



Future Communications Integrated circuit Inc.

EVK(Evaluation Kit) User Guide

FCM9000S

Ultra Low Power Wi-Fi Module for IoT Solution

Revision 1.6

Date of Release: Jan 31, 2018

Contact information

For more information, please visit: <http://www.fci.co.kr>

For sales office addresses, please send an email to: fc_i_sales@fci.co.kr

Revision History

Revision	Date	Description
1.6	Jan 31, 2018	- Initial release for FCM9000S module.

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1. FCM9000S Module Board

1.1. Board Description

Figure 1 shows the FCM9000S module evaluation board and descriptions for each part on it are below.

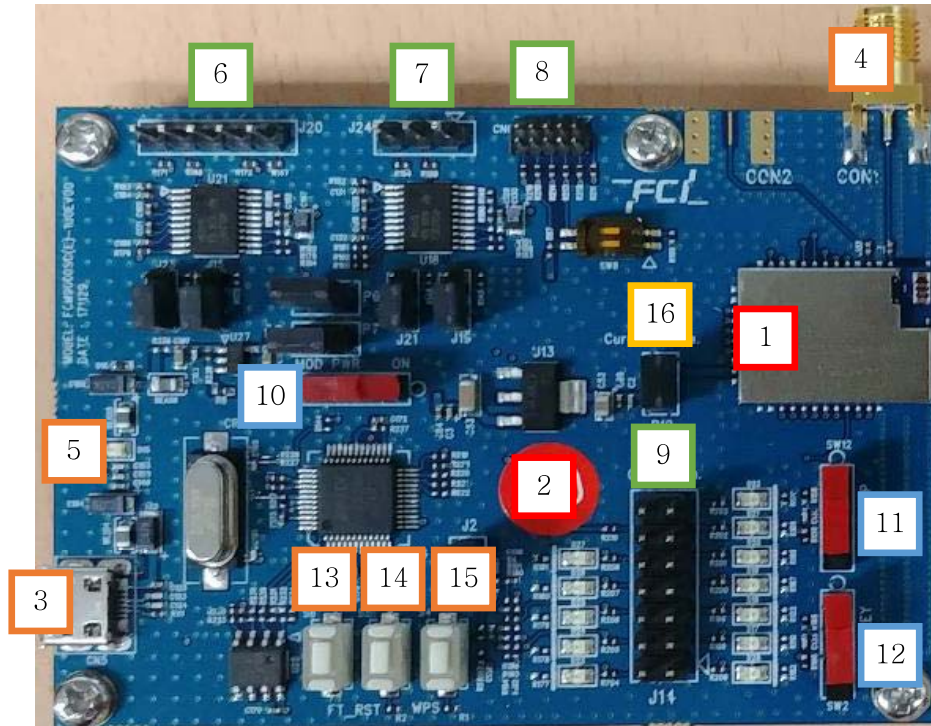
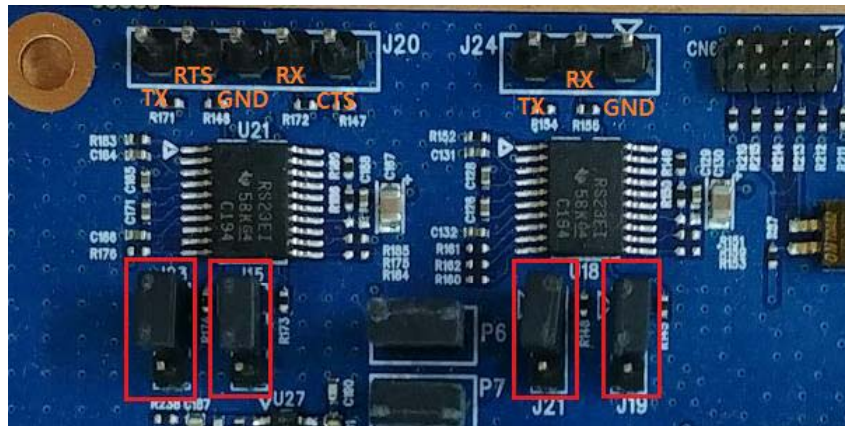


Figure 1.FCM9000S Module Board

- 1) FCM9000S module.
Supports two antenna types; u.FL connector for external antenna or Chip antenna. For the Chip antenna module EVB , it could not test for conduction but radiation performance only
- 2) Interface board for module
- 3) Micro USB connector to supply power and to control the board
- 4) Test point of Module when it need internal debugging.
- 5) LED indicator for USB power (5V)
- 6) UART0 RS-232 pinout
- 7) UART1 RS-232 pinout
The functions of UART0/1 pinout are described below and move jumpers to upside in order to use them and connect to other board. You need to use a USB-to-Serial cable if you connect them to PC.



- 8) JTAG pinout
- 9) GPIOs pinout
- 10) Power switch for FCM9000S module VDD
 - The switch should be on for normal operation.
 - The switch should be off before a micro USB cable is disconnected.



Power off



Power on (Normal operation)

- 11) External wakeup key of FCM9000S module



Normal operation



Wakeup interrupt

- 12) RTC power switch of FCM9000S module



RTC power off



RTC power on (Normal operation)

- 13) FT232 USB IC reset button
- 14) Factory reset button
- 15) WPS button
- 16) Pin header for Current measurement
 - Pin header should be short for normal operation
 - 3.3V operation

2. How to Connect

2.1. USB to Serial Driver

The FCM9000S module board supports both serial port (UART) and USB port (default USB). The user just needs to connect with a micro USB cable and then two COM ports will be detected automatically.

- If use the USB port, install the FT232 Driver for windows
- In most cases, it will be installed automatically, but if it is not installed you can get the driver from the following address.

http://www.ftdichip.com/Drivers/CDM/CDM21224_Setup.zip

2.2. Setup Serial Terminal Utility

Users can control the FCM9000S by using a serial terminal tool (e.g. Teraterm or SecureCRT) and the following configurations are required to connect to the console of the FCM9000S.

- Port: Com port number on Windows system
- Baud rate: 115,200 bps
- Data bits: 8 bits
- Parity: None
- Stop bits: 1 bit
- Flow control: None

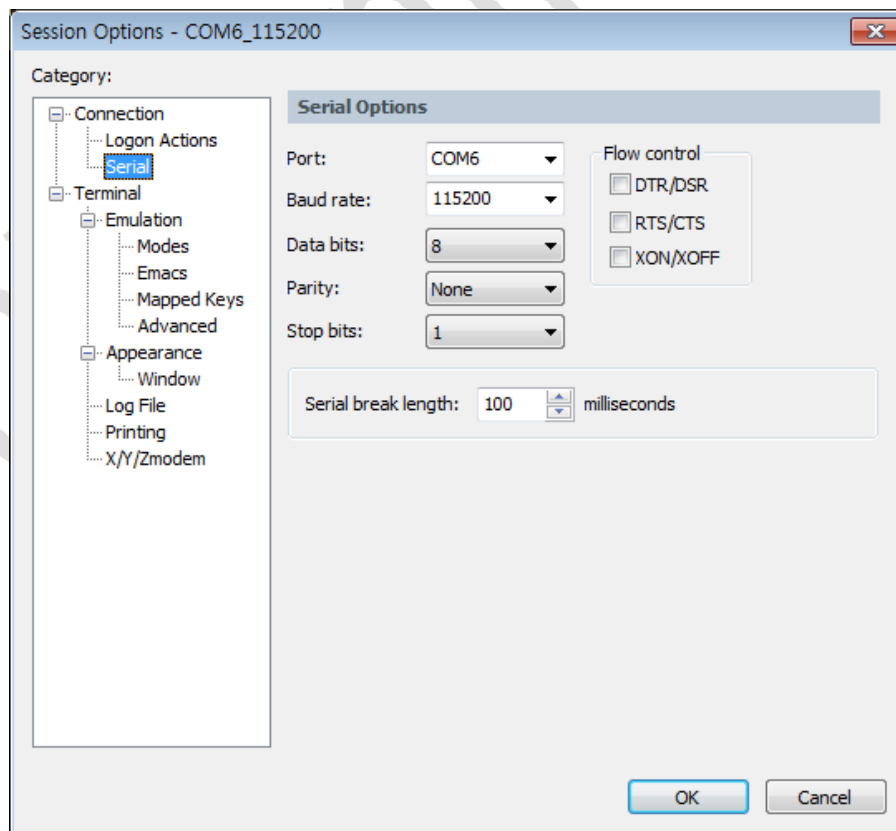


Figure 2. Terminal Configuration

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When the FCM9000S module board is connected, two COM ports will be detected on the Window machine. One (UART0) is for console command and the other (UART1) is for AT command. Normally, the small number COM port is for the AT commands and higher number COM port is for the console.

