WEP,    // WPS failed because that WEP is not supported
};
```

Note:

- If parameter `status == WPS_CB_ST_SUCCESS` in WPS callback, it means WPS got AP's information, user can call `wifi_wps_disable` to disable WPS and release resource, then call `wifi_station_connect` to connect to target AP.
- Otherwise, it means that WPS fail, user can create a timer to retry WPS by `wifi_wps_start` after a while, or call `wifi_wps_disable` to disable WPS and release resource.

Prototype:

```
bool wifi_set_wps_cb(wps_st_cb_t cb)
```

Parameter:

`wps_st_cb_t cb` : callback

Return:

true: succeed
false: fail



3.6. ESP-NOW APIs

Pay attention on following items:

- ESP-NOW is targeted to Smart-Light project, so it is suggested that slave role corresponding to soft-AP or soft-AP+station mode, controller role corresponding to station mode.
- When ESP8266 is in soft-AP+station mode, it will communicate through station interface if it is in slave role, and communicate through soft-AP interface if it is in controller role.
- ESP-NOW can not wake ESP8266 up from sleep, so if the target ESP8266 station is in sleep, ESP-NOW communication will fail.
- In station mode, ESP8266 supports 10 encrypt ESP-NOW peers at most, with the unencrypted peers, it can be 20 peers in total at most.
- In the soft-AP mode or soft-AP + station mode, the ESP8266 supports 6 encrypt ESP-NOW peers at most, with the unencrypted peers, it can be 20 peers in total at most.

1. esp_now_init

Function:

ESP-NOW initialization

Prototype:

```
init esp_now_init(void)
```

Parameter:

none

Return:

0, succeed

otherwise, fail

2. esp_now_deinit

Function:

Deinitialize ESP-NOW

Prototype:

```
int esp_now_deinit(void)
```

Parameter:

none

Return:

0, succeed

otherwise, fail



3. esp_now_register_recv_cb

Function:

Register ESP-NOW receive callback

Note:

When received an ESP-NOW packet, enter receive callback:

```
typedef void (*esp_now_recv_cb_t)(u8 *mac_addr, u8 *data, u8 len)
```

Parameters of ESP-NOW receive callback:

`u8 *mac_addr` : MAC address of the sender

`u8 *data` : data received

`u8 len` : data length

Prototype:

```
int esp_now_register_recv_cb(esp_now_recv_cb_t cb)
```

Parameter:

`esp_now_recv_cb_t cb` : receive callback

Return:

0, succeed

otherwise, fail

4. esp_now_unregister_recv_cb

Function:

Unregister ESP-NOW receive callback

Prototype:

```
int esp_now_unregister_recv_cb(void)
```

Parameter:

none

Return:

0, succeed

otherwise, fail

5. esp_now_register_send_cb

Function:

Register ESP-NOW send callback

Notice:



ESP-NOW send callback:

```
void esp_now_send_cb_t(u8 *mac_addr, u8 status)
```

Parameter:

`u8 *mac_addr` : MAC address of target device

`u8 status` : status of ESP-NOW sending packet

```
mt_tx_status {  
    T_TX_STATUS_OK = 0,  
    MT_TX_STATUS_FAILED,  
}
```

The status will be `T_TX_STATUS_OK`, if ESP-NOW send packet successfully.
Users should make sure by themselves that key of communication is correct.

Prototype:

```
u8 esp_now_register_send_cb(esp_now_send_cb_t cb)
```

Parameter:

`esp_now_send_cb_t cb` : callback

Return:

0, succeed

otherwise, fail

6. `esp_now_unregister_send_cb`

Function:

Unregister ESP-NOW send callback

Prototype:

```
int esp_now_unregister_send_cb(void)
```

Parameter:

null

Return:

0, succeed

otherwise, fail

7. `esp_now_send`

Function:

Send ESP-NOW packet



Prototype:

```
int esp_now_send(u8 *da, u8 *data, int len)
```

Parameter:

u8 *da : Destination MAC address. If it's **NULL**, send packet to all MAC addresses recorded by ESP-NOW; otherwise, send packet to target MAC address.

u8 *data : data need to send

u8 len : data length

Return:

0, succeed

otherwise, fail

8. esp_now_add_peer

Function:

Add an ESP-NOW peer, store MAC address of target device into ESP-NOW MAC list.

Structure:

```
typedef enum mt_role {  
    MT_ROLE_IDLE = 0,  
    MT_ROLE_CONTROLLER,  
    MT_ROLE_SLAVE,  
    MT_ROLE_MAX,  
}
```

Prototype:

```
int esp_now_add_peer(u8 *mac_addr, u8 role, u8 channel, u8 *key, u8 key_len)
```

Parameter:

u8 *mac_addr : MAC address of device

u8 role : role type of device

u8 channel : channel of device

u8 *key : 16 bytes key which is needed for ESP-NOW communication

u8 key_len : length of key, has to be 16 bytes now

Return:

0, succeed

otherwise, fail



9. esp_now_del_peer

Function:

Delete an ESP-NOW peer, delete MAC address of the device from ESP-NOW MAC list.

Prototype:

```
int esp_now_del_peer(u8 *mac_addr)
```

Parameter:

u8 *mac_addr : MAC address of device

Return:

0, succeed

otherwise, fail

10. esp_now_set_self_role

Function:

Set ESP-NOW role of device itself

Structure:

```
typedef enum mt_role {  
    MT_ROLE_IDLE = 0,  
    MT_ROLE_CONTROLLER,  
    MT_ROLE_SLAVE,  
    MT_ROLE_MAX,  
}
```

Prototype:

```
int esp_now_set_self_role(u8 role)
```

Parameter:

u8 role : role type

Return:

0, succeed

otherwise, fail

11. esp_now_get_self_role

Function:

Get ESP-NOW role of device itself

Prototype:

```
u8 esp_now_get_self_role(void)
```



Parameter:

none

Return:

role type

12. esp_now_set_peer_role

Function:

Set ESP-NOW role for a target device. If it is set multiple times, new role will cover the old one.

Structure:

```
typedef enum mt_role {  
    MT_ROLE_IDLE = 0,  
    MT_ROLE_CONTROLLER,  
    MT_ROLE_SLAVE,  
    MT_ROLE_MAX,  
}
```

Prototype:

```
int esp_now_set_peer_role(u8 *mac_addr, u8 role)
```

Parameter:

`u8 *mac_addr` : MAC address of target device
`u8 role` : role type

Return:

0, succeed
otherwise, fail

13. esp_now_get_peer_role

Function:

Get ESP-NOW role of a target device

Prototype:

```
int esp_now_get_peer_role(u8 *mac_addr)
```

Parameter:

`u8 *mac_addr` : MAC address of target device

Return:

`MT_ROLE_CONTROLLER`, role type is controller;



```
MT_ROLE_SLAVE, role type is slave;  
otherwise, fail
```

14. esp_now_set_peer_key

Function:

Set ESP-NOW key for a target device. If it is set multiple times, new role will cover the old one.

Prototype:

```
int esp_now_set_peer_key(u8 *mac_addr, u8 *key, u8 key_len)
```

Parameter:

u8 *mac_addr : MAC address of target device
u8 *key : 16 bytes key which is needed for ESP-NOW communication,
if it is **NULL**, current key will be reset to be none.
u8 key_len : key length, has to be 16 bytes now

Return:

0, succeed
otherwise, fail

15. esp_now_get_peer_key

Function:

Get ESP-NOW key of a target device.

Prototype:

```
int esp_now_get_peer_key(u8 *mac_addr, u8 *key, u8 *key_len)
```

Parameter:

u8 *mac_addr : MAC address of target device
u8 *key : pointer of key, buffer size has to be 16 bytes at least
u8 *key_len : key length

Return:

0, succeed
> 0, find target device but can't get key
< 0, fail



16. esp_now_set_peer_channel

Function:

Record channel information of a ESP-NOW device.

When communicate with this device,

- call `esp_now_get_peer_channel` to get its channel first,
- then call `wifi_set_channel` to be in the same channel and do communication.

Prototype:

```
int esp_now_set_peer_channel(u8 *mac_addr, u8 channel)
```

Parameter:

`u8 *mac_addr` : MAC address of target device

`u8 channel` : channel, usually to be 1 ~ 13, some area may use channel 14

Return:

0, succeed

otherwise, fail

17. esp_now_get_peer_channel

Function:

Get channel information of a ESP-NOW device. ESP-NOW communication needs to be at the same channel.

Prototype:

```
int esp_now_get_peer_channel(u8 *mac_addr)
```

Parameter:

`u8 *mac_addr` : MAC address of target device

Return:

1 ~ 13 (some area may get 14), succeed

otherwise, fail

18. esp_now_is_peer_exist

Function:

Check if target device exists or not.

Prototype:

```
int esp_now_is_peer_exist(u8 *mac_addr)
```

Parameter:



`u8 *mac_addr` : MAC address of target device

Return:

`0`, device does not exist
`< 0`, error occur, check fail
`> 0`, device exists

19. esp_now_fetch_peer

Function:

Get MAC address of ESP-NOW device which is pointed now, and move the pointer to next one in ESP-NOW MAC list or move the pointer to the first one in ESP-NOW MAC list

Note:

- This API can not re-entry
- Parameter has to be `true` when you call it the first time.

Prototype:

`u8 *esp_now_fetch_peer(bool restart)`

Parameter:

`bool restart` : `true`, move pointer to the first one in ESP-NOW MAC list
 `false`, move pointer to the next one in ESP-NOW MAC list

Return:

`NULL`, no ESP-NOW devices exist
Otherwise, MAC address of ESP-NOW device which is pointed now

20. esp_now_get_cnt_info

Function:

Get the total number of ESP-NOW devices which are associated, and the number count of encrypted devices.

Prototype:

`int esp_now_get_cnt_info(u8 *all_cnt, u8 *encryp_cnt)`

Parameter:

`u8 *all_cnt` : total number of ESP-NOW devices which are associated
`u8 *encryp_cnt` : number count of encrypted devices

Return:

`0`, succeed



otherwise, fail

21. esp_now_set_kok

Function:

Set the encrypt key of communication key. All ESP-NOW devices share the same encrypt key. If users do not set the encrypt key, ESP-NOW communication key will be encrypted by a default key.

Prototype:

```
int esp_now_set_kok(u8 *key, u8 len)
```

Parameter:

<code>u8 *key</code>	: pointer of encrypt key
<code>u8 len</code>	: key length, has to be 16 bytes now

Return:

0, succeed
otherwise, fail



3.7. Upgrade (FOTA) APIs

1. `system_upgrade_userbin_check`

Function:

Checks user bin

Prototype:

```
uint8 system_upgrade_userbin_check()
```

Parameter:

none

Return:

0x00 : UPGRADE_FW_BIN1, i.e. user1.bin

0x01 : UPGRADE_FW_BIN2, i.e. user2.bin

2. `system_upgrade_flag_set`

Function:

Sets upgrade status flag.

Note:

If you using `system_upgrade_start` to upgrade, this API need not be called.

If you using `spi_flash_write` to upgrade firmware yourself, this flag need to be set to `UPGRADE_FLAG_FINISH`, then call `system_upgrade_reboot` to reboot to run new firmware.

Prototype:

```
void system_upgrade_flag_set(uint8 flag)
```

Parameter:

uint8 flag:

```
#define UPGRADE_FLAG_IDLE      0x00
```

```
#define UPGRADE_FLAG_START    0x01
```

```
#define UPGRADE_FLAG_FINISH   0x02
```

Return:

null

3. `system_upgrade_flag_check`

Function:

Gets upgrade status flag.

Prototype:

```
uint8 system_upgrade_flag_check()
```



Parameter:

null

Return:

```
#define UPGRADE_FLAG_IDLE      0x00
#define UPGRADE_FLAG_START    0x01
#define UPGRADE_FLAG_FINISH   0x02
```

4. **system_upgrade_start**

Function:

Configures parameters and start upgrade

Prototype:

```
bool system_upgrade_start (struct upgrade_server_info *server)
```

Parameters:

```
struct upgrade_server_info *server : server related parameters
```

Return:

true: start upgrade
false: upgrade can't be started.

5. **system_upgrade_reboot**

Function: reboot system and use new version

Prototype:

```
void system_upgrade_reboot (void)
```

Parameters:

none

Return:

none



3.8. Sniffer Related APIs

1. `wifi_promiscuous_enable`

Function:

Enable promiscuous mode for sniffer

Note:

- (1) promiscuous mode can only be enabled in station mode.
- (2) During promiscuous mode (sniffer), ESP8266 station and soft-AP are disabled.
- (3) Before enable promiscuous mode, please call `wifi_station_disconnect` first
- (4) Don't call any other APIs during sniffer, please call `wifi_promiscuous_enable(0)` first.

Prototype:

```
void wifi_promiscuous_enable(uint8 promiscuous)
```

Parameter:

`uint8 promiscuous` :

- 0: disable promiscuous;
- 1: enable promiscuous

Return:

null

2. `wifi_promiscuous_set_mac`

Function:

Set MAC address filter for sniffer.

Note:

This filter only be available in the current sniffer phase, if you disable sniffer and then enable sniffer, you need to set filter again if you need it.

Prototype:

```
void wifi_promiscuous_set_mac(const uint8_t *address)
```

Parameter:

`const uint8_t *address` : MAC address

Return:

null

Example:

```
char ap_mac[6] = {0x16, 0x34, 0x56, 0x78, 0x90, 0xab};
```



```
wifi_promiscuous_set_mac(ap_mac);
```

3. **wifi_set_promiscuous_rx_cb**

Function:

Registers an RX callback function in promiscuous mode, which will be called when data packet is received.

Prototype:

```
void wifi_set_promiscuous_rx_cb(wifi_promiscuous_cb_t cb)
```

Parameter:

`wifi_promiscuous_cb_t cb` : callback

Return:

null



3.9. smart config APIs

Herein we only introduce smart-config APIs, users can inquire Espressif Systems for smart-config documentation which will contain more details. Please make sure the target AP is enabled before enable smart-config.

1. smartconfig_start

Function:

Start smart configuration mode, to connect ESP8266 station to AP, by sniffing for special packets from the air, containing SSID and password of desired AP. You need to broadcast the SSID and password (e.g. from mobile device or computer) with the SSID and password encoded.

Note:

- (1) This api can only be called in station mode.
- (2) During smart-config, ESP8266 station and soft-AP are disabled.
- (3) Can not call `smartconfig_start` twice before it finish, please call `smartconfig_stop` first.
- (4) Don't call any other APIs during smart-config, please call `smartconfig_stop` first.

Structure:

```
typedef enum {
    SC_STATUS_WAIT = 0,          // Please don't start connection in this phase
    SC_STATUS_FIND_CHANNEL,      // Start connection by APP in this phase
    SC_STATUS_GETTING_SSID_PSWD,
    SC_STATUS_LINK,
    SC_STATUS_LINK_OVER,         // Got IP, connect to AP successfully
} sc_status;

typedef enum {
    SC_TYPE_ESPTOUCH = 0,
    SC_TYPE_AIRKISS,
} sc_type;
```

Prototype:

```
bool smartconfig_start(
    sc_callback_t cb,
    uint8 log
)
```


**Parameter:**

`sc_callback_t cb` : smart config callback; executed when smart-config status changed;

parameter `status` of this callback shows the status of smart-config:

- if `status == SC_STATUS_GETTING_SSID_PSWD`, parameter `void *pdata` is a pointer of `sc_type`, means smart-config type: AirKiss or ESP-TOUCH.
- if `status == SC_STATUS_LINK`, parameter `void *pdata` is a pointer of `struct station_config`;
- if `status == SC_STATUS_LINK_OVER`, parameter `void *pdata` is a pointer of mobile phone's IP address, 4 bytes. This is only available in ESPTOUCH, otherwise, it is `NULL`.
- otherwise, parameter `void *pdata` is `NULL`.

`uint8 log` : 1: UART output logs; otherwise: UART only outputs the result.

Return:

true: succeed

false: fail

Example:

```
void ICACHE_FLASH_ATTR
smartconfig_done(sc_status status, void *pdata)
{
    switch(status) {
        case SC_STATUS_WAIT:
            os_printf("SC_STATUS_WAIT\n");
            break;
        case SC_STATUS_FIND_CHANNEL:
            os_printf("SC_STATUS_FIND_CHANNEL\n");
            break;
        case SC_STATUS_GETTING_SSID_PSWD:
            os_printf("SC_STATUS_GETTING_SSID_PSWD\n");
            sc_type *type = pdata;
            if (*type == SC_TYPE_ESPTOUCH) {
                os_printf("SC_TYPE:SC_TYPE_ESPTOUCH\n");
            } else {
                os_printf("SC_TYPE:SC_TYPE_AIRKISS\n");
            }
            break;
        case SC_STATUS_LINK:
```



```
        os_printf("SC_STATUS_LINK\n");
        struct station_config *sta_conf = pdata;
        wifi_station_set_config(sta_conf);
        wifi_station_disconnect();
        wifi_station_connect();
        break;
    case SC_STATUS_LINK_OVER:
        os_printf("SC_STATUS_LINK_OVER\n");
        if (pdata != NULL) {
            uint8 phone_ip[4] = {0};
            memcpy(phone_ip, (uint8*)pdata, 4);
            os_printf("Phone ip: %d.%d.%d.%d\n", phone_ip[0], phone_ip[1], phone_ip[2], phone_ip[3]);
        }
        smartconfig_stop();
        break;
    }
}

smartconfig_start(smartconfig_done);
```

2. smartconfig_stop

Function:

stop smart config, free the buffer taken by `smartconfig_start`.

Note:

Whether connect to AP succeed or not, this API should be called to free memory taken by `smartconfig_start`.

Prototype:

```
bool smartconfig_stop(void)
```

Parameter:

null

Return:

true: succeed
false: fail



3.10. SNTP APIs

1. `sntp_setserver`

Function:

Set SNTP server by IP address, support 3 SNTP server at most

Prototype:

```
void sntp_setserver(unsigned char idx, ip_addr_t *addr)
```

Parameter:

`unsigned char idx` : SNTP server index, support 3 SNTP server at most (0 ~ 2) ; index 0 is the main server, index 1 and 2 are as backup.

`ip_addr_t *addr` : IP address; users need to ensure that it's a SNTP server

Return:

none

2. `sntp_getserver`

Function:

Get IP address of SNTP server which set by `sntp_setserver`

Prototype:

```
ip_addr_t sntp_getserver(unsigned char idx)
```

Parameter:

`unsigned char idx` : SNTP server index, support 3 SNTP server at most (0 ~ 2)

Return:

IP address

3. `sntp_setservername`

Function:

Set SNTP server by domain name, support 3 SNTP server at most

Prototype:

```
void sntp_setservername(unsigned char idx, char *server)
```

Parameter:

`unsigned char idx` : SNTP server index, support 3 SNTP server at most (0 ~ 2) ; index 0 is the main server, index 1 and 2 are as backup.

`char *server` : domain name; users need to ensure that it's a SNTP server

Return:

none



4. `sntp_getservername`

Function:

Get domain name of SNTP server which set by `sntp_setservername`

Prototype:

```
char * sntp_getservername(unsigned char idx)
```

Parameter:

`unsigned char idx` : SNTP server index, support 3 SNTP server at most (0 ~ 2)

Return:

domain name

5. `sntp_init`

Function:

SNTP initialize

Prototype:

```
void sntp_init(void)
```

Parameter:

none

Return:

none

6. `sntp_stop`

Function:

Stop SNTP

Prototype:

```
void sntp_stop(void)
```

Parameter:

none

Return:

none

7. `sntp_get_current_timestamp`

Function:

Get current timestamp from basic time (1970.01.01 00: 00: 00 GMT + 8) ,
uint:second



Prototype:

```
uint32 sntp_get_current_timestamp()
```

Parameter:

none

Return:

time stamp

8. sntp_get_real_time

Function:

Get real time (GMT + 8)

Prototype:

```
char* sntp_get_real_time(long t)
```

Parameter:

`long t` – time stamp

Return:

real time

9. sntp_set_timezone

Function:

Set time zone

Prototype:

```
bool sntp_set_timezone (sint8 timezone)
```

Note:

Before call `sntp_set_timezone`, please call `sntp_stop` first

Parameter:

`sint8 timezone` – time zone, range: -11 ~ 13

Return:

true, succeed;

false, fail

Example:

```
sntp_stop();  
  
if( true == sntp_set_timezone(-5) ) {
```



```
sntp_init();  
}
```

10. sntp_get_timezone

Function:

Get time zone

Prototype:

```
sint8 sntp_get_timezone (void)
```

Parameter:

none

Return:

time zone, range: -11 ~ 13

11. SNTP Example

```
ip_addr_t *addr = (ip_addr_t *)os_zalloc(sizeof(ip_addr_t));  
sntp_setservername(0, "us.pool.ntp.org"); // set server 0 by domain name  
sntp_setservername(1, "ntp.sjtu.edu.cn"); // set server 1 by domain name  
ipaddr_aton("210.72.145.44", addr);  
sntp_setserver(2, addr); // set server 2 by IP address  
sntp_init();  
os_free(addr);  
  
uint32 current_stamp;  
current_stamp = sntp_get_current_timestamp();  
os_printf("sntp: %d, %s \n", current_stamp, sntp_get_real_time(current_stamp));
```



4. TCP/UDP APIs

Found in [esp_iot_sdk/include/espconn.h](#). The network APIs can be grouped into the following types:

- **General APIs:** APIs can be used for both TCP and UDP .
- **TCP APIs:** APIs that are only used for TCP.
- **UDP APIs:** APIs that are only used for UDP.
- **mDNS APIs:** APIs that related to mDNS.

4.1. Generic TCP/UDP APIs

1. espconn_delete

Function:

Delete a transmission.

Note:

Corresponding creation API :

TCP: [espconn_accept](#),

UDP: [espconn_create](#)

Prototype:

```
sint8 espconn_delete(struct espconn *espconn)
```

Parameter:

[struct espconn *espconn](#) : corresponding connected control block structure

Return:

0 : succeed

Non-0 : error, return error code [ESPCONN_ARG](#) - illegal argument, can't find network transmission according to structure [espconn](#)

2. espconn_gethostbyname

Function:

DNS

Prototype:

```
err_t espconn_gethostbyname(  
    struct espconn *pespconn,  
    const char *hostname,  
    ip_addr_t *addr,  
    dns_found_callback found  
)
```

**Parameters:**

`struct espconn *espconn` : corresponding connected control block structure
`const char *hostname` : domain name string pointer
`ip_addr_t *addr` : IP address
`dns_found_callback found` : callback

Return:

`err_t` : `ESPCONN_OK` - succeed
 `ESPCONN_INPROGRESS` - error code : already connected
 `ESPCONN_ARG` - error code : illegal argument, can't find network
transmission according to structure `espconn`

Example as follows. Pls refer to source code of IoT_Demo:

```
ip_addr_t esp_server_ip;
LOCAL void ICACHE_FLASH_ATTR
user_esp_platform_dns_found(const char *name, ip_addr_t *ipaddr, void *arg)
{
    struct espconn *pespconn = (struct espconn *)arg;
    if (ipaddr != NULL)
        os_printf(user_esp_platform_dns_found %d.%d.%d.%d/n,
            *((uint8 *)&ipaddr->addr), *((uint8 *)&ipaddr->addr + 1),
            *((uint8 *)&ipaddr->addr + 2), *((uint8 *)&ipaddr->addr + 3));
}
void dns_test(void) {
    espconn_gethostbyname(pespconn, "iot.espressif.cn", &esp_server_ip,
        user_esp_platform_dns_found);
}
```

3. espconn_port

Function: get void ports

Prototype:

```
uint32 espconn_port(void)
```

Parameter:

null

Return:

`uint32` : id of the port you get



4. `espconn_regist_sentcb`

Function:

Register data sent function which will be called back when data are successfully sent.

Prototype:

```
sint8 espconn_regist_sentcb(  
    struct espconn *espconn,  
    espconn_sent_callback sent_cb  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_sent_callback sent_cb` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find network transmission according to structure `espconn`

5. `espconn_regist_recvcb`

Function:

register data receive function which will be called back when data are received

Prototype:

```
sint8 espconn_regist_recvcb(  
    struct espconn *espconn,  
    espconn_recv_callback recv_cb  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_connect_callback connect_cb` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find network transmission according to structure `espconn`

6. `espconn_sent_callback`

Function:

Callback after the data are sent



Prototype:

```
void espconn_sent_callback (void *arg)
```

Parameters:

`void *arg` : pointer corresponding structure `espconn`. This pointer may be different in different callbacks, please don't use this pointer directly to distinguish one from another in multiple connections, use `remote_ip` and `remote_port` in `espconn` instead.

Return:

null

7. `espconn_recv_callback`

Function:

callback after data are received

Prototype:

```
void espconn_recv_callback (  
    void *arg,  
    char *pdata,  
    unsigned short len  
)
```

Parameters:

`void *arg` : pointer corresponding structure `espconn`. This pointer may be different in different callbacks, please don't use this pointer directly to distinguish one from another in multiple connections, use `remote_ip` and `remote_port` in `espconn` instead.

`char *pdata` : received data entry parameters

`unsigned short len` : received data length

Return:

null

8. `espconn_send`

Function:

Send data through Wi-Fi

Note:

Please call `espconn_send` after `espconn_sent_callback` of the pre-packet.



Prototype:

```
sint8 espconn_send(  
    struct espconn *espconn,  
    uint8 *psent,  
    uint16 length  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`uint8 *psent` : sent data pointer
`uint16 length` : sent data length

Return:

0 : succeed
Non-0 : error code

`ESPCONN_MEM` – Out of memory
`ESPCONN_ARG` – illegal argument, can't find network transmission according to structure `espconn`

9. espconn_sent

[@deprecated] This API is deprecated, please use `espconn_send` instead.

