



# **ESP8266 SDK API Guide**

**Version 1.1.0**

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 the application or to offload Wi-Fi networking functions from another application processor. When ESP8266 hosts the application, it boots up directly from an external flash. It has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to 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, besides the 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 context switching for energy-efficient VoIP, adaptive radio biasing for low-power operation, advance signal processing, and 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 layer so programmers can focus on application development on the high level. Users can easily make use of the corresponding interfaces to realize data receive and transmit.

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, refer to IOT\_Demo. It is provided for RF initialization. User can call `system_phy_set_rfoption` to set RF option in `user_rf_pre_init`. If RF is disable, ESP8266 station and soft-AP are both disabled.

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, any task should not occupy CPU too long;
  - ▶ If a task occupied CPU for a long time, ESP8266 can't feed the dog, will cause a watchdog reset;
  - ▶ Task should not occupy CPU more than 10 ms, otherwise may cause Wi-Fi connection break.
- We suggest to use a timer to check periodically.
- Using non-OS SDK, please don't call any function defined with `ICACHE_FLASH_ATTR` in interrupt handler.
- We suggest to use RTOS SDK, RTOS can schedule different tasks.



## 3. Application Programming Interface (APIs)

### 3.1. Timer

Timer can be found: [/esp\\_iot\\_sdk/include/osapi.h](#).

Please be noted that [os\\_timer\\_arm](#) (or [os\\_timer\\_arm\\_us](#)) cannot be invoked during interruption.

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](#)).

Timer callback may not be precisely executed at the right time, it depends on priority.

#### 1. [os\\_timer\\_arm](#)

**Function:**

Enable a millisecond timer.

**Prototype:**

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

**Parameters:**

[ETSTimer \\*ptimer](#) : Timer structure

[uint32\\_t milliseconds](#) : Timing, Unit: millisecond

if don't define [USE\\_US\\_TIMER](#), the maximum value is 6871947 ms

if define [USE\\_US\\_TIMER](#), the maximum value is 429496 ms

[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 (ETSTimer *ptimer)
```



**Parameters:**

`ETSTimer *ptimer` : Timer structure

**Return:**

null

### 3. `os_timer_setfn`

**Function:**

Set timer callback function

**Prototype:**

```
void os_timer_setfn(  
    ETSTimer *ptimer,  
    ETSTimerFunc *pfunction,  
    void *parg  
)
```

**Parameters:**

`ETSTimer *ptimer` : Timer structure

`ETSTimerFunc *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 (  
    ETSTimer *ptimer,  
    uint32_t microseconds,  
    bool repeat_flag  
)
```

**Parameters:**

`ETSTimer *ptimer` : Timer structure  
`uint32_t microseconds` : Timing, Unit: microsecond, the maximum value is 429496729 us  
`bool repeat_flag` : Whether the timer will be invoked repeatedly or not

**Return:**

null

## 3.2. System APIs

### 1. `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





## 2. `system_restart`

**Function:**

Restart

**Prototype:**

```
void system_restart(void)
```

**Parameters:**

null

**Return:**

null

## 3. `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);  
}
```

## 4. `system_get_chip_id`

**Function:**

Get chip ID

**Prototype:**

```
uint32 system_get_chip_id (void)
```

**Parameters:**

null



**Return:**

Chip ID

## 5. `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

## 6. `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].

**Prototype:**

```
uint16 system_adc_read(void)
```

**Parameter:**

none



**Return:**

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

## 7. `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`

**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

## 8. `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.

**Prototype:**

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

**Parameter:**

`uint8 option` :

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

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

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

`deep_sleep_set_option(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

## 9. `system_phy_set_rfoption`

**Function:**

Enable RF or not. This API can only be called in `user_rf_pre_init`.

**Note:**

Function `system_phy_set_rfoption` 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.

**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

## 10. 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

## 11. 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

## 12. 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

### 13. `system_print_meminfo`

**Function:**

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

**Prototype:**

`void system_print_meminfo (void)`

**Parameters:**

null

**Return:**

null

### 14. `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

### 15. `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_PRIO_0,testQueue,TEST_QUEUE_LEN);  
}
```

**16. 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_PRIO_0, SIG_RX, 'a');  
}
```

**Printout:**

```
sig_rx a
```

## 17. system\_get\_time

**Function:**

Get system time (us).

**Prototype:**