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3. Firmware Update

There are 3 images required to run the FCM9000S and these are loaded individually through the console by using a serial terminal tool.

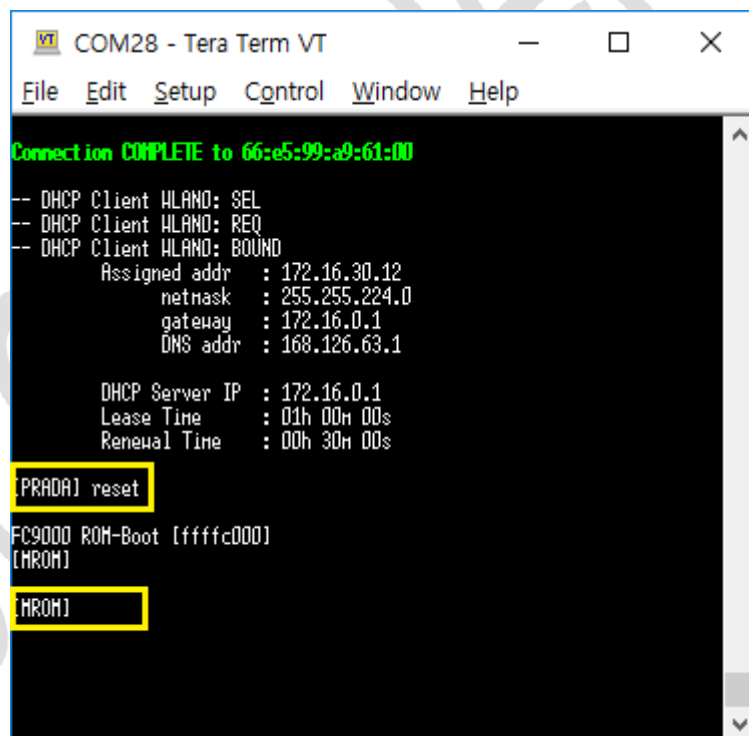
- RAM Library
- pTIM
- Main

Each image's loading address in the following chapters are applicable since FCM9000S SDK v1.1.0.

3.1. RAM Library Image

This image is the FCM9000S system driver and it can be loaded by following below procedure. The file name would likely be "FC9000_RLIB-xxxxx.img".

- 1) Power on the FCM9000S board.
- 2) At [PRADA] prompt, type "reset" to go to the bootloader mode. (note: press enter to get [PRADA] prompt)



```

COM28 - Tera Term VT
File Edit Setup Control Window Help

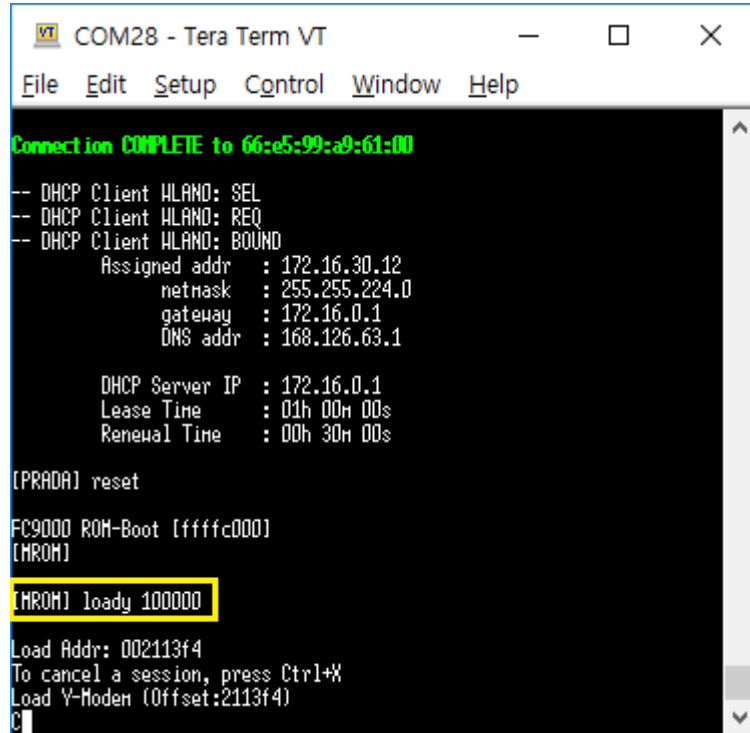
Connection COMPLETE to 66:e5:99:a9:61:00

-- DHCP Client WLAND: SEL
-- DHCP Client WLAND: REQ
-- DHCP Client WLAND: BOUND
    Assigned addr : 172.16.30.12
    netmask      : 255.255.224.0
    gateway      : 172.16.0.1
    DNS addr     : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time     : 01h 00m 00s
    Renewal Time   : 00h 30m 00s

[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
  
```

- 3) At [MROM] prompt, type "loady 100000".



```

COM28 - Tera Term VT
File Edit Setup Control Window Help

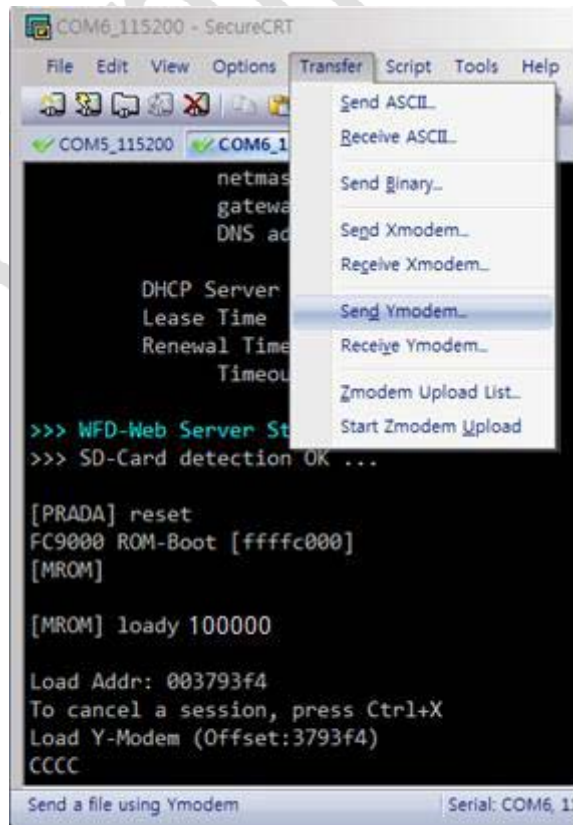
Connection COMPLETE to 66:e5:99:a9:61:00

-- DHCP Client WLAND: SEL
-- DHCP Client WLAND: REQ
-- DHCP Client WLAND: BOUND
    Assigned addr : 172.16.30.12
    netmask       : 255.255.224.0
    gateway       : 172.16.0.1
    DNS addr      : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time     : 01h 00m 00s
    Renewal Time   : 00h 30m 00s

[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
[MROM] loady 100000
Load Addr: 002113f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:2113f4)
C
  