Function:

Send data through WiFi

Note:

Please call `espconn_sent` after `espconn_sent_callback` of the pre-packet.

Prototype:

```
sint8 espconn_sent(  
    struct espconn *espconn,  
    uint8 *psent,  
    uint16 length  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`uint8 *psent` : sent data pointer
`uint16 length` : sent data length

Return:

0 : succeed
Non-0 : error code

`ESPCONN_MEM` – Out of memory



`ESPCONN_ARG` – illegal argument, can't find network transmission according to structure `espconn`

4.2. TCP APIs

TCP APIs act only on TCP connections and do not affect nor apply to UDP connections.

1. `espconn_accept`

Function:

Creates a TCP server (i.e. accepts connections.)

Prototype:

```
sint8 espconn_accept(struct espconn *espconn)
```

Parameter:

`struct espconn *espconn` : corresponding connected control block structure

Return:

0 : succeed

Non-0 : error code

`ESPCONN_MEM` – Out of memory

`ESPCONN_ISCONN` – Already connected

`ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

2. `espconn_secure_accept`

Function:

Creates an SSL TCP server.

Note:

- (1) Only created one SSL server is allowed, this API can be called only once, and only one SSL client is allowed to connect.
- (2) If SSL encrypted packet size is larger than ESP8266 SSL buffer size (default 2KB, set by `espconn_secure_set_size`), SSL connection will fail, will enter `espconn_reconnect_callback`
- (3) SSL related APIs named as `espconn_secure_XXX` are different from normal TCP APIs, so please don't mixed use. In SSL connection, only `espconn_secure_XXX` APIs, `espconn_regist_XXX` APIs and `espconn_port` can be used.

Prototype:

```
sint8 espconn_secure_accept(struct espconn *espconn)
```



Parameter:

`struct espconn *espconn` : corresponding connected control block structure

Return:

0 : succeed

Non-0 : error code

`ESPCONN_MEM` – Out of memory

`ESPCONN_ISCONN` – Already connected

`ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

3. `espconn_regist_time`

Function:

Register timeout interval of ESP8266 TCP server.

Note:

Call this API after `espconn_accept`, before listened a TCP connection.

This timeout interval is not very precise, only as reference.

If timeout is set to 0, timeout will be disable and ESP8266 TCP server will not disconnect TCP clients has stopped communication. This usage of `timeout=0`, is deprecated.

Prototype:

```
sint8 espconn_regist_time(  
    struct espconn *espconn,  
    uint32 interval,  
    uint8 type_flag  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure

`uint32 interval` : timeout interval, unit: second, maximum: 7200 seconds

`uint8 type_flag` : 0, set all connections; 1, set a single connection

Return:

0 : succeed

Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

4. `espconn_get_connection_info`

Function:

Get a connection's info in TCP multi-connection case



Prototype:

```
sint8 espconn_get_connection_info(  
    struct espconn *espconn,  
    remot_info **pcon_info,  
    uint8 typeflags  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`remot_info **pcon_info` : connect to client info
`uint8 typeflags` : 0, regular server;1, ssl server

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

5. `espconn_connect`

Function:

Connect to a TCP server (ESP8266 acting as TCP client).

Note:

If `espconn_connect` fail, returns non-0 value, there is no connection, so it won't enter any `espconn` callback.

Prototype:

```
sint8 espconn_connect(struct espconn *espconn)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure

Return:

0 : succeed
Non-0 : error code

`ESPCONN_RTE` – Routing Problem
`ESPCONN_MEM` – Out of memory
`ESPCONN_ISCONN` – Already connected
`ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`



6. `espconn_connect_callback`

Function: successful listening (ESP8266 as TCP server) or connection (ESP8266 as TCP client) callback, register by `espconn_regist_connectcb`

Prototype:

```
void espconn_connect_callback (void *arg)
```

Parameter:

`void *arg` : pointer corresponding structure `espconn`. This pointer may be different in different callbacks, please don't use this pointer directly to distinguish one from another in multiple connections, use `remote_ip` and `remote_port` in `espconn` instead.

Return:

null

7. `espconn_regist_connectcb`

Function:

Register connection function which will be called back under successful TCP connection

Prototype:

```
sint8 espconn_regist_connectcb(  
    struct espconn *espconn,  
    espconn_connect_callback connect_cb  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_connect_callback connect_cb` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

8. `espconn_set_opt`

Function: Set option of TCP connection

Prototype:

```
sint8 espconn_set_opt( struct espconn *espconn, uint8 opt)
```

Structure:

```
enum espconn_option{  
    ESPCONN_START = 0x00,
```



```
    ESPCONN_REUSEADDR = 0x01,  
    ESPCONN_NODELAY = 0x02,  
    ESPCONN_COPY = 0x04,  
    ESPCONN_KEEPAIVE = 0x08,  
    ESPCONN_END  
}
```

Parameter:

`struct espconn *espconn` : corresponding connected control structure
`uint8 opt` : Option of TCP connection, refer to `espconn_option`
bit 0: 1: free memory after TCP disconnection happen need not wait 2 minutes;
bit 1: 1: disable nagle algorithm during TCP data transmission, quiken the data transmission.
bit 2: 1: enable `espconn_regist_write_finish`, enter write finish callback means the data `espconn_sent` sending was written into 2920 bytes write-buffer waiting for sending or already sent.
bit 3: 1: enable TCP keep alive

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

Note:

In general, we need not call this API;
If call `espconn_set_opt`, please call it in `espconn_connect_callback`.

9. `espconn_clear_opt`

Function:

Clear option of TCP connection.

Prototype:

```
sint8 espconn_clear_opt(  
    struct espconn *espconn,  
    uint8 opt  
)
```

Structure:

```
enum espconn_option{  
    ESPCONN_START = 0x00,  
    ESPCONN_REUSEADDR = 0x01,  
    ESPCONN_NODELAY = 0x02,  
    ESPCONN_KEEPAIVE = 0x08,  
    ESPCONN_END  
}
```




```
    ESPCONN_COPY = 0x04,  
    ESPCONN_KEEPALIVE = 0x08,  
    ESPCONN_END  
}
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`uint8 opt` : option of TCP connection, refer to `espconn_option`

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

10. espconn_set_keepalive

Function:

Set configuration of TCP keep alive .

Prototype:

```
sint8 espconn_set_keepalive(struct espconn *espconn, uint8 level, void*  
optarg)
```

Structure:

```
enum espconn_level{  
    ESPCONN_KEEPIDLE,  
    ESPCONN_KEEPINTVL,  
    ESPCONN_KEEPCNT  
}
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`uint8 level` : Default to do TCP keep-alive detection every `ESPCONN_KEEPIDLE`, if there in no response, retry `ESPCONN_KEEPCNT` times every `ESPCONN_KEEPINTVL`. If still no response, considers it as TCP connection broke, goes into `espconn_reconnect_callback`.

Notice, keep alive interval is not precise, only for reference, it depends on priority.

Description:

`ESPCONN_KEEPIDLE` – TCP keep-alive interval, unit: 500 millisecond



`ESPCONN_KEEPINTVL` - packet interval during TCP keep-alive, unit: 500 millisecond

`ESPCONN_KEEPCNT` - maximum packet count of TCP keep-alive

`void* optarg` : value of parameter

Return:

0 : succeed

Non-0 : error code `ESPCONN_ARG` - illegal argument, can't find TCP connection according to structure `espconn`

Note:

In general, we need not call this API;

If needed, please call it in `espconn_connect_callback` and call `espconn_set_opt` to enable keep alive first.

11. `espconn_get_keepalive`

Function:

Get value of TCP keep-alive parameter

Prototype:

```
sint8 espconn_set_keepalive(struct espconn *espconn, uint8 level, void* optarg)
```

Structure:

```
enum espconn_level{
    ESPCONN_KEEPIDLE,
    ESPCONN_KEEPINTVL,
    ESPCONN_KEEPCNT
}
```

Parameter:

`struct espconn *espconn` : corresponding connected control block structure

`uint8 level` :

`ESPCONN_KEEPIDLE` - TCP keep-alive interval, unit: 500 millisecond

`ESPCONN_KEEPINTVL` - packet interval during TCP keep-alive, unit: 500 millisecond

`ESPCONN_KEEPCNT` - maximum packet count of TCP keep-alive

`void* optarg` : value of parameter



Return:

0 : succeed
Non-0 : error code [ESPCONN_ARG](#) – illegal argument, can't find TCP connection according to structure [espconn](#)

12. [espconn_reconnect_callback](#)

Function:

Enter this callback when error occurred, TCP connection broke. This callback is registered by [espconn_regist_reconcb](#)

Prototype:

```
void espconn_reconnect_callback (void *arg, sint8 err)
```

Parameter:

[void *arg](#) : pointer corresponding structure [espconn](#). This pointer may be different in different callbacks, please do not use this pointer directly to distinguish one from another in multiple connections, use [remote_ip](#) and [remote_port](#) in [espconn](#) instead.

[sint8 err](#) : error code

[ESPCONN_TIMEOUT](#) – Timeout

[ESPCONN_ABRT](#) – TCP connection aborted

[ESPCONN_RST](#) – TCP connection abort

[ESPCONN_CLSD](#) – TCP connection closed

[ESPCONN_CONN](#) – TCP connection

[ESPCONN_HANDSHAKE](#) – TCP SSL handshake fail

[ESPCONN_PROTO_MSG](#) – SSL application invalid

Return:

none

13. [espconn_regist_reconcb](#)

Function:

Register reconnect callback

Note:

[espconn_reconnect_callback](#) is more like a network-broken error handler; it handles errors that occurs in any phase of the connection. For instance, if [espconn_send](#) fails, [espconn_reconnect_callback](#) will be called because the network is broken.



Prototype:

```
sint8 espconn_regist_reconcb(  
    struct espconn *espconn,  
    espconn_reconnect_callback recon_cb  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_reconnect_callback recon_cb` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

14. `espconn_disconnect`

Function:

Disconnect a TCP connection

Note:

Don't call this API in any `espconn` callback. If needed, please use `system_os_task` and `system_os_post` to trigger `espconn_disconnect`

Prototype:

```
sint8 espconn_disconnect(struct espconn *espconn)
```

Parameters:

`struct espconn *espconn` : corresponding connected control structure

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

15. `espconn_regist_disconcb`

Function:

Register disconnection function which will be called back under successful TCP disconnection

Prototype:

```
sint8 espconn_regist_disconcb(  
    struct espconn *espconn,  
    espconn_connect_callback discon_cb  
)
```



Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_connect_callback connect_cb` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

16. `espconn_regist_write_finish`

Function:

Register a callback which will be called when all sending data is completely write into write buffer or sent. Need to call `espconn_set_opt` to enable write-buffer first.