```
uint32 system_get_time(void)
```

**Parameter:**

null

**Return:**

System time in microsecond.

## 18. 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

## 19. `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.  $((RTC\_CAL * 100) \gg 12)$

**Note:**

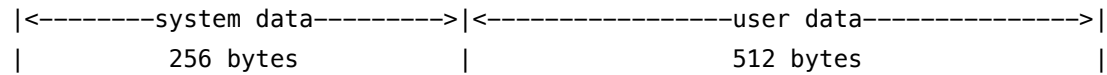
see RTC demo in Appendix.



## 20. 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.



### 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)

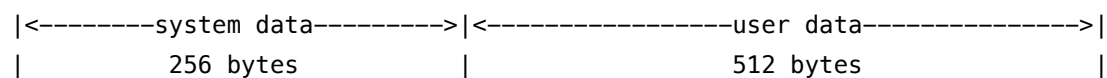
### Return:

true: succeed  
false: fail

## 21. 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

## 22. 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

## 23. 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



## 24. 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  $\geq 3$  , you could enable boot enhance mode (refer to [system\\_restart\\_enhance](#))

## 25. 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.

## 26. 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).



## 27. 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.

## 28. system\_update\_cpu\_freq

**Function:**

Set CPU frequency. Default is 80MHz.

**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
```

## 29. system\_get\_cpu\_freq

**Function:**

Get CPU frequency.



**Prototype:**

```
uint8 system_get_cpu_freq(void)
```

**Parameter:**

null

**Return:**

CPU frequency, unit : MHz.

### 30. 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

### 31. 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));
```

### 32. `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);
```

### 33. `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));
```

### 34. **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());
```

### 35. **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

### 36. **os\_delay\_us**

**Function:**

Time delay, max : 65535 us





**Prototype:**

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

**Parameter:**

uint16 us – time, unit: us

**Return:**

none

### 37. os\_install\_putc1

**Function:**

Register print output function.

**Prototype:**

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

**Parameter:**

void(\*)(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.

## 3.3. SPI Flash Related APIs

### 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



**Note:**

More details in document Espressif IOT Flash RW Operation

**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.

**Note:**

More details in document Espressif IOT Flash RW Operation

**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]);
```



### 3.4. WIFI Related APIs

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:**

- 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



## 8. `wifi_station_set_config_current`

### Function:

Set WiFi station configuration, won't save to flash

### Note:

- 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 ESP8266 has already connected to a router, then 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 initialize done and ESP8266 station enable.

### 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 initialize done and ESP8266 station enable.

**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 initialize done and ESP8266 station enable.



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

### 19. `wifi_station_set_auto_connect`

**Function:**

Set whether ESP8266 station will connect to AP (which is recorded) automatically or not when power on. Default to enable auto-connect.

**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 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_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 dhcp_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 ESP8266 station disconnected from AP

**Note:**

We suggest to call this API in `user_init`

This API can only be called when ESP8266 station enable.

**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\_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

## 26. wifi\_softap\_get\_config\_default

**Function:**

Get WiFi soft-AP configuration that 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



## 27. wifi\_softap\_set\_config

**Function:**

Set WiFi soft-AP configuration and save it to flash

**Note:**

- (1) This configuration will be saved in flash system parameter area if changed.
- (2) In soft-AP + station mode, ESP8266 soft-AP will adjust its channel configuration to be as same as 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

## 28. wifi\_softap\_set\_config\_current

**Function:**

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

**Note:**

In soft-AP + station mode, ESP8266 soft-AP will adjust its channel configuration to be as same as 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

## 29. wifi\_softap\_get\_station\_num

**Function:**

Number count of stations which connected to ESP8266 soft-AP



**Prototype:**

```
uint8 wifi_softap_get_station_num(void)
```

**Parameter:**

none

**Return:**

how many stations connected to ESP8266 soft-AP

### 30. wifi\_softap\_get\_station\_info

**Function:**

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

**Note:**

This API can only be used when ESP8266 soft-AP DHCP enabled.

**Prototype:**

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

**Input Parameters:**

null

**Return:**

`struct station_info*` : station information structure

### 31. 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
```