```

- 4) Run "Transfer YMODEM protocol" menu to flash the new image and select the image file.
 - SecureCRT option menu



```

COM6_115200 - SecureCRT
File Edit View Options Transfer Script Tools Help

netmas
gatewa
DNS ad

DHCP Server
Lease Time
Renewal Time
Timeou

>>> WFD-Web Server St
>>> SD-Card detection OK ...

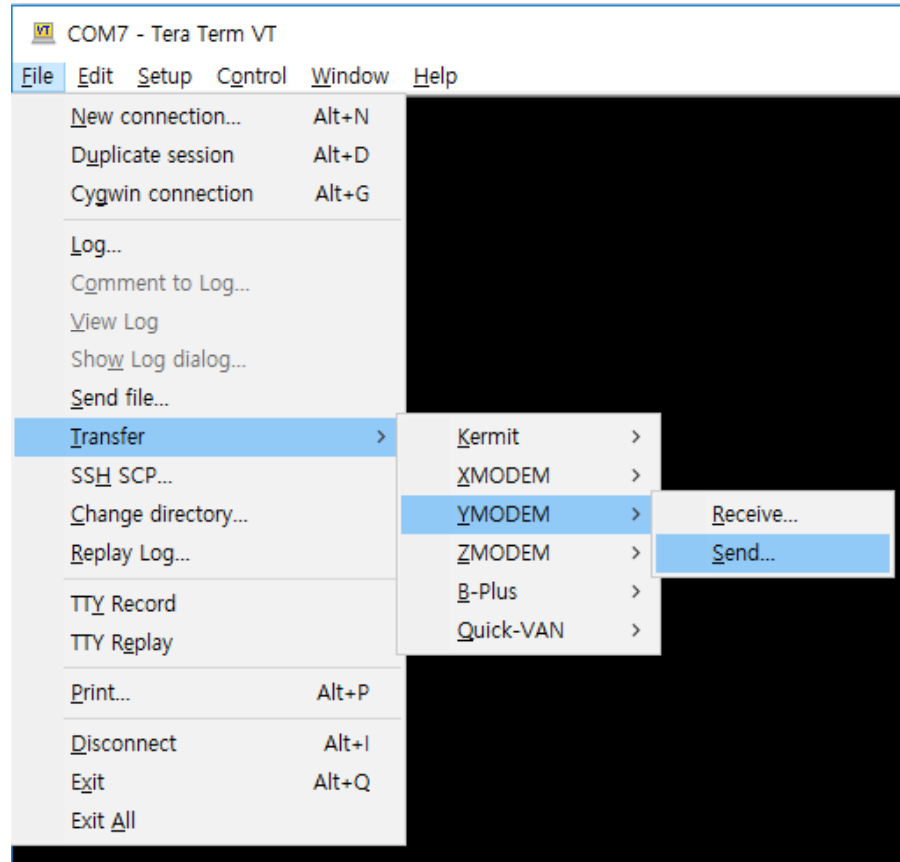
[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]

[MROM] loady 100000

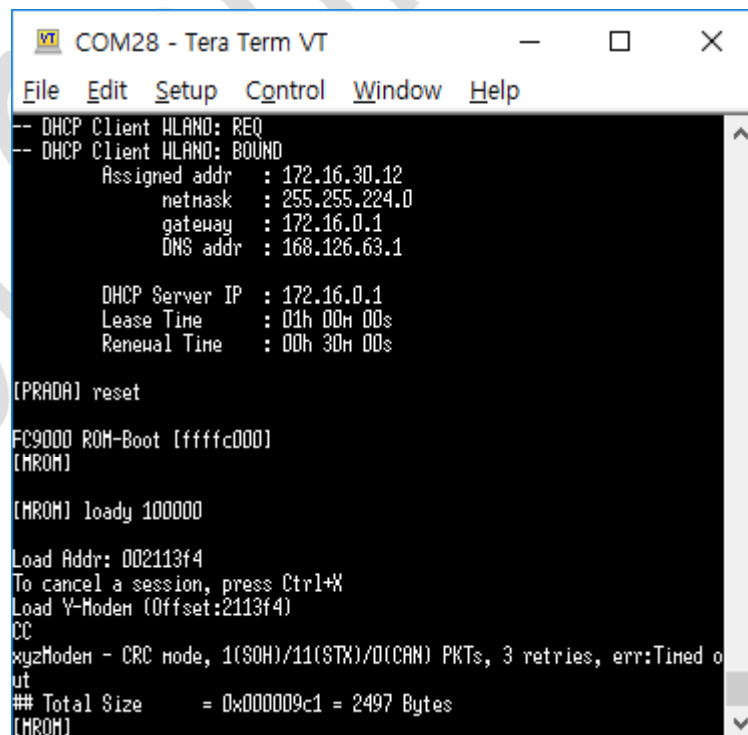
Load Addr: 003793f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:3793f4)
CCCC

Send a file using Ymodem
Serial: COM6, 11
  
```

- Teraterm option menu



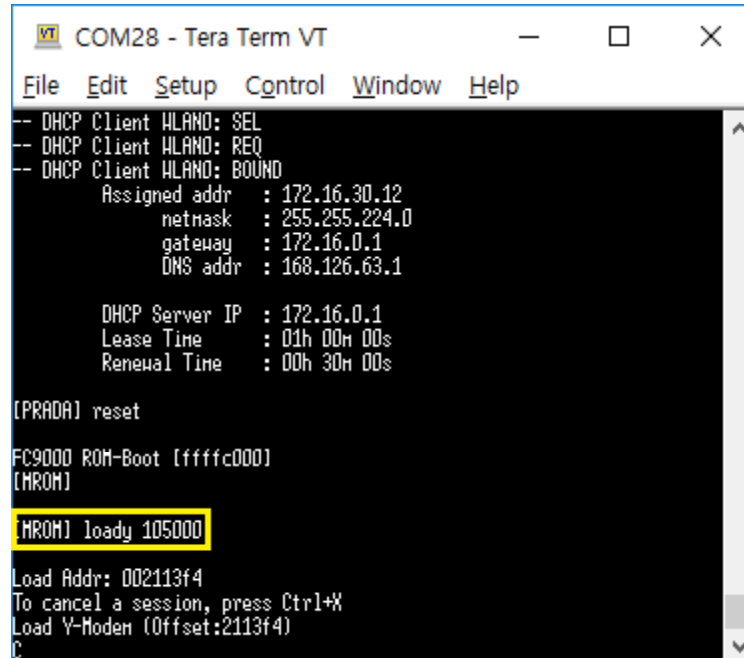
- 5) The result will be printed at the end of transfer.



3.2. PTIM Image

This image is required for DPM operation and it can be loaded by following below procedure. The file name would likely be "FC9000_PTIM-xxxxx.img".

- 1) At [MROM] prompt, type "loady 105000".

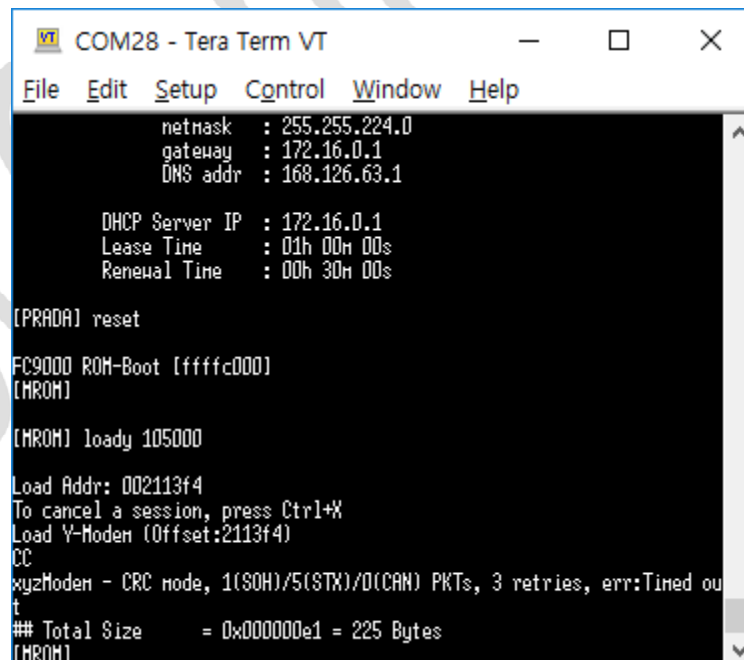


```
COM28 - Tera Term VT
File Edit Setup Control Window Help
-- DHCP Client WLAN: SEL
-- DHCP Client WLAN: REQ
-- DHCP Client WLAN: BOUND
    Assigned addr : 172.16.30.12
    netmask      : 255.255.224.0
    gateway     : 172.16.0.1
    DNS addr    : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time    : 01h 00m 00s
    Renewal Time  : 00h 30m 00s

[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
[MROM] loady 105000
Load Addr: 002113f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:2113f4)
C
```