Note:

write-buffer is used to keep TCP data that waiting to be sent, users can enable it by using `espconn_set_opt`. Users can call `espconn_send` to send the next packet in `write_finish_callback` instead of using `espconn_sent_callback`.

Prototype:

```
sint8 espconn_regist_write_finish (  
    struct espconn *espconn,  
    espconn_connect_callback write_finish_fn  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure
`espconn_connect_callback write_finish_fn` : registered callback function

Return:

0 : succeed
Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

17. `espconn_secure_set_size`

Function:

Set buffer size of encrypted data (SSL)

Note:

Buffer size default to be 2Kbytes. If need to change, please call this API before `espconn_secure_accept` (ESP8266 as TCP SSL server) or `espconn_secure_connect` (ESP8266 as TCP SSL client)



Prototype:

```
bool espconn_secure_set_size (uint8 level, uint16 size)
```

Parameters:

`uint8 level` : set buffer for ESP8266 SSL server/client:

`0x01` SSL client;

`0x02` SSL server;

`0x03` both SSL client and SSL server

`uint16 size` : buffer size, range: 1 ~ 8192, unit: byte, default to be 2048

Return:

true : succeed

false : fail

18. espconn_secure_get_size

Function:

Get buffer size of encrypted data (SSL)

Prototype:

```
sint16 espconn_secure_get_size (uint8 level)
```

Parameters:

`uint8 level` : buffer for ESP8266 SSL server/client:

`0x01` SSL client;

`0x02` SSL server;

`0x03` both SSL client and SSL server

Return:

buffer size

19. espconn_secure_connect

Function:

Secure connect (SSL) to a TCP server (ESP8266 is acting as TCP client.)

Note:

- If `espconn_connect` fails, returns non-0 value, it is not connected and therefore will not enter any `espconn` callback.
- Only one connection is allowed when the ESP8266 acts as a SSL client, this API can be called only once, or call `espconn_secure_disconnect` to disconnect first, then call this API to create another SSL connection.



- If SSL encrypted packet size is larger than the ESP8266 SSL buffer size (default 2KB, set by `espconn_secure_set_size`), the SSL connection will fail, will enter `espconn_reconnect_callback`
- SSL related APIs named as `espconn_secure_XXX` are different from normal TCP APIs, so please don't mixed use. In SSL connection, only `espconn_secure_XXX` APIs, `espconn_regist_XXX` APIs and `espconn_port` can be used.

Prototype:

```
sint8 espconn_secure_connect (struct espconn *espconn)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure

Return:

0 : succeed

Non-0 : error code

`ESPCONN_MEM` - Out of memory

`ESPCONN_ISCONN` - Already connected

`ESPCONN_ARG` - illegal argument, can't find TCP connection

according to structure `espconn`

20. espconn_secure_send

Function: send encrypted data (SSL)

Note:

Please call `espconn_secure_send` after `espconn_sent_callback` of the pre-packet.

Prototype:

```
sint8 espconn_secure_send (  
    struct espconn *espconn,  
    uint8 *psent,  
    uint16 length  
)
```

Parameters:

`struct espconn *espconn` : corresponding connected control block structure

`uint8 *psent` : sent data pointer

`uint16 length` : sent data length



Return:

0 : succeed
Non-0 : error code [ESPCONN_ARG](#) – illegal argument, can't find TCP connection according to structure [espconn](#)

21. [espconn_secure_sent](#)

[@deprecated] This API is deprecated, please use [espconn_secure_send](#) instead.

Function: send encrypted data (SSL)

Note:

Please call [espconn_secure_sent](#) after [espconn_sent_callback](#) of the pre-packet.

Prototype:

```
sint8 espconn_secure_sent (  
    struct espconn *espconn,  
    uint8 *psent,  
    uint16 length  
)
```

Parameters:

[struct espconn *espconn](#) : corresponding connected control block structure
[uint8 *psent](#) : sent data pointer
[uint16 length](#) : sent data length

Return:

0 : succeed
Non-0 : error code [ESPCONN_ARG](#) – illegal argument, can't find TCP connection according to structure [espconn](#)

22. [espconn_secure_disconnect](#)

Function: secure TCP disconnection(SSL)

Note:

Do not call this API in any [espconn](#) callback. If needed, please use [system_os_task](#) and [system_os_post](#) to trigger [espconn_secure_disconnect](#)

Prototype:

```
sint8 espconn_secure_disconnect(struct espconn *espconn)
```

Parameters:

[struct espconn *espconn](#) : corresponding connected control block structure



Return:

0 : succeed
Non-0 : error code [ESPCONN_ARG](#) – illegal argument, can't find TCP connection according to structure [espconn](#)

23. [espconn_secure_ca_disable](#)

Function:

Disable SSL CA (certificate authenticate) function

Note:

- CA function is disabled by default, more details in document “ESP8266__SDK__SSL_User_Manual”
- If user wants to call this API, please call it before [espconn_secure_accept](#) (ESP8266 as TCP SSL server) or [espconn_secure_connect](#) (ESP8266 as TCP SSL client)

Prototype:

```
bool espconn_secure_ca_disable (uint8 level)
```

Parameter:

[uint8 level](#) : set configuration for ESP8266 SSL server/client:

```
0x01  SSL client;  
0x02  SSL server;  
0x03  both SSL client and SSL server
```

Return:

true : succeed
false : fail

24. [espconn_secure_ca_enable](#)

Function:

Enable SSL CA (certificate authenticate) function

Note:

- CA function is disabled by default, more details in document “ESP8266__SDK__SSL_User_Manual”
- If user want to call this API, please call it before [espconn_secure_accept](#) (ESP8266 as TCP SSL server) or [espconn_secure_connect](#) (ESP8266 as TCP SSL client)



Prototype:

```
bool espconn_secure_ca_enable (uint8 level, uint16 flash_sector)
```

Parameter:

uint8 level : set configuration for ESP8266 SSL server/client:

0x01 SSL client;

0x02 SSL server;

0x03 both SSL client and SSL server

uint16 flash_sector : flash sector in which CA (esp_ca_cert.bin) is downloaded. For example, **flash_sector** is 0x3B, then esp_ca_cert.bin need to download into flash 0x3B000

Return:

true : succeed

false : fail

25. espconn_tcp_get_max_con

Function:

Get maximum number of how many TCP connections are allowed.

Prototype:

```
uint8 espconn_tcp_get_max_con(void)
```

Parameter:

null

Return:

Maximum number of how many TCP connections are allowed.

26. espconn_tcp_set_max_con

Function:

Set the maximum number of how many TCP connection is allowed.

Prototype:

```
sint8 espconn_tcp_set_max_con(uint8 num)
```

Parameter:

uint8 num : Maximum number of how many TCP connection is allowed.

Return:

0 : succeed

Non-0 : error code **ESPCONN_ARG** – illegal argument, can't find TCP connection according to structure **espconn**



27. `espconn_tcp_get_max_con_allow`

Function:

Get the maximum number of TCP clients which are allowed to connect to ESP8266 TCP server.

Prototype:

```
sint8 espconn_tcp_get_max_con_allow(struct espconn *espconn)
```

Parameter:

`struct espconn *espconn` : corresponding connected control structure

Return:

> 0 : Maximum number of TCP clients which are allowed.

< 0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

28. `espconn_tcp_set_max_con_allow`

Function:

Set the maximum number of TCP clients allowed to connect to ESP8266 TCP server.

Prototype:

```
sint8 espconn_tcp_set_max_con_allow(struct espconn *espconn, uint8 num)
```

Parameter:

`struct espconn *espconn` : corresponding connected control structure

`uint8 num` : Maximum number of TCP clients which are allowed.

Return:

0 : succeed

Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

29. `espconn_recv_hold`

Function:

Puts in a request to block the TCP receive function.

Note:

The function does not act immediately; we recommend calling it while reserving 5*1460 bytes of memory.

This API can be called more than once.

Prototype:

```
sint8 espconn_recv_hold(struct espconn *espconn)
```



Parameter:

`struct espconn *espconn` : corresponding connected control structure

Return:

0 : succeed

Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

30. `espconn_recv_unhold`

Function:

Unblock TCP receiving data (i.e. undo `espconn_recv_hold`).

Note:

This API takes effect immediately.

Prototype:

`sint8 espconn_recv_unhold(struct espconn *espconn)`

Parameter:

`struct espconn *espconn` : corresponding connected control structure

Return:

0 : succeed

Non-0 : error code `ESPCONN_ARG` – illegal argument, can't find TCP connection according to structure `espconn`

4.3. UDP APIs

1. `espconn_create`

Function: create UDP transmission.

Prototype:

`sin8 espconn_create(struct espconn *espconn)`

Parameter:

`struct espconn *espconn` : corresponding connected control block structure

Return:

0 : succeed

Non-0 : error code

`ESPCONN_ISCONN` – Already connected

`ESPCONN_MEM` – Out of memory



`ESPCONN_ARG` – illegal argument, can't find UDP transmission according to structure `espconn`

2. `espconn_igmp_join`

Function:

Join a multicast group

Note:

This API can only be called after the ESP8266 station connects to a router.

Prototype:

```
sint8 espconn_igmp_join(ip_addr_t *host_ip, ip_addr_t *multicast_ip)
```

Parameters:

`ip_addr_t *host_ip` : IP of host

`ip_addr_t *multicast_ip` : IP of multicast group

Return:

0 : succeed

Non-0 : error code `ESPCONN_MEM` – Out of memory

3. `espconn_igmp_leave`

Function:

Quit a multicast group

Prototype:

```
sint8 espconn_igmp_leave(ip_addr_t *host_ip, ip_addr_t *multicast_ip)
```

Parameters:

`ip_addr_t *host_ip` : IP of host

`ip_addr_t *multicast_ip` : IP of multicast group

Return:

0 : succeed

Non-0 : error code `ESPCONN_MEM` – Out of memory

4. `espconn_dns_setserver`

Function:

Set default DNS server. Two DNS server is allowed to be set.

Note:

Only if ESP8266 DHCP client is disabled (`wifi_station_dhcpc_stop`), this API can be used.



Prototype:

```
void espconn_dns_setserver(char numdns, ip_addr_t *dnsserver)
```

Parameter:

```
char numdns      : DNS server ID, 0 or 1  
ip_addr_t *dnsserver : DNS server IP
```

Return:

```
none
```

4.4. mDNS APIs

1. espconn_mdns_init

Function:

```
mdns initialization
```

Note:

- In soft-AP+station mode, call `wifi_set_broadcast_if(STATIONAP_MODE);` first to enable broadcast for both soft-AP and station interface.
- Using station interface, please obtain IP address of the ESP8266 station first before calling the API to initialize mDNS;
- `txt_data` has to be set as " `key = value` ", as **Example**;

Structure:

```
struct mdns_info{  
    char *host_name;  
    char *server_name;  
    uint16 server_port;  
    unsigned long ipAddr;  
    char *txt_data[10];  
};
```

Prototype:

```
void espconn_mdns_init(struct mdns_info *info)
```

Parameter:

```
struct mdns_info *info : mDNS information
```

Return:

```
none
```

Example:



```
struct mdns_info *info = (struct mdns_info *)os_zalloc(sizeof(struct
mdns_info));

info->host_name = "espressif";

info->ipAddr = station_ipconfig.ip.addr; //ESP8266 station IP

info->server_name = "iot";

info->server_port = 8080;

info->txt_data[0] = "version = now";

info->txt_data[1] = "user1 = data1";

info->txt_data[2] = "user2 = data2";

espconn_mdns_init(info);
```

2. espconn_mdns_close

Function:

close mDNS, corresponding creation API : `espconn_mdns_init`

Prototype:

```
void espconn_mdns_close(void)
```

Parameter:

none

Return:

none

3. espconn_mdns_server_register

Function:

register mDNS server

Prototype:

```
void espconn_mdns_server_register(void)
```

Parameter:

none

Return:

none

4. espconn_mdns_server_unregister

Function:

unregister mDNS server



Prototype:

```
void espconn_mdns_server_unregister(void)
```

Parameter:

none

Return:

none

5. espconn_mdns_get_servername

Function:

Get mDNS server name

Prototype:

```
char* espconn_mdns_get_servername(void)
```

Parameter:

none

Return:

server name

6. espconn_mdns_set_servername

Function:

Set mDNS server name

Prototype:

```
void espconn_mdns_set_servername(const char *name)
```

Parameter:

`const char *name` – server name

Return:

none

7. espconn_mdns_set_hostname

Function:

Set mDNS host name

Prototype:

```
void espconn_mdns_set_hostname(char *name)
```

Parameter:

`char *name` – host name



Return:

none

8. `espconn_mdns_get_hostname`

Function:

Get mDNS host name

Prototype:

```
char* espconn_mdns_get_hostname(void)
```

Parameter:

none

Return:

host name

9. `espconn_mdns_disable`

Function:

Disable mDNS , corresponding creation API : `espconn_mdns_enable`

Prototype:

```
void espconn_mdns_disable(void)
```

Parameter:

none

Return:

none

10. `espconn_mdns_enable`

Function:

Enable mDNS

Prototype:

```
void espconn_mdns_enable(void)
```

Parameter:

none

Return:

none



5. Application Related

5.1. AT APIs

for AT APIs examples, refer to [esp_iot_sdk/examples/at/user/user_main.c](#).