## 32. 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

## 33. 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

### 34. wifi\_softap\_set\_dhcps\_lease

**Function:**

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

**Note:**

This API has to be called during DHCP server disable([wifi\\_softap\\_dhcps\\_stop](#))

This configuration only take effect on next [wifi\\_softap\\_dhcps\\_start](#), if then [wifi\\_softap\\_dhcps\\_stop](#) is called; user needs to call this API to set IP range again if needed, then call [wifi\\_softap\\_dhcps\\_start](#) 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 dhcpc_lease_test(void)
{
    struct dhcpc_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);
}
```

### 35. 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
};
```

### 36. wifi\_softap\_set\_dhcps\_offer\_option

**Function:**

Set ESP8266 soft-AP DHCP server option.

**Structure:**

```
enum dhcpc_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);
```

### 37. 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



### 38. 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
};
```

### 39. 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

### 40. 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
```

#### 41. **wifi\_set\_macaddr**

**Function:**

Sets MAC address

**Note:**

Can only be used in `user_init`.

**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:**

```
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
```

**42. 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
```

**43. 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
```

#### 44. 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  
};
```

#### 45. 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)
```

## 46. wifi\_status\_led\_uninstall

**Function:** Uninstall WiFi status LED

**Prototype:**

```
void wifi_status_led_uninstall ()
```

**Parameter:**

null

**Return:**

null

## 47. 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



#### 48. 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:**

null

**Return:**

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

#### 49. 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

**返回:**

无

**示例:**

```
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);
}
```



## 3.5. Upgrade (FOTA) APIs

### 1. `system_upgrade_userbin_check`

**Function:**

Checks user bin

**Prototype:**

```
uint8 system_upgrade_userbin_check()
```

**Input Parameters:**

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



## 3.6. 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

### 4. **wifi\_get\_channel**

**Function:**

Get channel number for sniffer functions

**Prototype:**

```
uint8 wifi_get_channel(void)
```

**Parameters:**

null

**Return:**

Channel number

### 5. **wifi\_set\_channel**

**Function:**

Set channel number for sniffer functions

**Prototype:**

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

**Parameters:**

`uint8 channel` : channel number

**Return:**

true: succeed  
false: fail





## 3.7. smart config APIs

### 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.

**Prototype:**

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

**Parameter:**

`sc_type type` : smart config protocol type: AirKiss or ESP-TOUCH.

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

parameter `status` of this callback shows the status of smartconfig:

- if `status == SC_STATUS_LINK`, parameter `void *pdata` is a pointer of `struct station_config`;
- 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  
  
sc_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");
            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");
            smartconfig_stop();
            break;
    }
}

smartconfig_start(SC_TYPE_ESPTOUCH, 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

## 3.8. 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 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;  
    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_recv_callback recv_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_sent`

**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`.

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).

**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_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_KEEPALIVE = 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: use 2920 bytes write buffer for the data `espconn_sent` sending.  
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](#).

## 8. [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_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`

## 9. `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.

## 10. `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](#)

## 11. [espconn\\_disconnect](#)

**Function:**

disconnect a TCP connection

**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](#)

## 12. [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](#)



### 13. `espconn_regist_reconcb`

**Function:**

Register reconnect callback

**Note:**

Reconnect callback is more like a network error handler; it handles errors that occurred in any phase of the connection. For instance, if `espconn_sent` fails, reconnect callback will be called because the network is broken.

**Prototype:**

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

**Parameters:**

`struct espconn *espconn` : corresponding connected control block structure  
`espconn_connect_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_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 discon_cb` : registered callback function

**Return:**

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



## 15. `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 for sending, users can enable it by `espconn_set_opt`. Then users can call `espconn_sent` to send next packet in `write_finish_callback` instead of `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`

## 16. `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 SSL client and SSL server  
`uint16 size` : buffer size, range: 1 ~ 8192, unit: byte, default to be 2048



**Return:**

true : succeed  
false : fail

## 17. `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 SSL client and SSL server

**Return:**

buffer size

## 18. `espconn_secure_connect`

**Function:**

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

**Note:**

- (1) Only one connection is allowed when ESP8266 as 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.
- (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_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`

## 19. `espconn_secure_sent`

**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`

## 20. `espconn_secure_disconnect`

**Function:** secure TCP disconnection(SSL)

**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`



## 21. `espconn_tcp_get_max_con`

**Function:**

Get maximum number of how many TCP connection is allowed.