- 2) Run "Transfer YMODEM protocol" menu to flash the new image and select the image file.
- 3) The result will be printed at the end of transfer.



```
COM28 - Tera Term VT
File Edit Setup Control Window Help
    netmask      : 255.255.224.0
    gateway     : 172.16.0.1
    DNS addr    : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time    : 01h 00m 00s
    Renewal Time  : 00h 30m 00s

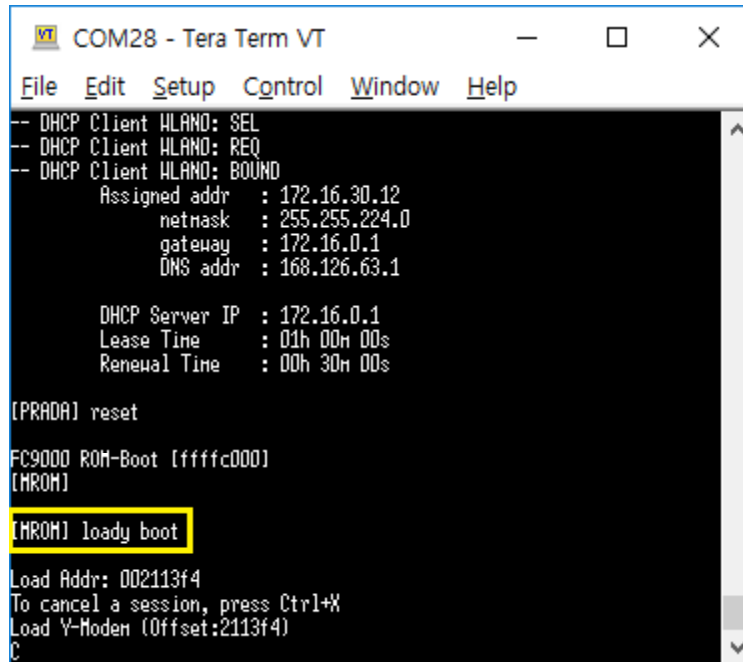
[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
[MROM] loady 105000
Load Addr: 002113f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:2113f4)
CC
xyzModem - CRC mode, 1(SOH)/5(STX)/0(CAN) PKTs, 3 retries, err:Timed out
## Total Size      = 0x000000e1 = 225 Bytes
[MROM]
```

3.3. Main Image

This image contains application & RTOS and it can be loaded by following the below procedure. The file name would be likely "FC9000_rtos_XXXXX_yy_zzz.img". Please carefully load the correct image based on the flash type on the board. It is possible to verify the flash ID in [MROM] prompt. Refer to chapter 3.4.

("XXXXX", at the end of the image file name indicates the product name of the external flash memory, "yy" indicates the SPI speed of the flash IC and "zzz" indicates the revision.)

- 1) At [MROM] prompt, type "loady boot".

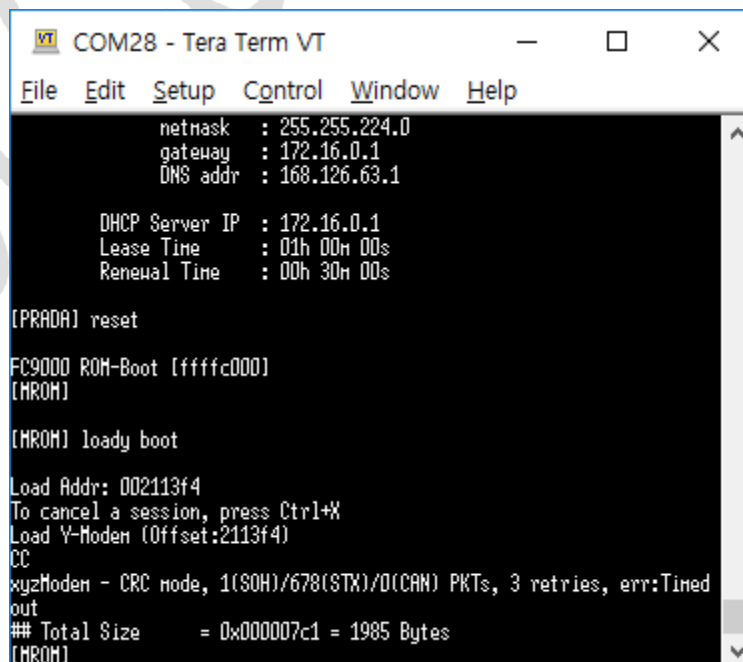


```
COM28 - Tera Term VT
File Edit Setup Control Window Help
-- DHCP Client WLAN: SEL
-- DHCP Client WLAN: REQ
-- DHCP Client WLAN: BOUND
    Assigned addr : 172.16.30.12
    netmask      : 255.255.224.0
    gateway      : 172.16.0.1
    DNS addr     : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time      : 01h 00m 00s
    Renewal Time    : 00h 30m 00s

[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
[MROM] loady boot
Load Addr: 002113f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:2113f4)
C
```

- 2) Run "Transfer YMODEM protocol" menu to flash the new image and select the image file.
- 3) The result will be printed at the end of transfer.



```
COM28 - Tera Term VT
File Edit Setup Control Window Help
    netmask      : 255.255.224.0
    gateway      : 172.16.0.1
    DNS addr     : 168.126.63.1

    DHCP Server IP : 172.16.0.1
    Lease Time      : 01h 00m 00s
    Renewal Time    : 00h 30m 00s

[PRADA] reset
FC9000 ROM-Boot [ffffc000]
[MROM]
[MROM] loady boot
Load Addr: 002113f4
To cancel a session, press Ctrl+X
Load Y-Modem (Offset:2113f4)
CC
xyzModem - CRC mode, 1(SOH)/678(STX)/0(CAN) PKTs, 3 retries, err:Timed
out
## Total Size      = 0x000007c1 = 1985 Bytes
[MROM]
```

- 4) Type "boot" or power off/on to restart the FCM9000S.

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3.4. Serial Flash Recovery

When the serial flash is replaced, flash memory map is changed or flash memory is corrupted it can be initialized and recovered by the following procedure.

- 1) After booting, run "reset" command on [PRADA] prompt and check the flash product ID.

```
[PRADA] reset
FC9000 ROM-Boot [fffc000]
      ← Enter-key
[MROM] sflash info
SFLASH:c2201615 ← This is the flash ID of MX25L3233F
Density:01ffffff
```

Here are several flash product IDs that were used in FCM9000S EVB.

- IS25LQ032B: 9d401615
- IS25LP032D: 9d601615
- MX25L3233F: c2201615

- 2) Download the SFLASH control binary image.

```
[MROM] ymodem sfdp
      ← Terminal > File > Transfer > YMODEM > send
```

Several SFLASH control binaries are stored in the SDK source. Go to \build\asic\Release\Exe\SFDP folder and choose a proper binary.

The binary file is named as "[Product].[Clock].bin". For example with "IS25LP032D.P80.bin", the product name is IS25LP032D and the flash operation clock speed is 80MHz. The basic clock speed is 80MHz.