1. `at_response_ok`

Function:

Output `OK` to AT Port (UART0)

Prototype:

```
void at_response_ok(void)
```

Parameter:

null

Return:

null

2. `at_response_error`

Function:

output `ERROR` to AT Port (UART0)

Prototype:

```
void at_response_error(void)
```

Parameter:

null

Return:

null

3. `at_cmd_array_regist`

Function:

register user-define AT commands.

Can be called only once to register all user-define AT commands.

Prototype:

```
void at_cmd_array_regist (  
    at_function * custom_at_cmd_arrar,  
    uint32 cmd_num  
)
```



Parameter:

`at_function * custom_at_cmd_arrar` : Array of user-define AT commands
`uint32 cmd_num` : Number counts of user-define AT commands

Return:

null

Example:

refer to [esp_iot_sdk/examples/at/user/user_main.c](#)

4. `at_get_next_int_dec`

Function:

parse int from AT command

Prototype:

`bool at_get_next_int_dec (char **p_src,int* result,int* err)`

Parameter:

`char **p_src` : *p_src is the AT command that need to be parsed
`int* result` : int number parsed from the AT command
`int* err` : 1: no number is found; 3: only '-' is found.

Return:

`true`: parser succeeds (NOTE: if no number is found, it will return True, but returns error code 1)
`false`: parser is unable to parse string; some probable causes are: int number more than 10 bytes; string contains termination characters '/r'; string contains only '-'.

Example:

refer to [esp_iot_sdk/examples/at/user/user_main.c](#)

5. `at_data_str_copy`

Function: parse string from AT command

Prototype:

`int32 at_data_str_copy (char * p_dest, char ** p_src,int32 max_len)`

Parameter:

`char * p_dest` : string parsed from the AT command
`char ** p_src` : *p_src is the AT command that need to be parsed
`int32 max_len` : max string length that allowed



Return:

length of string:

`>=0`: succeed and returns the length of the string

`<0` : fail and returns -1

Example:

refer to [esp_iot_sdk/examples/at/user/user_main.c](#)

6. `at_init`

Function:

AT initialize

Prototype:

`void at_init (void)`

Parameter:

null

Return:

null

Example:

refer to [esp_iot_sdk/examples/at/user/user_main.c](#)

7. `at_port_print`

Function:

output string to AT PORT(UART0)

Prototype:

`void at_port_print(const char *str)`

Parameter:

`const char *str` : string that need to output

Return:

null

Example:

refer to [esp_iot_sdk/examples/at/user/user_main.c](#)

8. `at_set_custom_info`

Function:

User-define version info of AT which can be got by AT+GMR.

Prototype:

`void at_set_custom_info (char *info)`



Parameter:

`char *info` : version info

Return:

null

9. `at_enter_special_state`

Function:

Enter processing state. In processing state, AT core will return `busy` for any further AT commands.

Prototype:

`void at_enter_special_state (void)`

Parameter:

null

Return:

null

10. `at_leave_special_state`

Function:

Exit from AT processing state.

Prototype:

`void at_leave_special_state (void)`

Parameter:

null

Return:

null

11. `at_get_version`

Function:

Get Espressif AT lib version.

Prototype:

`uint32 at_get_version (void)`

Parameter:

null

Return:

Espressif AT lib version



12. `at_register_uart_rx_intr`

Function:

Set UART0 to be used by user or AT commands.

Note:

This API can be called multiple times.

Running AT, UART0 default to be used by AT commands.

Prototype:

```
void at_register_uart_rx_intr(at_custom_uart_rx_intr rx_func)
```

Parameter:

`at_custom_uart_rx_intr` : register a UART0 RX interrupt handler so that UART0 can be used by the customer, while if it's NULL, UART0 is assigned to AT commands.

Return:

null

Example:

```
void user_uart_rx_intr(uint8* data, int32 len)
{
    // UART0 rx for user
    os_printf("len=%d \r\n", len);
    os_printf(data);

    // change UART0 for AT
    at_register_uart_rx_intr(NULL);
}

void user_init(void){ at_register_uart_rx_intr(user_uart_rx_intr); }
```

13. `at_response`

Function:

Set AT response

Note:

`at_response` outputs from UART0 TX by default which is same as `at_port_print`. But if called `at_register_response_func`, the string of `at_response` will be the parameter of `response_func`, users can define their own behavior.

Prototype:

```
void at_response (const char *str)
```



Parameter:

`const char *str` : string

Return:

none

14. `at_register_response_func`

Function:

Register callback of `at_response` for user-defined responses. After called `at_register_response_func`, the string of `at_response` will be the parameter of `response_func`, users can define their own behavior.

Prototype:

`void at_register_response_func (at_custom_response_func_type response_func)`

Parameter:

`at_custom_response_func_type` : callback of `at_response`

Return:

none



5.2. Related JSON APIs

Found in : [esp-iot-sdk/include/json/jsonparse.h](#) & [jsontree.h](#)

1. `jsonparse_setup`

Function:

json initialize parsing

Prototype:

```
void jsonparse_setup(  
    struct jsonparse_state *state,  
    const char *json,  
    int len  
)
```

Parameters:

`struct jsonparse_state *state` : json parsing pointer
`const char *json` : json parsing character string
`int len` : character string length

Return:

null

2. `jsonparse_next`

Function:

Returns jsonparse next object

Prototype:

```
int jsonparse_next(struct jsonparse_state *state)
```

Parameters:

`struct jsonparse_state *state` : json parsing pointer

Return:

int : parsing result

3. `jsonparse_copy_value`

Function:

Copies current parsing character string to a certain buffer



Prototype:

```
int jsonparse_copy_value(  
    struct jsonparse_state *state,  
    char *str,  
    int size  
)
```

Parameters:

`struct jsonparse_state *state` : json parsing pointer
`char *str` : buffer pointer
`int size` : buffer size

Return:

`int` : copy result

4. `jsonparse_get_value_as_int`

Function:

Parses json to get integer

Prototype:

```
int jsonparse_get_value_as_int(struct jsonparse_state *state)
```

Parameters:

`struct jsonparse_state *state` : json parsing pointer

Return:

`int` : parsing result

5. `jsonparse_get_value_as_long`

Function:

Parses json to get long integer

Prototype:

```
long jsonparse_get_value_as_long(struct jsonparse_state *state)
```

Parameters:

`struct jsonparse_state *state` : json parsing pointer

Return:

`long` : parsing result

6. `jsonparse_get_len`

Function:

Gets parsed json length



Prototype:

```
int jsonparse_get_value_len(struct jsonparse_state *state)
```

Parameters:

```
struct jsonparse_state *state : json parsing pointer
```

Return:

```
int : parsed json length
```

7. jsonparse_get_value_as_type

Function:

Parses json data type

Prototype:

```
int jsonparse_get_value_as_type(struct jsonparse_state *state)
```

Parameters:

```
struct jsonparse_state *state : json parsing pointer
```

Return:

```
int : parsed json data type
```

8. jsonparse_strcmp_value

Function:

Compares parsed json and certain character string

Prototype:

```
int jsonparse_strcmp_value(struct jsonparse_state *state, const char *str)
```

Parameters:

```
struct jsonparse_state *state : json parsing pointer
```

```
const char *str : character buffer
```

Return:

```
int : comparison result
```

9. jsontree_set_up

Function:

Creates json data tree



Prototype:

```
void jsontree_setup(  
    struct jsontree_context *js_ctx,  
    struct jsontree_value *root,  
    int (* putchar)(int)  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree element pointer
`struct jsontree_value *root` : root element pointer
`int (* putchar)(int)` : input function

Return:

null

10. jsontree_reset

Function:

Resets json tree

Prototype:

```
void jsontree_reset(struct jsontree_context *js_ctx)
```

Parameters:

`struct jsontree_context *js_ctx` : json data tree pointer

Return:

null

11. jsontree_path_name

Function:

get json tree parameters

Prototype:

```
const char *jsontree_path_name(  
    const struct jsontree_cotext *js_ctx,  
    int depth  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer
`int depth` : json tree depth

Return:

`char*` : parameter pointer



12. jsontree_write_int

Function:

write integer to json tree

Prototype:

```
void jsontree_write_int(  
    const struct jsontree_context *js_ctx,  
    int value  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer
`int value` : integer value

Return:

null

13. jsontree_write_int_array

Function:

Writes integer array to json tree

Prototype:

```
void jsontree_write_int_array(  
    const struct jsontree_context *js_ctx,  
    const int *text,  
    uint32 length  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer
`int *text` : array entry address
`uint32 length` : array length

Return:

null

14. jsontree_write_string

Function:

Writes string to json tree



Prototype:

```
void jsontree_write_string(  
    const struct jsontree_context *js_ctx,  
    const char *text  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer
`const char* text` : character string pointer

Return:

null

15. jsontree_print_next

Function:

json tree depth

Prototype:

```
int jsontree_print_next(struct jsontree_context *js_ctx)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer

Return:

`int` : json tree depth

16. jsontree_find_next

Function:

find json tree element

Prototype:

```
struct jsontree_value *jsontree_find_next(  
    struct jsontree_context *js_ctx,  
    int type  
)
```

Parameters:

`struct jsontree_context *js_ctx` : json tree pointer
`int` : type

Return:

`struct jsontree_value *` : json tree element pointer



6. Definitions & Structures

6.1. Timer

```
typedef void ETSTimerFunc(void *timer_arg);
typedef struct _ETSTIMER_ {
    struct _ETSTIMER_ *timer_next;
    uint32_t timer_expire;
    uint32_t timer_period;
    ETSTimerFunc *timer_func;
    void *timer_arg;
} ETSTimer;
```

6.2. WiFi Related Structures

1. Station Related

```
struct station_config {
    uint8 ssid[32];
    uint8 password[64];
    uint8 bssid_set;
    uint8 bssid[6];
};
```

Note:

BSSID as MAC address of AP, will be used when several APs have the same SSID.

If `station_config.bssid_set==1`, `station_config.bssid` has to be set, otherwise, the connection will fail.

In general, `station_config.bssid_set` need to be 0.

2. soft-AP related

```
typedef enum _auth_mode {
    AUTH_OPEN = 0,
    AUTH_WEP,
    AUTH_WPA_PSK,
    AUTH_WPA2_PSK,
    AUTH_WPA_WPA2_PSK
} AUTH_MODE;
struct softap_config {
```



```
uint8 ssid[32];
uint8 password[64];
uint8 ssid_len;
uint8 channel;          // support 1 ~ 13
uint8 authmode;         // Don't support AUTH_WEP in soft-AP mode
uint8 ssid_hidden;      // default 0
uint8 max_connection;   // default 4, max 4
uint16 beacon_interval; // 100 ~ 60000 ms, default 100
};
```

Note:

If `softap_config.ssid_len==0`, check ssid till a termination character is found; otherwise, it will depend on `softap_config.ssid_len`.