**Prototype:**

```
uint8 espconn_tcp_get_max_con(void)
```

**Parameter:**

null

**Return:**

Maximum number of how many TCP connection is allowed.

## 22. `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`

## 23. `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`



## 24. `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`

## 25. `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`

## 26. `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

**Prototype:**

`sin8 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:**



(1) Only ESP8266 station support mDNS, please get IP address of ESP8266 station first, then call this API to initial mDNS;

(2) `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); }
```



## 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. Definition of 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 find a termination characters; otherwise, it depends 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.
};

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
};
```



## 7. Peripheral Related Drivers

### 7.1. GPIO Related APIs

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

#### 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 debug output interface. In the case of dual Uart, UART0 works as data receive and transmit interface, and UART1 as debug output interface.

Please make sure all hardware are correctly connected.

### 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

### 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

ESP8266 supports 4x PWM outputs. More details can be found in [pwm.h](#). It is possible to increase the number of PWM outputs, but it is beyond the scope of this document.

### 1. pwm\_init

**Function:**

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

**Prototype:**

```
void pwm_init(uint16 freq, uint8 *duty)
```



**Input Parameters:**

`uint16 freq` : PWM frequency;  
`uint8 *duty` : duty cycle of each output

**Return:**

`null`

## 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 an output

**Prototype:**

`void pwm_set_duty(uint8 duty, uint8 channel)`

**Input Parameters:**

`uint8 duty` : duty cycle  
`uint8 channel` : an output

**Return:**

`null`

## 4. `pwm_set_freq`

**Function:**

Sets PWM frequency

**Prototype:**

`void pwm_set_freq(uint16 freq)`

**Input Parameters:**

`uint16 freq` : PWM frequency

**Return:**

`null`



## 5. `pwm_get_duty`

**Function:**

Gets duty cycle of PWM output

**Prototype:**

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

**Input Parameters:**

`uint8 channel` : channel of which to get duty cycle

**Return:**

`uint8` : duty cycle

## 6. `pwm_get_freq`

**Function:**

Gets PWM frequency.

**Prototype:**

```
uint16 pwm_get_freq(void)
```

**Input Parameters:**

null

**Return:**

`uint16` : frequency



## 8. Appendix

### 8.1. ESPCONN Programming

#### 1. TCP Client Mode

##### Notes

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

##### 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 function will be called after successful connection, which will register the corresponding callback function. Recommend to register 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 the firmware functions are completed.

#### 2. TCP Server Mode

##### Notes

- If ESP8266 is in Station mode, it will start server listening when given an IP address.
- If 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 successful connection, which will register corresponding callback function.
  - ▶ (Call [espconn\\_regist\\_recvcb](#) , [espconn\\_regist\\_sentcb](#) and [espconn\\_regist\\_disconcb](#) in connected callback)

### 3. **espconn callback**

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

Notice: Parameter [arg](#) of callback is the 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.

## 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_calib_proc();
    os_delay_us(300);

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

    cal2 = system_rtc_clock_calib_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

ESP8266 can enter promiscuous mode (sniffer) and capture IEEE 802.11 packets in the air.

The following HT20 packets are support:

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



The following are not supported:

- HT40
- LDPC

Although ESP8266 can not completely decipher these kinds of IEEE80211 packets completely, it can still obtain the length of these special packets.

In summary, while in sniffer mode, ESP8266 can either capture completely the packets or obtain the length of the packet:

- Packets that ESP8266 can decipher completely; ESP8266 returns with the
  - MAC address of the both side of communication and encryption type and
  - the length of entire packet.
- Packets that ESP8266 can only partial decipher; ESP8266 returns with
  - the length of 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
};
```

Callback `wifi_promiscuous_rx` has two parameters ( `buf` and `len`). `len` means the length of `buf`, it can be: `len = 128`, `len = X * 10`, `len = 12` :

### Case of `LEN == 128`

- `buf` contains structure `sniffer_buf2`: it is the management packet, it has 112 bytes data.
- `sniffer_buf2.cnt` is 1.
- `sniffer_buf2.len` is the length of packet.

### Case of `LEN == X * 10`

- `buf` contains structure `sniffer_buf`: this structure is reliable, data packets represented by it has been verified by CRC.
- `sniffer_buf.cnt` means the count of packets in `buf`. The value of `len` depends on `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` represent a length information of packet.



`lenseq[0]` represents the length of first packet. If there are two packets where `(sniffer_buf.cnt == 2)`, `lenseq[1]` represents the length of second packet.

- If `sniffer_buf.cnt > 1`, it is a AMPDU packet, head of each MPDU packets are similar, so we only provide the length of each packet (from head of MAC packet to FCS)
- This structure contains: length of packet, MAC address of both sides of communication, length of the head of packet.

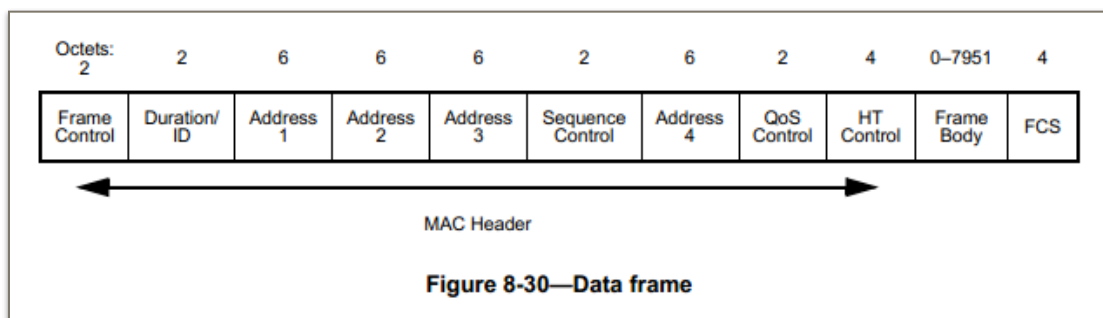
### Case of LEN == 12

- `buf` contains structure `RxControl`; but this structure is not reliable, we can not get neither MAC address of both sides of communication nor length of the head of packet.
- For AMPDU packet, we can not get the count of packets or the length of packet.
- This structure contains: length of packet, `rssi` and `FEC_CODING`.
- `RSSI` and `FEC_CODING` are used to guess if the packets are sent from same device.

### Summary

We should not take too long to process the packets. Otherwise, other packets may be lost.

The diagram below shows the format of a ieee80211 packet:



- The first 24 bytes of MAC Header of data packet are needed:
  - ▶ `Address 4` field depends on `FromDS` and `ToDS` which is in `Frame Control`;
  - ▶ `QoS Control` field depends on `Subtype` which is in `Frame Control`;
  - ▶ `HT Control` field depends on `Order Field` which is in `Frame Control`;
  - ▶ More details are found in IEEE Std 80211-2012.
- For WEP packets, MAC Header is followed by 4 bytes IV and before FCS there are 4 bytes ICV.
- For TKIP packet, MAC Header is followed by 4 bytes IV and 4 bytes EIV, and before FCS there are 8 bytes MIC and 4 bytes ICV.



- For CCMP packet, MAC Header is followed by 8 bytes CCMP header, and before FCS there are 8 bytes MIC.

## 8.4. ESP8266 soft-AP and station channel configuration

Even though ESP8266 can be in soft-AP + station mode, it actually has only one hardware channel. So in soft-AP + station mode, ESP8266 soft-AP will adjust its channel configuration to be as same as ESP8266 station.

This limitation may cause some inconvenience in softAP + station mode users need to pay attention, for example:

Case 1.

- (1) If user connect ESP8266 station to a router(e.g. router is in channel 6)
- (2) Then set ESP8266 softAP by [wifi\\_softap\\_set\\_config](#)
- (3) The API may return true, but channel will always be channel 6. Because we have only one hardware channel.

Case 2.

- (1) If user set ESP8266 softAP a channel number(e.g. channel 5) by [wifi\\_softap\\_set\\_config](#)
- (2) Some stations connected to ESP8266 softAP.
- (3) Then connect ESP8266 station to a router of which channel number is different (e.g. channel 6).
- (4) ESP8266 softAP has to adjust its channel to be as same as ESP8266 station, in this case, is channel 6.
- (5) So the stations that connected to ESP8266 softAP in step 2 will be disconnected because of the channel change.