- 3) Erase the flash. Erase operation is OK when the result displays all "FF".

```
[MROM] sflash erase 100000 100
[MROM] sflash erase 200000 100
[MROM] sflash erase 300000 100
[MROM] sflash read 100000 100

[00100000] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
[00100010] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
[00100020] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
[00100030] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
[00100040] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
[00100050] : FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
```

- 4) Load all 3 images that are required.

```
[MROM] loady 100000
      ← Terminal > File > Transfer > YMODEM > send > select the ramlib image
[MROM] loady 105000
```

```

    < Terminal > File > Transfer > YMODEM > send > select the ptim image
[MROM] loady boot
    < Terminal > File > Transfer > YMODEM > send > select the main image

```

- 5) Run "boot" command to restart the FCM9000S and check the image versions.

```

[MROM] boot
Reset(0x00)

*****
*      >>> FC9000 SDK Information <<<
*   Cortex-M0+ (XTAL 40MHz, CPU 80MHz)
*   OS : ThreadX 5.7 , IAR
*   SW Version Num.   : 1.2.0 (Build 16335)
*   SDK Package Name  : Generic
*   HW Version Num.   : FC900040
*   LMAC Version      : v4.8.0.0
*   RaLIB Version     : FC9K-20171220:155003
*   RoSDK Date & Time : Apr  7 2017 15:21:47
*   Build Date & Time : Dec 21 2017 15:31:37
*           http://www.fci.co.kr
*****

Build Option: SRAM
CODE/RO   : 0021C000 , size 000E4000
RWDATA    : 00300000 , size 0003C000
FREE(POOL): 0033C000 , size 00063800

supported features:
SYSCLK, PLLP55T, 18.75-120MHz (5MHz step)
NVIC, VTOR supported
CMSDK WDOG

supported services:
NVRAM, full functions
NVRAM, SFLASH supported

```

- 6) Initialize the NVRAM.

```

[PRADA] nvrnm
[PRADA:NVRAM] nvedit erase nor

```

[PRADA:NVRAM] **nvedit clear**
[PRADA:NVRAM] **nvcfg update nor**
update , nor completed
[PRADA:NVRAM] **nvedit load nor**
nvedit , load completed

- 7) If the FCM9000S doesn't have a MAC address written in the OTP memory then write a user MAC address in the NVRAM. If a user MAC address exists then OTP MAC address is ignored.

[PRADA] **setwlanmac aa:ff:00:00:00:00**
← Needs a unique MAC address for each board. The Last value has to be an even value.

4. How to Operate

The FCM9000S provides various console commands to operate its functions. Console is connected through UART0 interface with a serial terminal tool.

Some commands in the following chapters can be disabled according to the SDK features.

4.1. Console Commands

The FCM9000S console commands are categorized as follow;

- root
- mem
- sys
- nvram
- net
- user

"help" command lists the available commands and the options.

There is a function to display the console command history and up to 5 commands can be saved. Below is how to use the history function.

- Up/Down arrow keys: Show the command history one by one.
- "!" command: View the list of the command history.
- "!" + Number: Select and execute one in the list.

It is possible to transfer between categories.

- "top" command: Move to the highest-rank, root.
- "up" command: Move to one step upper rank category.
- Category command (e.g. sys, nvram, net): Move to the category. To run each category's commands, you should go to the category first or prefix category name to the command as below;
 - net
 - net.ifconfig

4.1.1. Root Commands

Table 1. Root Commands

Command	Parameters	Description
help / ?	<i>(none)</i>	Display the help for the corresponding category
top	<i>(none)</i>	Moving to the Root category
up	<i>(none)</i>	Moving to a one-step upper rank category
!	<i>(none)</i>	Display the history of command executions

	<i>[index]</i>	index Command index in the history Ex) ! 1:echo test 2:echo 3:repeat 4:trace 5:help Ex) !3 → Re-execute the command of No. 3
.	<i>(none)</i>	Re-execute the previous command.
repeat	<i>[count] [command]</i>	Execute the designated command repeatedly count → Repetition count of command execution command → The command to be executed (including the path) Ex) repeat 10 net.cli scan → Repeat the Scan command 10 times
ver	<i>(none)</i>	Display the version info.
hidden	<i>[value]</i>	Set console command display on/off value 0 → Console command display off 1 → Console command display on
reboot	<i>(none)</i> <i>[mode]</i>	Reboot mode por → POR rebooting
reset	<i>(none)</i>	Reset to the Bootloader prompt
setup	<i>(none)</i>	FCM9000S general function setting wizard(EasySetup). Step by step setting for such elements as SYSMODE, WI-FI, and NETWORK.
time	<i>[option]</i>	Display or set the current time. option time set [YYYY-MM-DD] [hh:mm:ss] → Set date and time time zone [-hh:mm] → Set time zone time boot → Display booting time time uptime → Display booting duration time help → Display help

factory	<i>(none)</i>	Factory reset for all settings
getwlanmac	<i>(none)</i>	Display the MAC address for network interfaces
setwlanmac	<i>[xx:xx:xx:xx:xx:xx / xx-xx-xx-xx-xx-xx / xxxxxxxxxxxx]</i>	Set up the MAC address for network interfaces Ex) setwlanmac aa:bb:cc:00:00:02
dpm	<i><options></i>	Set DPM condition on off → DPM feature enable or disable status → DPM Status print rtm → View DPM backup data rtc → View DPM RTC timer debug [level] → Turn DPM debug on and off level = 1(MSG_ERROR), 2(MSG_INFO), 3(MSG_DEBUG), 4(MSG_EXCESSIVE)

4.1.2. Network Commnads

Table 2. Network Commands

Command	Parameters	Description
setsysmode	<i>[mode]</i>	Set the system mode mode 0 → Station 1 → Soft-AP
ifconfig	<i>(none)</i> <i>[interface wlan0/wlan1]</i> <i>[options]</i>	Display or set the basic network setting and status ifconfig → Display basic network setting info. ifconfig -a → Display details of all network interfaces ifconfig [wlan0 wlan1] → Display details of a network interface ifconfig [wlan0 wlan1] [ipaddress] [subnet] [gateway] → Set static IP addresses to a network interface ifconfig [wlan0 wlan1] dhcp

		→ Enable/Disable DHCP to a network interface ifconfig [wlan0 wlan1] [up down] → Up/Down a network interface ifconfig [wlan0 wlan1] [start stop renew release] → DHCP Client commands ifconfig [wlan0 wlan1] [dns] [DNS ServerIP] → Set DNS server address (static IP) to a network interface ifconfig help → Display help
ping	<i>-I [interface wlan0 wlan1]</i> <i>[domain/ip] -n [count] -l [size] -w [timeout] -i [interval]</i>	Ping test to the target address with a certain interface wlan0 wlan1 → Network interface. With no designated interface, an interface for a subnet band of the same destination IP address is designated count → The count of ping tests size → The size of data to be transmitted(Max.:10000) timeout → Waiting time for a response to the transmitted message (Min.:10ms) interval → Waiting time for a message transmission(Min.:10ms) -6 → Ping test with an IPv6 address Ex) ping 172.16.0.1 -l 1024 -n 10 -w 1000 -i 1000 ping -6 fe80::1:2 -I wlan0
arp	<i>[interface] [options]</i>	Display the ARP table of a network interface -a → Display the ARP table of every interface -d → Delete all of ARP table help → Help display
arp send	<i>[interface] [dst ipaddress]</i>	Transmit the ARP request message of the target IP Ex) arp send wlan0 10.0.0.1
garpsend	<i>[interface] [option]</i>	Transmit a GARP message

		option 0 → Normal grap 1 → Check IP conflict Ex) arpsend wlan0
dhcpcd	<i>[interface] [options]</i>	DHCP server setting boot [on off] → Automatic start setting with a certain interface range <Start IP ADDRESS> <END IP Address> → IP lease band setting (max. 10) lease_time <Integer> → Lease time setting (min. 60 sec.) dns <IP Address> → Lease IP DNS server address setting response_delay <Integer> → Time of response delay status → Display DHCP Server status lease [0 1] → Display IP lease table. Display tables including un-allotted tables when flag = 1 help → Help
iperf	<i>-I [interface] [-s/-c host] [options]</i>	Setup Iperf client/server.
cli	<i>[options]</i>	Refer to the CLI chapter .
debug	<i>[options]</i>	Various types of debug commands executed arp [on off] → arp debug message output on/off dhcpcd [level] → DHCP Server debug level setting (level=0~2 default 0) dhcpc [level] → DHCP Client debug level setting (level=0~5 default 1) umac on off mask → debug umac 1 0x4

4.2. CLI (Comand Line Interface)

4.2.1. Overview

FCM9000S Supplicant plays a key role in providing users with Wi-Fi function. Major functions include IEEE 802.11 management frame, various security functions (WPA & RSN by IEEE 802.11i) and CLI to control FCM9000S Wi-Fi performance.