3. scan related

```
struct scan_config {
    uint8 *ssid;
    uint8 *bssid;
    uint8 channel;
    uint8 show_hidden; // Scan APs which are hiding their SSID or not.
};

struct bss_info {
    STAILQ_ENTRY(bss_info) next;
    u8 bssid[6];
    u8 ssid[32];
    u8 channel;
    s8 rssi;
    u8 authmode;
    uint8 is_hidden; // SSID of current AP is hidden or not.
    sint16 freq_offset; // AP's frequency offset
};

typedef void (* scan_done_cb_t)(void *arg, STATUS status);
```

4. WiFi event related structure

```
enum {
    EVENT_STAMODE_CONNECTED = 0,
    EVENT_STAMODE_DISCONNECTED,
    EVENT_STAMODE_AUTHMODE_CHANGE,
    EVENT_STAMODE_GOT_IP,
```



```
EVENT_SOFTAPMODE_STACONNECTED,
    EVENT_SOFTAPMODE_STADISCONNECTED,
    EVENT_MAX
};

enum {
    REASON_UNSPECIFIED            = 1,
    REASON_AUTH_EXPIRE           = 2,
    REASON_AUTH_LEAVE            = 3,
    REASON_ASSOC_EXPIRE          = 4,
    REASON_ASSOC_TOOMANY         = 5,
    REASON_NOT_AUTHED            = 6,
    REASON_NOT_ASSOCED           = 7,
    REASON_ASSOC_LEAVE           = 8,
    REASON_ASSOC_NOT_AUTHED      = 9,
    REASON_DISASSOC_PWRCAP_BAD    = 10, /* 11h */
    REASON_DISASSOC_SUPCHAN_BAD  = 11, /* 11h */
    REASON_IE_INVALID            = 13, /* 11i */
    REASON_MIC_FAILURE           = 14, /* 11i */
    REASON_4WAY_HANDSHAKE_TIMEOUT = 15, /* 11i */
    REASON_GROUP_KEY_UPDATE_TIMEOUT = 16, /* 11i */
    REASON_IE_IN_4WAY_DIFFERS    = 17, /* 11i */
    REASON_GROUP_CIPHER_INVALID  = 18, /* 11i */
    REASON_PAIRWISE_CIPHER_INVALID = 19, /* 11i */
    REASON_AKMP_INVALID          = 20, /* 11i */
    REASON_UNSUPP_RSN_IE_VERSION = 21, /* 11i */
    REASON_INVALID_RSN_IE_CAP    = 22, /* 11i */
    REASON_802_1X_AUTH_FAILED    = 23, /* 11i */
    REASON_CIPHER_SUITE_REJECTED = 24, /* 11i */

    REASON_BEACON_TIMEOUT        = 200,
    REASON_NO_AP_FOUND           = 201,
};

typedef struct {
    uint8 ssid[32];
    uint8 ssid_len;
    uint8 bssid[6];
    uint8 channel;
```




```
} Event_StaMode_Connected_t;

typedef struct {
    uint8 ssid[32];
    uint8 ssid_len;
    uint8 bssid[6];
    uint8 reason;
} Event_StaMode_Disconnected_t;

typedef struct {
    uint8 old_mode;
    uint8 new_mode;
} Event_StaMode_AuthMode_Change_t;

typedef struct {
    struct ip_addr ip;
    struct ip_addr mask;
    struct ip_addr gw;
} Event_StaMode_Got_IP_t;

typedef struct {
    uint8 mac[6];
    uint8 aid;
} Event_SoftAPMode_StaConnected_t;

typedef struct {
    uint8 mac[6];
    uint8 aid;
} Event_SoftAPMode_StaDisconnected_t;

typedef union {
    Event_StaMode_Connected_t        connected;
    Event_StaMode_Disconnected_t     disconnected;
    Event_StaMode_AuthMode_Change_t  auth_change;
    Event_StaMode_Got_IP_t           got_ip;
    Event_SoftAPMode_StaConnected_t  sta_connected;
    Event_SoftAPMode_StaDisconnected_t sta_disconnected;
} Event_Info_u;
```



```
typedef struct _esp_event {
    uint32 event;
    Event_Info_u event_info;
} System_Event_t;
```

5. smart config structure

```
typedef enum {
    SC_STATUS_WAIT = 0,          // Please don't start connection in this phase
    SC_STATUS_FIND_CHANNEL,      // Start connection by APP in this phase
    SC_STATUS_GETTING_SSID_PSWD,
    SC_STATUS_LINK,
    SC_STATUS_LINK_OVER,         // Got IP, connect to AP successfully
} sc_status;
typedef enum {
    SC_TYPE_ESPTOUCH = 0,
    SC_TYPE_AIRKISS,
} sc_type;
```

6.3. JSON Related Structure

1. json structure

```
struct jsontree_value {
    uint8_t type;
};

struct jsontree_pair {
    const char *name;
    struct jsontree_value *value;
};

struct jsontree_context {
    struct jsontree_value *values[JSONTREE_MAX_DEPTH];
    uint16_t index[JSONTREE_MAX_DEPTH];
    int (* putchar)(int);
    uint8_t depth;
    uint8_t path;
    int callback_state;
};
```



```
struct jsontree_callback {
    uint8_t type;
    int (* output)(struct jsontree_context *js_ctx);
    int (* set)(struct jsontree_context *js_ctx,
                struct jsonparse_state *parser);
};

struct jsontree_object {
    uint8_t type;
    uint8_t count;
    struct jsontree_pair *pairs;
};

struct jsontree_array {
    uint8_t type;
    uint8_t count;
    struct jsontree_value **values;
};

struct jsonparse_state {
    const char *json;
    int pos;
    int len;
    int depth;
    int vstart;
    int vlen;
    char vtype;
    char error;
    char stack[JSONPARSE_MAX_DEPTH];
};
```

2. json macro definition

```
#define JSONTREE_OBJECT(name, ...) /
static struct jsontree_pair jsontree_pair_##name[] = {__VA_ARGS__}; /
static struct jsontree_object name = { /
    JSON_TYPE_OBJECT, /
    sizeof(jsontree_pair_##name)/sizeof(struct jsontree_pair), /
    jsontree_pair_##name }
```



```
#define JSONTREE_PAIR_ARRAY(value) (struct jsontree_value *)(value)
#define JSONTREE_ARRAY(name, ...) /
static struct jsontree_value* jsontree_value_##name[] = {__VA_ARGS__}; /
static struct jsontree_array name = { /
    JSON_TYPE_ARRAY, /
    sizeof(jsontree_value_##name)/sizeof(struct jsontree_value*), /
    jsontree_value_##name }
```

6.4. espconn parameters

1. callback function

```
/** callback prototype to inform about events for a espconn */
typedef void (* espconn_rcv_callback)(void *arg, char *pdata, unsigned short
len);
typedef void (* espconn_callback)(void *arg, char *pdata, unsigned short len);
typedef void (* espconn_connect_callback)(void *arg);
```

2. espconn

```
typedef void* espconn_handle;
typedef struct _esp_tcp {
    int remote_port;
    int local_port;
    uint8 local_ip[4];
    uint8 remote_ip[4];
    espconn_connect_callback connect_callback;
    espconn_reconnect_callback reconnect_callback;
    espconn_connect_callback disconnect_callback;
    espconn_connect_callback write_finish_fn;
} esp_tcp;

typedef struct _esp_udp {
    int remote_port;
    int local_port;
    uint8 local_ip[4];
    uint8 remote_ip[4];
} esp_udp;
```



```
/** Protocol family and type of the espconn */
enum espconn_type {
    ESPCONN_INVALID    = 0,
    /* ESPCONN_TCP Group */
    ESPCONN_TCP        = 0x10,
    /* ESPCONN_UDP Group */
    ESPCONN_UDP        = 0x20,
};

/** Current state of the espconn. Non-TCP espconn are always in state
    ESPCONN_NONE! */
enum espconn_state {
    ESPCONN_NONE,
    ESPCONN_WAIT,
    ESPCONN_LISTEN,
    ESPCONN_CONNECT,
    ESPCONN_WRITE,
    ESPCONN_READ,
    ESPCONN_CLOSE
};

enum espconn_option{
    ESPCONN_START = 0x00,
    ESPCONN_REUSEADDR = 0x01,
    ESPCONN_NODELAY = 0x02,
    ESPCONN_COPY = 0x04,
    ESPCONN_KEEPAIVE = 0x08,
    ESPCONN_END
}

enum espconn_level{
    ESPCONN_KEEPIIDLE,
    ESPCONN_KEEPIINTVL,
    ESPCONN_KEEPCNT
}

/** A espconn descriptor */
struct espconn {
    /** type of the espconn (TCP, UDP) */
    enum espconn_type type;
```



```
/** current state of the espconn */
enum espconn_state state;
union {
    esp_tcp *tcp;
    esp_udp *udp;
} proto;
/** A callback function that is informed about events for this espconn */
espconn_recv_callback recv_callback;
espconn_sent_callback sent_callback;
uint8 link_cnt;
void *reverse; // reversed for customer use
};
```

6.5. interrupt related definition

```
/* interrupt related */

#define ETS_SPI_INUM      2
#define ETS_GPIO_INUM    4
#define ETS_UART_INUM    5
#define ETS_UART1_INUM   5
#define ETS_FRC_TIMER1_INUM 9

/* disable all interrupts */
#define ETS_INTR_LOCK()      ets_intr_lock()
/* enable all interrupts */
#define ETS_INTR_UNLOCK()    ets_intr_unlock()

/* register interrupt handler of frc timer1 */
#define ETS_FRC_TIMER1_INTR_ATTACH(func, arg) \
ets_isr_attach(ETS_FRC_TIMER1_INUM, (func), (void *) (arg))

/* register interrupt handler of GPIO */
#define ETS_GPIO_INTR_ATTACH(func, arg) \
```



```
ets_isr_attach(ETS_GPIO_INUM, (func), (void *) (arg))

/* register interrupt handler of UART */
#define ETS_UART_INTR_ATTACH(func, arg) \
ets_isr_attach(ETS_UART_INUM, (func), (void *) (arg))

/* register interrupt handler of SPI */
#define ETS_SPI_INTR_ATTACH(func, arg) \
ets_isr_attach(ETS_SPI_INUM, (func), (void *) (arg))

/* enable a interrupt */
#define ETS_INTR_ENABLE(inum)    ets_isr_unmask((1<<inum))

/* disable a interrupt */
#define ETS_INTR_DISABLE(inum)  ets_isr_mask((1<<inum))

/* enable SPI interrupt */
#define ETS_SPI_INTR_ENABLE()    ETS_INTR_ENABLE(ETS_SPI_INUM)

/* enable UART interrupt */
#define ETS_UART_INTR_ENABLE()  ETS_INTR_ENABLE(ETS_UART_INUM)

/* disable UART interrupt */
#define ETS_UART_INTR_DISABLE() ETS_INTR_DISABLE(ETS_UART_INUM)

/* enable frc1 timer interrupt */
#define ETS_FRC1_INTR_ENABLE()   ETS_INTR_ENABLE(ETS_FRC_TIMER1_INUM)

/* disable frc1 timer interrupt */
#define ETS_FRC1_INTR_DISABLE() ETS_INTR_DISABLE(ETS_FRC_TIMER1_INUM)

/* enable GPIO interrupt */
#define ETS_GPIO_INTR_ENABLE()   ETS_INTR_ENABLE(ETS_GPIO_INUM)

/* disable GPIO interrupt */
#define ETS_GPIO_INTR_DISABLE()  ETS_INTR_DISABLE(ETS_GPIO_INUM)
```



7. Peripheral Related Drivers

7.1. GPIO Related APIs

Please refer to [/user/user_plug.c](#).

Users can inquire Espressif Systems for GPIO documentations which will contain more details.