FCM9000S CLI can be typed in through the console window at FCM9000S. Enter "cli" followed by a command available at FCM9000S CLI in the "net" (network command) category.

```
[PRADA] net
      Command-List is changed, "NET"
[PRADA:NET] cli status
p2p1
bssid=aa:ff:01:01:44:01
ssid=DIRECT-XF
id=2
mode=P2P GO
channel=1
pairwise_cipher=CCMP
group_cipher=CCMP
key_mgmt=WPA2-PSK
wpa_state=COMPLETED
p2p_device_address=aa:ff:01:01:44:01
mac_address=aa:ff:01:01:44:01
uuid=bfbdb356b-4f17-5983-a084-fb2a50a62db9
```

Figure 3. Execute FCM9000S CLI in the Console Window

4.2.2. CLI Format

- 1) Parameter Read/Write (Type A)
 - Read
 - > net.cli [CLI]
 - Write
 - > net.cli [CLI] <value(s) ...>
- 2) Write Only (Type B)
 - Write Only
 - > net.cli [CLI] <value(s) ...>
 - or
 - > net.cli [CLI] <option(s) ...> <value(s) ...>
- 3) Read Only (Type C)
 - Read Only
 - > net.cli [CLI]
 - or
 - > net.cli [CLI] <option(s) ...>
- 4) Execution (Type D)
 - Execution

```
> net.cli [CLI]
or
> net.cli [CLI] <options ...>
```

4.2.3. CLI Structure

The basic structure of FCM9000S is illustrated in the figure below.

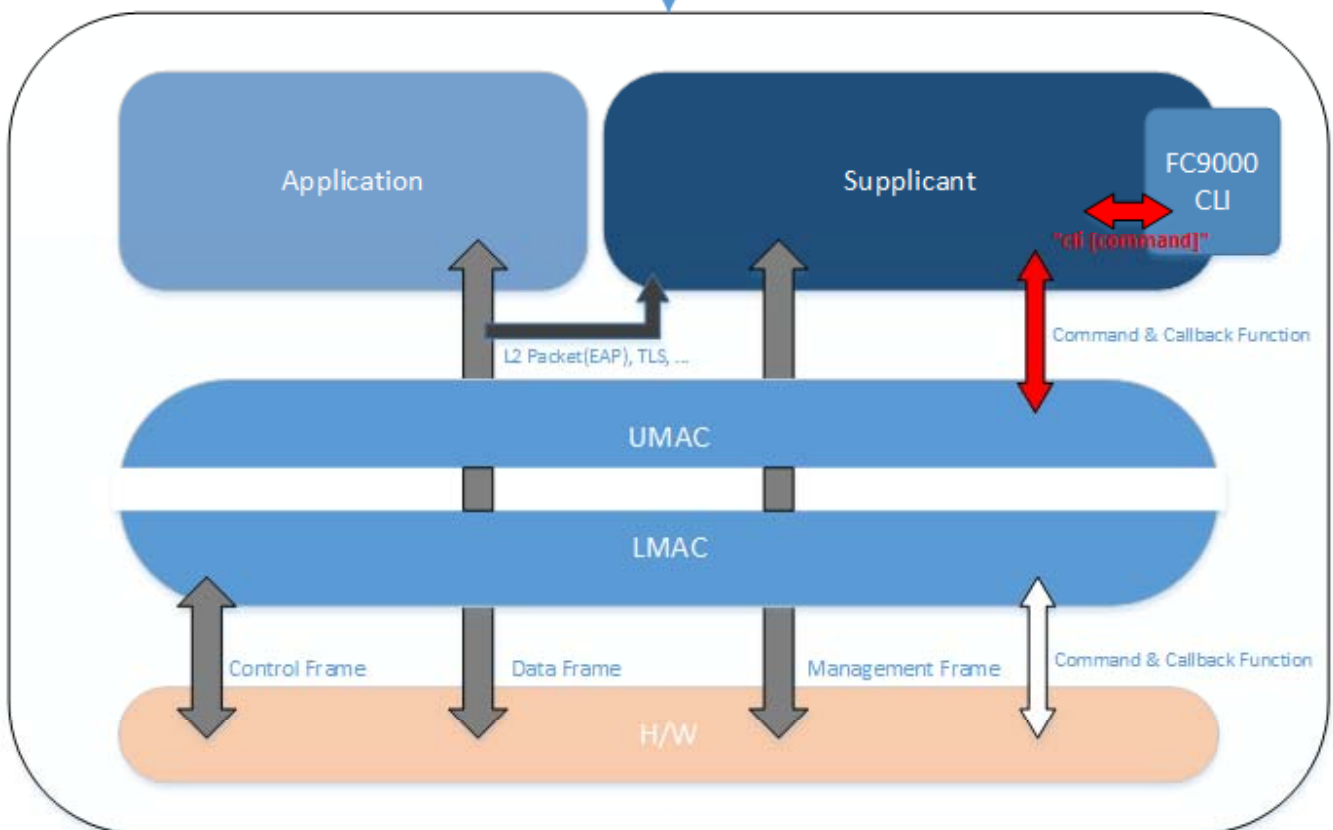


Figure 4. The basic structure of FCM9000S including the CLI

FCM9000S CLI uses the command "cli [command]" in the console window to order the Supplicant. Once it receives a command, the Supplicant may handle it or order Upper MAC(UMAC) to convert it into a form that can be handled by MAC and then transmit the CLI command. For instance, FCM9000S Status Inquiry (access STA info., user interface info.) can be handled by the Supplicant while scan/connection commands need a request for related Management Frame (Probe Request, Authentication Request, etc.) transmission via UMAC.

In the structure diagram above, the arrow between the Supplicant and FCM9000S is interactive because the Supplicant responds to FCM9000S CLI by reporting the result of handling a command. When a command is handled successfully, the Supplicant sends "OK" to FCM9000S CLI, when it fails, "FAIL" (depending on the command), and when it is for information inquiry, the corresponding information respectively.

4.2.4. Common Commands

Table 3. CLI Commands on common mode

CLI	Parameters	Description
status	<i>(none)</i>	Inquiry of main information on the interface being operated at FCM9000S (C) (refer to the Example) Ex) <u>net.cli status</u> <pre>sta0 bssid=08:bd:43:a8:54:18 ssid=NDT_N300_OPEN id=0 mode=STATION pairwise_cipher=NONE group_cipher=NONE key_mgmt=NONE channel=8 wpa_state=COMPLETED mac_address=aa:ff:01:01:44:00 uuid=7c9c7679-c019-5bc7-b814-8bb237684af0</pre>
set_log	<module> <value>	Output on/off setting on a certain log level (module) (B) <module> log level (notice warn err fatal) <value> On: 1 Off: 0 Default: notice: on / warn, err, fatal: off Ex) <u>net.cli set log notice 0</u> → "notice" level log message output - off <u>net.cli set log err 1</u> → "notice" level log message output - on
get_log	<i>(none)</i>	Inquiry of a log level (module) list that is 'On' (C) Ex) <u>net.cli get log</u> <pre>notice err</pre>
save_config	<i>(none)</i>	Saving all parameters modified through CLI, etc. in NVRAM (Saved values become applicable after a reboot) (D)

		Ex) <u>net.cli save config</u> OK * Information saved in NVRAM may be inquired by using the following command: <u>nvr.am.printenv</u> Total length (354) p2p_oper_channel (STR,02) 1 SYSMODE (STR,02) 5 1:NETMODE (STR,02) 2 DHCPD_S_IP (STR,13) 192.168.20.2 DHCPD_E_IP (STR,14) 192.168.20.10 DHCPD_DNS (STR,08) 8.8.8.8 DHCPD_TIME (STR,05) 3600 dev_name (STR,06) PRADA manuf (STR,04) FCI m_name (STR,07) FCM9000S m_num (STR,05) 9000 srl_num (STR,06) 12345 dev_type (STR,13) 1-0050F204-1
select_network	<mode>	Execute a motion in a certain mode (STA access, AP operation, etc.) (D) <mode> STA: 0 AP: 1 Ex) <u>net.cli select network 0</u> ➔ Implement an STA access * For a certain mode through the 'select_network' CLI, the following tasks need to be carried out first: - add_network (profile generation) - SSID generation through set_network - For AP operation, set up the frequency and country code values through set_network - For Security, generate WPA or WEP key values through set_network (option)

add_network	<mode>	Generate a specific mode (STA, AP) Profile (access info. table) (D) <mode> STA: 0 AP: 1 P2P: 2 Ex) <u>net.cli add_network 1</u> → Generate a profile for AP Mode
remove_network	<mode>	Delete a certain mode (STA, AP) profile (D) <mode> STA: 0 AP: 1 P2P: 2 Ex) <u>net.cli remove_network 1</u> → Delete a profile for AP Mode
set_network	<mode> <variable> <value>	Set up specific parameter values for a specific mode (STA, AP) (B) <mode> STA: 0 AP: 1 P2P: 2 <variable> a specific parameter - ssid: [STA] Operation SSID for AP SSID / [AP, P2P] AP interface to be connected - psk: Passphrase or PSK values - proto: For WPA use, set up the version (<WPA(=WPA1)> <RSN(=WPA2)> <WPA RSN>) - key_mgmt: Key management mode (<NONE> <WPA_PSK> <WPA-EAP>) - pairwise: Unicast data message encryption mode, (<TKIP> <CCMP> <TKIP CCMP>) - group: Broadcast data message encryption mode, (<TKIP> <CCMP> <TKIP CCMP>) - wep_key#: WEP Key (#:0~3) values - wep_tx_keyidx: WEP Key index to be used - frequency: [AP] Operation Frequency (MHz) - mode: Operation Mode <0(STA)> <2(AP)> - Wi-Fi_mode: <0(BGN)> <1(GN)> <2(BG)> <3(N)> <4(G)> <5(B)> - beacon_int: [AP] Beacon transport interval - dtim_period: [AP] DTIM interval - ap_power: [AP] Output Power (dBm) - isolate: 'Isolate' Use (<0(off)> <1(on)>)

		- disabled: Automatic profiling prevented upon rebooting (<0(off)> <1(on)>) ... <value> settings for a certain variable Ex) <u>net.cli set network 1 ssid 'FCM9000S AP'</u> → For FCM9000S AP operation, SSID=FCM9000S_AP setting <u>net.cli set network 1 beacon int 200</u> → For FCM9000S AP operation, Beacon interval 200ms setting <u>net.cli set network 0 key mgmt WPA PSK</u> → For FCM9000S STA operation, access in the WPA PSK security mode * A profile needs to be generated through add_network so that a profile can be set through set_network(With no profile, 'FAIL')
get_network	<mode> <variable>	Inquire specific parameter values for a specific mode (STA, AP) (C) <mode> STA: 0 AP: 1 P2P: 2 <variable> a specific parameter Ex) <u>net.cli set network 0 ssid</u> → Inquiry of an object subject to FCM9000S STA access ("TEST_BED_AP") <u>net.cli set network 1 psk</u> → For FCM9000S AP operation, inquiry of the PSK password setting
list_networks	(none)	Inquiry of a major information list in the Profile (C) (refer to the Example) Ex) <u>net.cli list network</u> network id / ssid / bssid / flags 0 NDT_N804V_OPEN any [CURRENT] STA
country	<value>	Setting of a country related to channel operation (A)

		<value> Country Code that meets ISO 3166-1 alpha-2 standards Default: U.S. Ex) <u>net.cli country KR</u> → Set the Country Code to KR (channels No. 1 to 13) <u>net.cli country</u> KR
flush	<i>(none)</i>	FCM9000S For every interface (STA, AP, P2P), delete the Profile + close FCM9000S service operation (D)

4.2.5. STA Commands

Table 4. CLI Commands on STA mode

Command	Parameters	Description
scan	<i>(none)</i> or <freq>	Active scanning (Probe Request Broadcast) (D) For <freq> inputs, it is possible to scan APs of a certain frequency range (MHz) only (option) Ex) <u>net.cli scan</u> → Scanning for the entire channels corresponding to the current country setting <u>net.cli scan freq=2412</u> → Scanning No. 1 channel (2412MHz) only
disconnect	<i>(none)</i>	Disconnect the accessed AP (D) Ex) <u>net.cli disconnect</u> → OK (With no AP being accessed, 'FAIL')
roam	<i>(none)</i> or <oper>	Roaming On/Off and Roaming status inquiry (A) <oper> run: On stop: Off Default: Roaming Off Ex) <u>net.cli roam</u>

		Simple Roam = [RUN] / Threshold = -65 Usage : cli roam [run/stop] <u>net.cli roam stop</u> → Roaming function-off
roam_threshold	<value>	Roaming triggering RSSI value (dBm) setting (B) <value> Roaming threshold RSSI (dBm) Default: -65 (dBm) Ex) <u>net.cli roam threshold -85</u> → Set the roaming threshold to -85dBm

4.2.6. Soft-AP Commands

Table 5. CLI Commands on Soft-AP mode

Command	Parameters	Description
ap	<option>	AP interface beginning/closing/restarting (Applicable with no reboot after main info. modification of AP interface SSID, PSK, etc.) (D) <option> start stop restart Ex) <u>net.cli ap start</u> → AP interface initiating (If it is being operated, 'FAIL') <u>net.cli ap stop</u> → AP interface closing (If not being operated, 'FAIL') <u>net.cli set network 1 ssid 'FCM9000S AP2' →</u> <u>net.cli ap restart</u> → Modify SSID of the interface of AP being operated <u>net.cli set network 1 pairwise TKIP →</u> <u>net.cli ap restart</u> → Modify the AP interface encryption mode to TKIP
ap_chan_switch	<ch>	Modify the AP interface operation channel (B) <ch> AP operation channel (1~14) or frequency (MHz) Ex) <u>net.cli ap chan switch 3</u> → Modify the AP interface channel to 3 (2422MHz)

		<u>net.cli ap chan switch 2462</u> ➔ Modify the AP interface channel to 11 (2462MHz)
ap_status	<i>(none)</i>	Inquiry of main information on the interface at FCM9000S (C) (refer to the Example) Ex) <u>net.cli ap status</u> state=ENABLED phy=fc9k_phy0 freq=2412 num_sta_non_erp=0 num_sta_no_short_slot_time=0 num_sta_no_short_preamble=0 olbc=0 num_sta_ht_no_gf=2 num_sta_no_ht=0 num_sta_ht_20_mhz=2 num_sta_ht40_intolerant=0 olbc_ht=0 ht_op_mode=0x4
all_sta	<i>(none)</i>	Output the list info. of STA being accessed to the AP interface (C) (refer to the Example) Ex) <u>net.cli all sta</u> 60:E3:27:12:C5:98 flags=[AUTH][ASSOC][AUTHORIZED][SHORT_PREAMBLE][WM M] aid=2 capability=0x431 listen_interval=1 supported_rates=0c 12 18 24 30 48 60 6c timeout_next=0 p2p_dev_capab=0x27 p2p_group_capab=0x0 p2p_primary_device_type=1-0050F204-1

		26:DB:ED:FA:73:C4 flags=[AUTH][ASSOC][AUTHORIZED][SHORT_PREAMBLE][WM M] aid=1 capability=0x431 listen_interval=10 supported_rates=8c 12 98 24 b0 48 60 6c timeout_next=0 p2p_dev_capab=0x27 p2p_group_capab=0x0 p2p_primary_device_type=10-0050F204-5 ...
deauthenticate	<addr>	The Deauthentication message is transmitted to the access STA with a certain MAC address in order to cancel the access (D) <addr> MAC address of the access STA Ex) <u>net.cli deauthenticate aa:ff:01:00:00:00</u> ➔ Transmit the Deauthentication message to STA whose MAC address is AA:FF:01:00:00:00
disassociate	<addr>	The Disassociation message is transmitted to the access STA with a certain MAC address in order to cancel the access (D) <addr> MAC address of the access STA Ex) <u>net.cli disassociate aa:ff:01:00:00:00</u> ➔ Transmit the Disassociation message to STA whose MAC address is AA:FF:01:00:00:00
wmm_enabled	<value>	WMM function availability setting and inquiry (A) <value> On: 1 Off: 0 Default: Off Ex) <u>net.cli wmm_enabled 1</u> ➔ Use the WMM function
wmm_ps_enabled	<value>	WMM-PS function availability setting and inquiry (A) <value> On: 1 Off: 0 Default: Off