1. PIN Related Macros

The following macros are used to control the GPIO pins' status.

```
PIN_PULLUP_DIS(PIN_NAME)
```

Disable pin pull up

```
PIN_PULLUP_EN(PIN_NAME)
```

Enable pin pull up

```
PIN_FUNC_SELECT(PIN_NAME, FUNC)
```

Select pin function

Example:

```
PIN_FUNC_SELECT(PERIPHS_IO_MUX_MTDI_U, FUNC_GPIO12); // Use MTDI pin as  
GPIO12.
```

2. gpio_output_set

Function: set gpio property

Prototype:

```
void gpio_output_set(  
    uint32 set_mask,  
    uint32 clear_mask,  
    uint32 enable_mask,  
    uint32 disable_mask  
)
```

Input Parameters:

`uint32 set_mask` : set high output; 1:high output; 0:no status change

`uint32 clear_mask` : set low output; 1:low output; 0:no status change

`uint32 enable_mask` : enable output bit

`uint32 disable_mask` : enable input bit

Return:

null



Example:

```
gpio_output_set(BIT12, 0, BIT12, 0):  
    Set GPIO12 as high-level output;  
gpio_output_set(0, BIT12, BIT12, 0):  
    Set GPIO12 as low-level output  
gpio_output_set(BIT12, BIT13, BIT12|BIT13, 0):  
    Set GPIO12 as high-level output, GPIO13 as low-level output.  
gpio_output_set(0, 0, 0, BIT12):  
    Set GPIO12 as input
```

3. GPIO input and output macro

```
GPIO_OUTPUT_SET(gpio_no, bit_value)  
    Set gpio_no as output bit_value, the same as the output example in 5.1.2  
  
GPIO_DIS_OUTPUT(gpio_no)  
    Set gpio_no as input, the same as the input example in 5.1.2.  
  
GPIO_INPUT_GET(gpio_no)  
    Get the level status of gpio_no.
```

4. GPIO interrupt

```
ETS_GPIO_INTR_ATTACH(func, arg)  
    Register GPIO interrupt control function  
  
ETS_GPIO_INTR_DISABLE()  
    Disable GPIO interrupt  
  
ETS_GPIO_INTR_ENABLE()  
    Enable GPIO interrupt
```

5. gpio_pin_intr_state_set

Function:

set GPIO interrupt state

Prototype:

```
void gpio_pin_intr_state_set(  
    uint32 i,  
    GPIO_INT_TYPE intr_state  
)
```



Input Parameters:

```
uint32 i : GPIO pin ID, if you want to set GPIO14, pls use GPIO_ID_PIN(14);
GPIO_INT_TYPE intr_state : interrupt type as the following:
typedef enum {
    GPIO_PIN_INTR_DISABLE = 0,
    GPIO_PIN_INTR_POSEDGE = 1,
    GPIO_PIN_INTR_NEGEDGE = 2,
    GPIO_PIN_INTR_ANYEDGE = 3,
    GPIO_PIN_INTR_LOLEVEL = 4,
    GPIO_PIN_INTR_HILEVEL = 5
} GPIO_INT_TYPE;
```

Return:

```
null
```

6. GPIO Interrupt Handler

Follow the steps below to clear interrupt status in GPIO interrupt processing function:

```
uint32 gpio_status;
gpio_status = GPIO_REG_READ(GPIO_STATUS_ADDRESS);
//clear interrupt status
GPIO_REG_WRITE(GPIO_STATUS_W1TC_ADDRESS, gpio_status);
```

7.2. UART Related APIs

By default, UART0 is a debug output interface. In the case of a dual UART, UART0 works as data receive and transmit interface, while UART1 debug output interface. Please make sure all hardware are correctly connected.

Users can inquire Espressif Systems for UART documentation which will contain more details.

1. uart_init

Function:

Initializes baud rates of the two UARTs

Prototype:

```
void uart_init(
    UartBautRate uart0_br,
    UartBautRate uart1_br
)
```



Parameters:

`UartBautRate uart0_br` : uart0 baud rate
`UartBautRate uart1_br` : uart1 baud rate

Baud Rates:

```
typedef enum {  
    BIT_RATE_9600    = 9600,  
    BIT_RATE_19200   = 19200,  
    BIT_RATE_38400   = 38400,  
    BIT_RATE_57600   = 57600,  
    BIT_RATE_74880   = 74880,  
    BIT_RATE_115200  = 115200,  
    BIT_RATE_230400  = 230400,  
    BIT_RATE_460800  = 460800,  
    BIT_RATE_921600  = 921600  
} UartBautRate;
```

Return:

null

2. `uart0_tx_buffer`

Function:

Sends user-defined data through UART0

Prototype:

```
void uart0_tx_buffer(uint8 *buf, uint16 len)
```

Parameter:

`uint8 *buf` : data to send later
`uint16 len` : the length of data to send later

Return:

null

3. `uart0_rx_intr_handler`

Function:

UART0 interrupt processing function. Users can add the processing of received data in this function. (Receive buffer size: `0x100`; if the received data are more than `0x100`, pls handle them yourselves.)

Prototype:

```
void uart0_rx_intr_handler(void *para)
```

Parameter:

`void *para` : the pointer pointing to `RcvMsgBuff` structure



Return:
null

7.3. I2C Master Related APIs

Users can inquire apply to Espressif Systems for I2C documentation which will contain more details.

1. i2c_master_gpio_init

Function:
Set GPIO in I2C master mode

Prototype:
`void i2c_master_gpio_init (void)`

Input Parameters:
null

Return:
null

2. i2c_master_init

Function:
Initialize I2C

Prototype:
`void i2c_master_init(void)`

Input Parameters:
null

Return:
null

3. i2c_master_start

Function: configures I2C to start sending data

Prototype:
`void i2c_master_start(void)`

Input Parameters:
null

Return:
null



4. i2c_master_stop

Function:

configures I2C to stop sending data

Prototype:

```
void i2c_master_stop(void)
```

Input Parameters:

null

Return:

null

5. i2c_master_send_ack

Function:

Sends I2C ACK

Prototype:

```
void i2c_master_send_ack (void)
```

Input Parameters:

null

Return:

null

6. i2c_master_send_nack

Function:

Sends I2C NACK

Prototype:

```
void i2c_master_send_nack (void)
```

Input Parameters:

null

Return:

null

7. i2c_master_checkAck

Function:

Checks ACK from slave

Prototype:

```
bool i2c_master_checkAck (void)
```



Input Parameters:

 null

Return:

 true: get I2C slave ACK

 false: get I2C slave NACK

8. **i2c_master_readByte**

Function:

 Read one byte from I2C slave

Prototype:

 uint8 i2c_master_readByte (void)

Input Parameters:

 null

Return:

 uint8 : the value that was read

9. **i2c_master_writeByte**

Function:

 Write one byte to slave

Prototype:

 void i2c_master_writeByte (uint8 wrdata)

Input Parameters:

 uint8 wrdata : data to write

Return:

 null



7.4. PWM Related

Herein only introduces the PWM related APIs in [pwm.h](#). Users can inquire Espressif Systems for PWM documentation which will contain more details.

PWM APIs can not be called when APIs in [hw_timer.c](#) are in use, because they use the same hardware timer.

1. `pwm_init`

Function:

Initialize PWM function, including GPIO selection, period and duty cycle.

Note:

This API can be called only once.

Prototype:

```
void pwm_init(  
    uint32 period,  
    uint8 *duty,  
    uint32 pwm_channel_num,  
    uint32 (*pin_info_list)[3])
```

Parameter:

`uint32 period` : PWM period

`uint8 *duty` : duty cycle of each output

`uint32 pwm_channel_num`: PWM channel number

`uint32 (*pin_info_list)[3]`: GPIO parameter of PWM channel, it is a pointer of $n * 3$ array which defines GPIO register, IO reuse of corresponding PIN and GPIO number.

Return:

null

Example:

```
uint32 io_info[][3] =  
    {{PWM_0_OUT_IO_MUX, PWM_0_OUT_IO_FUNC, PWM_0_OUT_IO_NUM},  
     {PWM_1_OUT_IO_MUX, PWM_1_OUT_IO_FUNC, PWM_1_OUT_IO_NUM},  
     {PWM_2_OUT_IO_MUX, PWM_2_OUT_IO_FUNC, PWM_2_OUT_IO_NUM}};  
  
pwm_init(light_param.pwm_period, light_param.pwm_duty, 3, io_info);
```



2. `pwm_start`

Function:

Starts PWM. This function needs to be called after PWM config is changed.

Prototype:

```
void pwm_start (void)
```

Parameter:

null

Return:

null

3. `pwm_set_duty`

Function:

Sets duty cycle of a PWM output. Set the time that high-level single will last, duty depends on period, the maximum value can be $\text{Period} * 1000 / 45$. For example, 1KHz PWM, duty range is 0 ~ 22222

Note:

After set configuration, `pwm_start` need to be called to take effect.

Prototype:

```
void pwm_set_duty(uint32 duty, uint8 channel)
```

Input Parameters:

`uint32 duty` : the time that high-level single will last, duty cycle will be $(\text{duty} * 45) / (\text{period} * 1000)$

`uint8 channel` : PWM channel, depends on how many PWM channels is used, in `IOT_Demo` it depends on `#define PWM_CHANNEL`

Return:

null

4. `pwm_get_duty`

Function:

Gets duty cycle of PWM output, duty cycle will be $(\text{duty} * 45) / (\text{period} * 1000)$

Prototype:

```
uint8 pwm_get_duty(uint8 channel)
```

Input Parameters:

`uint8 channel` : PWM channel, depends on how many PWM channels is used, in `IOT_Demo` it depends on `#define PWM_CHANNEL`



Return:

`uint8` : duty cycle of PWM output

5. `pwm_set_period`

Function:

Sets PWM period, unit: us. For example, for 1KHz PWM, period is 1000 us

Note:

After set configuration, `pwm_start` need to be called to take effect.

Prototype:

```
void pwm_set_period(uint32 period)
```

Input Parameters:

`uint32 period` : PWM period, unit: us

Return:

null

6. `pwm_get_period`

Function:

Gets PWM period.

Prototype:

```
uint32 pwm_get_period(void)
```

Parameter:

null

Return:

PWM period, unit: us.

7. `get_pwm_version`

Function:

Get version information of PWM.

Prototype:

```
uint32 get_pwm_version(void)
```

Parameter:

none

Return:

PWM version



8. Appendix

8.1. ESPCONN Programming

1. TCP Client Mode

Notes

- ESP8266, working in Station mode, will start client connections when given an IP address.
- ESP8266, working in soft-AP mode, will start client connections when the devices connected to the ESP8266 are given IP addresses.

Steps

- Initialize `espconn` parameters according to protocols.
- Register connect callback function, and register reconnect callback function.
 - (Call `espconn_regist_connectcb` and `espconn_regist_reconcb`)
- Call `espconn_connect` function and set up the connection with TCP Server.
- Registered connected callback functions will be called after successful connection, which will register corresponding callback function. We recommend registering a disconnect callback function.
 - (Call `espconn_regist_recvcb` , `espconn_regist_sentcb` and `espconn_regist_disconcb` in connected callback)
- When using receive callback function or sent callback function to run disconnect, it is recommended to set a time delay to make sure that the all firmware functions are completed.

2. TCP Server Mode

Notes

- If the ESP8266 is in Station mode, it will start server listening when given an IP address.
- If the ESP8266 is in soft-AP mode, it will start server listening.

Steps

- Initialize `espconn` parameters according to protocols.
- Register connect callback and reconnect callback function.
 - (Call `espconn_regist_connectcb` and `espconn_regist_reconcb`)
- Call `espconn_accept` function to listen to the connection with host.



- Registered connect function will be called after a successful connection, which will register a corresponding callback function.
 - ▶ (Call `espconn_regist_recvcb` , `espconn_regist_sentcb` and `espconn_regist_disconcb` in connected callback)

3. espconn callback

Register Function	Callback	Description
<code>espconn_regist_connectcb</code>	<code>espconn_connect_callback</code>	TCP connected successfully
<code>espconn_regist_reconcb</code>	<code>espconn_reconnect_callback</code>	Error occur, TCP disconnected
<code>espconn_regist_sentcb</code>	<code>espconn_sent_callback</code>	Sent TCP or UDP data
<code>espconn_regist_recvcb</code>	<code>espconn_recv_callback</code>	Received TCP or UDP data
<code>espconn_regist_write_finish</code>	<code>espconn_write_finish_callback</code>	Write data into TCP-send-buffer
<code>espconn_regist_disconcb</code>	<code>espconn_disconnect_callback</code>	TCP disconnected successfully

Notice:

- Parameter `arg` of callback is the pointer corresponding structure `espconn`. This pointer may be different in different callbacks, please do not use this pointer directly to distinguish one from another in multiple connections, use `remote_ip` and `remote_port` in `espconn` instead.
- If `espconn_connect` (or `espconn_secure_connect`) fail, returns non-0 value, there is no connection, so it won't enter any `espconn` callback.
- Don't call `espconn_disconnect` (or `espconn_secure_disconnect`) to break the TCP connection in any `espconn` callback.
 - ▶ If it is needed, please use `system_os_task` and `system_os_post` to trigger the disconnection (`espconn_disconnect` or `espconn_secure_disconnect`).

8.2. RTC APIs Example

Demo code below shows how to get RTC time and to read and write to RTC memory.

```
#include "ets_sys.h"
#include "osapi.h"
#include "user_interface.h"

os_timer_t rtc_test_t;
#define RTC_MAGIC 0x55aaaa55
```



```
typedef struct {
    uint64 time_acc;
    uint32 magic ;
    uint32 time_base;
}RTC_TIMER_DEMO;

void rtc_count()
{
    RTC_TIMER_DEMO rtc_time;
    static uint8 cnt = 0;
    system_rtc_mem_read(64, &rtc_time, sizeof(rtc_time));

    if(rtc_time.magic!=RTC_MAGIC){
        os_printf("rtc time init...\r\n");
        rtc_time.magic = RTC_MAGIC;
        rtc_time.time_acc= 0;
        rtc_time.time_base = system_get_rtc_time();
        os_printf("time base : %d \r\n",rtc_time.time_base);
    }

    os_printf("=====\r\n");
    os_printf("RTC time test : \r\n");

    uint32 rtc_t1,rtc_t2;
    uint32 st1,st2;
    uint32 cal1, cal2;

    rtc_t1 = system_get_rtc_time();
    st1 = system_get_time();

    cal1 = system_rtc_clock_cali_proc();
    os_delay_us(300);

    st2 = system_get_time();
    rtc_t2 = system_get_rtc_time();

    cal2 = system_rtc_clock_cali_proc();
    os_printf(" rtc_t2-t1 : %d \r\n",rtc_t2-rtc_t1);
    os_printf(" st2-t2 : %d \r\n",st2-st1);
}
```



```
    os_printf("cal 1 : %d.%d \r\n", ((cal1*1000)>>12)/1000,
((cal1*1000)>>12)%1000 );
    os_printf("cal 2 : %d.%d \r\n",((cal2*1000)>>12)/1000,
((cal2*1000)>>12)%1000 );
    os_printf("=====\r\n\r\n");
    rtc_time.time_acc += ( ((uint64)(rtc_t2 - rtc_time.time_base)) *
( (uint64)((cal2*1000)>>12)) ) ;
    os_printf("rtc time acc : %lld \r\n",rtc_time.time_acc);
    os_printf("power on time : %lld us\r\n", rtc_time.time_acc/1000);
    os_printf("power on time : %lld.%02lld S\r\n", (rtc_time.time_acc/
1000000)/100, (rtc_time.time_acc/1000000)%100);

    rtc_time.time_base = rtc_t2;
    system_rtc_mem_write(64, &rtc_time, sizeof(rtc_time));
    os_printf("-----\r\n");

    if(5== (cnt++)){
        os_printf("system restart\r\n");
        system_restart();
    }else{
        os_printf("continue ... \r\n");
    }
}

void user_init(void)
{
    rtc_count();
    os_printf("SDK version:%s\n", system_get_sdk_version());

    os_timer_disarm(&rtc_test_t);
    os_timer_setfn(&rtc_test_t,rtc_count,NULL);
    os_timer_arm(&rtc_test_t,10000,1);
}
```

8.3. Sniffer Structure Introduction

The ESP8266 can enter the promiscuous mode (sniffer) and capture IEEE 802.11 packets in the air. The following HT20 packet types are supported:



- 802.11b
- 802.11g
- 802.11n (from MCS0 to MCS7)
- AMPDU

The following packet types are not supported:

- HT40
- LDPC

Although the ESP8266 can not decipher some IEEE80211 packets completely, it can Get the length of these packets.

Therefore, when in the sniffer mode, the ESP8266 can either (1) completely capture the packets or (2) Get the length of the packets.

- For packets that ESP8266 can decipher completely, the ESP8266 returns with the
 - MAC addresses of both communication sides and the encryption type
 - the length of the entire packet.
- For packets that ESP8266 cannot completely decipher, the ESP8266 returns with
 - the length of the entire packet.

Structure `RxControl` and `sniffer_buf` are used to represent these two kinds of packets. Structure `sniffer_buf` contains structure `RxControl`.

```
struct RxControl {
    signed rssi:8;           // signal intensity of packet
    unsigned rate:4;
    unsigned is_group:1;
    unsigned:1;
    unsigned sig_mode:2;     // 0:is 11n packet; 1:is not 11n packet;
    unsigned legacy_length:12; // if not 11n packet, shows length of packet.
    unsigned damatch0:1;
    unsigned damatch1:1;
    unsigned bssidmatch0:1;
    unsigned bssidmatch1:1;
    unsigned MCS:7;         // if is 11n packet, shows the modulation
                           // and code used (range from 0 to 76)
    unsigned CWB:1; // if is 11n packet, shows if is HT40 packet or not
    unsigned HT_length:16; // if is 11n packet, shows length of packet.
    unsigned Smoothing:1;
    unsigned Not_Sounding:1;
```



```
    unsigned:1;
    unsigned Aggregation:1;
    unsigned STBC:2;
    unsigned FEC_CODING:1; // if is 11n packet, shows if is LDPC packet or not.
    unsigned SGI:1;
    unsigned rxend_state:8;
    unsigned ampdu_cnt:8;
    unsigned channel:4; //which channel this packet in.
    unsigned:12;
};

struct LenSeq{
    u16 len; // length of packet
    u16 seq; // serial number of packet, the high 12bits are serial number,
           // low 14 bits are Fragment number (usually be 0)
    u8 addr3[6]; // the third address in packet
};

struct sniffer_buf{
    struct RxControl rx_ctrl;
    u8 buf[36 ]; // head of ieee80211 packet
    u16 cnt;      // number count of packet
    struct LenSeq lenseq[1]; //length of packet
};

struct sniffer_buf2{
    struct RxControl rx_ctrl;
    u8 buf[112];
    u16 cnt;
    u16 len; //length of packet
};
```

The callback function `wifi_promiscuous_rx` contains two parameters (`buf` and `len`). `len` shows the length of `buf`, it can be: `len = 128`, `len = X * 10`, `len = 12`.

LEN == 128

- `buf` contains structure `sniffer_buf2`: it is the management packet, it has 112 bytes of data.
- `sniffer_buf2.cnt` is 1.
- `sniffer_buf2.len` is the length of the management packet.

**LEN == X * 10**

- `buf` contains structure `sniffer_buf`: this structure is reliable, data packets represented by it have been verified by CRC.
- `sniffer_buf.cnt` shows the number of packets in `buf`. The value of `len` is decided by `sniffer_buf.cnt`.
 - ▶ `sniffer_buf.cnt==0`, invalid buf; otherwise, `len = 50 + cnt * 10`
- `sniffer_buf.buf` contains the first 36 bytes of IEEE80211 packet. Starting from `sniffer_buf.lenseq[0]`, each structure `lenseq` shows the length of a packet. `lenseq[0]` shows the length of the first packet. If there are two packets where (`sniffer_buf.cnt == 2`), `lenseq[1]` shows the length of the second packet.
- If `sniffer_buf.cnt > 1`, it is a AMPDU packet. Because headers of each MPDU packets are similar, we only provide the length of each packet (from the header of MAC packet to FCS)
- This structure contains: length of packet, MAC address of both communication sides, length of the packet header.

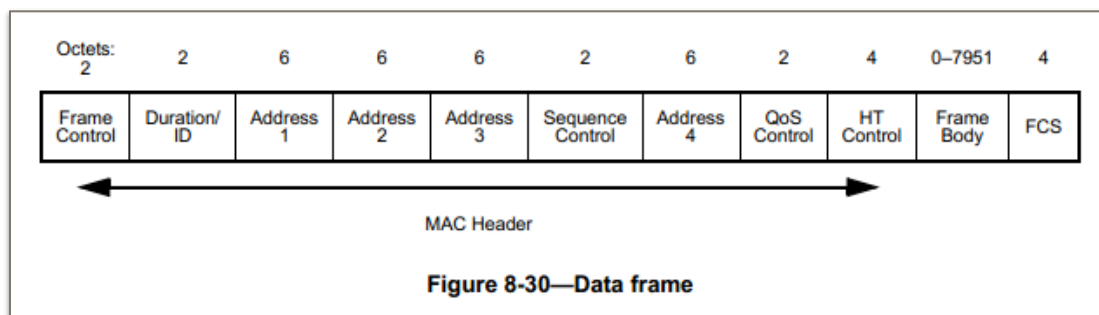
LEN == 12

- `buf` contains structure `RxControl`; but this structure is not reliable. It cannot show the MAC addresses of both communication sides, or the length of the packet header.
- It does not show the number or the length of the sub-packets of AMPDU packets.
- This structure contains: length of the packet, `rssi` and `FEC_CODING`.
- `RSSI` and `FEC_CODING` are used to judge whether the packets are from the same device.

Summary

It is recommended that users speed up the processing of individual packets, otherwise, some follow-up packets may be lost.

Format of an entire IEEE802.11 packet is shown as below.



- The first 24 bytes of MAC header of the data packet are needed:
 - ▶ `Address 4` field is decided by `FromDS` and `ToDS` in `Frame Control`;



- ▶ **QoS Control** field is decided by **Subtype** in **Frame Control**;
- ▶ **HT Control** field is decided by **Order Field** in **Frame Control**;
- ▶ For more details, refer to *IEEE Std 80211-2012*.
- For WEP encrypted packets, the MAC header is followed by an 4-byte IV, and there is a 4-byte ICV before the FCS.
- For TKIP encrypted packets, the MAC header is followed by a 4-byte IV and a 4-byte EIV, and there are an 8-byte MIC and a 4-byte ICV before the FCS.
- For CCMP encrypted packets, the MAC header is followed by an 8-byte CCMP header, and there is an 8-byte MIC before the FCS.

8.4. ESP8266 soft-AP and station channel configuration

Even though ESP8266 supports the softAP+station mode, it is limited to only one hardware channel. In the softAP+station mode, the ESP8266 soft-AP will adjust its channel configuration to be same as the ESP8266 station.

This limitation may cause some inconveniences in the softAP+station mode that users need to pay special attention to, for example:

Case 1:

- (1) When the user connects the ESP8266 to a router (for example, channel 6),
- (2) and sets the ESP8266 soft-AP through `wifi_softap_set_config`,
- (3) If the value is effective, the API will return to true. However, the channel will be automatically adjusted to channel 6 in order to be in line with the ESP8266 station interface. This is because there is only one hardware channel in this mode.

Case 2:

- (1) If the user sets the channel of the ESP8266 soft-AP through `wifi_softap_set_config` (for example, channel 5),
- (2) other stations will connect to the ESP8266 soft-AP,
- (3) then the user connects the ESP8266 station to a router (for example, channel 6),
- (4) the ESP8266 softAP will adjust its channel to be as same as the ESP8266 station (which is channel 6 in this case).
- (5) As a result of the change of channel, the station Wi-Fi connected to the ESP8266 soft-AP in step two will be disconnected.

Case 3:

- (1) Other stations are connected to the ESP8266 softAP .



- (2) If the ESP8266's station interface has been scanning or trying to connect to a target router, the ESP8266 softAP-end connection may break.

This is because the ESP8266 station will try to find its target router in different channels, which means it will keep changing channels, and as a result, the ESP8266 channel is changing, too. Therefore, the ESP8266 softAP-end connection may break.

In cases like this, users can set a timer to call [wifi_station_disconnect](#) to stop the ESP8266 station from continuously trying to connect to the router. Or use [wifi_station_set_reconnect_policy](#) or [wifi_station_set_auto_connect](#) to disable the ESP8266 station from reconnecting to the router.

8.5. ESP8266 boot messages

ESP8266 outputs boot messages through UART0 with baud rate 74880:

```
ets Jan  8 2013,rst cause:2, boot mode:(3,6)

load 0x4010f000, len 1264, room 16

tail 0

chksum 0x42

csum 0x42
```

Messages		Description
rst cause	1:	power on
	2:	external reset
	4:	hardware watchdog-reset
boot mode (first parameter)	1 :	ESP8266 is in UART-down mode (download firmware into Flash)
	2 :	ESP8266 is in Flash-boot mode (boot up from Flash)
chksum		If chksum == csum, it means that read Flash correctly during booting.