		Ex) <u>net.cli wmm ps enabled 1</u> ➔ Use the WMM-PS function																																																		
wmm_params	<target> <category> <AIFS> <CWmin> <CWmax> <Burst(AP) or TxOP Limit(STA)>	Set up details of FCM9000S AP or STA's certain 특정 category WMM parameters (B) <target> ap sta <category> be(best-effort) bk(background) vi(video) vo(voice) Ex) <u>net.cli wmm params ap be 3 15 63 10</u> ➔ For WMM AP's best-effort category, AIFS=3, CWmin=15, CWmax=63, and Burst=10 <u>net.cli wmm params sta vo 4 7 15 60</u> ➔ For WMM STA's voice category, AIFS=4, CWmin=7, CWmax=15, TXOP_Limit=60																																																		
all_wmm	(none)	Inquiry of all parameters that can be set up by means of wmm_params CLI (C) (refer to the Example) Ex) <u>net.cli all wmm</u> [AP] <table><tr><td>Category</td><td>AIFS</td><td>CWmin</td><td>CWmax</td><td>Burst</td></tr><tr><td>AC_BE:</td><td>3</td><td>15</td><td>63</td><td>0</td></tr><tr><td>AC_BK:</td><td>7</td><td>15</td><td>1023</td><td>0</td></tr><tr><td>AC_VI:</td><td>1</td><td>7</td><td>15</td><td>30</td></tr><tr><td>AC_VO:</td><td>1</td><td>3</td><td>7</td><td>15</td></tr></table> [STA] <table><tr><td>Category</td><td>AIFS</td><td>CWmin</td><td>CWmax</td><td>TXOP Limit</td></tr><tr><td>AC_BE:</td><td>3</td><td>15</td><td>1023</td><td>0</td></tr><tr><td>AC_BK:</td><td>7</td><td>15</td><td>1023</td><td>0</td></tr><tr><td>AC_VI:</td><td>2</td><td>7</td><td>15</td><td>94</td></tr><tr><td>AC_VO:</td><td>2</td><td>3</td><td>7</td><td>47</td></tr></table>	Category	AIFS	CWmin	CWmax	Burst	AC_BE:	3	15	63	0	AC_BK:	7	15	1023	0	AC_VI:	1	7	15	30	AC_VO:	1	3	7	15	Category	AIFS	CWmin	CWmax	TXOP Limit	AC_BE:	3	15	1023	0	AC_BK:	7	15	1023	0	AC_VI:	2	7	15	94	AC_VO:	2	3	7	47
Category	AIFS	CWmin	CWmax	Burst																																																
AC_BE:	3	15	63	0																																																
AC_BK:	7	15	1023	0																																																
AC_VI:	1	7	15	30																																																
AC_VO:	1	3	7	15																																																
Category	AIFS	CWmin	CWmax	TXOP Limit																																																
AC_BE:	3	15	1023	0																																																
AC_BK:	7	15	1023	0																																																
AC_VI:	2	7	15	94																																																
AC_VO:	2	3	7	47																																																

acl_mac	<addr>	Add the MAC address to the Access Control Management List (B) <addr> AP MAC Address Ex) <u>net.cli acl_mac AA:FF:01:00:00:06</u> → Add AA:FF:01:00:00:06 MAC Address to ACL
acl	<oper> <addr>	Set up, delete, or inquire the use of ACL (A) <oper> allow deny clear delete (If none, inquire of it) <addr> AP MAC Address (only when oper="delete") Ex) <u>net.cli acl</u> acl [allow/deny/clear/delete [mac_addr]] ACL - Allow AA:FF:01:00:00:07 AA:FF:01:00:00:08 00:00:00:00:00:00 00:00:00:00:00:00 00:00:00:00:00:00 00:00:00:00:00:00 <u>net.cli acl allow</u> → Access allowed only for AP Lists in ACL <u>net.cli acl deny</u> → Access denied only for AP Lists in ACL <u>net.cli acl clear</u> → Entire ACL clear <u>net.cli delete aa:ff:01:00:00:08</u> → Delete AA:FF:01:00:00:08 from ACL
ap_max_inactivity	<value>	If there is no data frame exchange of accessed STA during the time setting, disconnect the STA (A) <value> Inactivity timeout (sec) Default: 300(sec.) Ex) <u>net.cli ap_max_inactivity 600</u>

		→ Disconnect the access STA with no data frame exchange for 600 seconds <u>net.cli ap max_inactivity 0</u> → Uncheck data frame exchange of the accessed STA <u>net.cli ap max_inactivity</u> ap_max_inactivity=600
ap_send_ka	<value>	A function to send 'keep-alive' NULL packets to the accessed STA at intervals of 30 seconds and check ACK receipts (A) <value> On: 1 Off: 0 - On: If the STA accessed to FCM9000S AP (or P2P_GO) interface goes out of the coverage or is closed abnormally, disconnect it after 'ap_max_inactivity timeout' passes - Off: If there is no data frame exchange with the STA accessed to FCM9000S AP (or P2P_GO) interface for 'ap_max_inactivity timeout' constantly, disconnect it. Default: 0 (not used) Ex) <u>net.cli ap_send_ka 1</u> OK <u>net.cli ap_send_ka</u> ap_send_ka=1
ap_rts	<value>	For AP mode operation, set up the RTS Threshold value to be used (A) <value> The standard for a size of packets that use the RTS Control Frame (bytes) Default: 2437 (bytes) Ex) <u>net.cli ap_rts 1000</u> → Use RTS for transmission of 1000bytes or larger frames <u>net.cli ap_rts</u> ap_rts=1000
greenfield	<value>	Decide whether to use Greenfield <value> On: 1 Off: 0

		- For Greenfield On setting, FCM9000S uses 11n HT mode only. (11b, 11g info. and STA access not allowed) Default: 0 (not used) Ex) <u>net.cli greenfield 1</u> → Use the Greenfield function <u>net.cli greenfield</u> greenfield=1
--	--	--

5. FCM9000S Setup

The FCM9000S device supports Station and Soft-AP modes.

- Station: A device that has the capability to use the 802.11 protocol
- Soft-AP: Software enabled access point, This is software enabling FCM9000S which hasn't been specifically made to be a router into a wireless access point

5.1. Setup Station Mode

- 1) Clear all saved configuration. (Using "factory" command)

```
[PRADA] factory
FACTORY RESET [N/y/?] y

Factory Resetting...

Rebooting...

*****
*      FCI   PRADA Project
*  Cortex-M0+ (XTAL 40000 KHz, CPU 80000 KHz)
*  OS : ThreadX 5.7   , IAR
*  SW Version Num.   : 1.0.3 (Build 0)
*  SVN Revision      : 14727
*  SVN Repository    : NULL
*  HW Version Num.   : fc900040
*  LMAC Version      : v4.8.0.0
*  RaLIB Version     : FC9K-20170731:144634
*  RoSDK Date & Time : Apr  7 2017 15:21:47
*  Build Date & Time : Aug 10 2017 13:28:57
*                   http://www.fci.co.kr
*****
System Mode : Station Only (0)

>>> Start FC9000 supplicant ...
>>> PRADA supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : aa:ff:01:18:2a:00
>>> sta0 interface add OK
>>> Start STA mode...

[PRADA]
```

- 2) Boot FCM9000S and run "setup" command.

```
[PRADA]
[PRADA] setup
```

- 3) Stop all services for the setting. → Yes

```
Stop all services for the setting.
Are you sure ? [Yes/No] : y
```

- 4) Select Country Code. (Type the national code as two characters)

```
[ FC9000 EASY SETUP ]

Country Code List:
AT AU BR CA CH CY CZ DE DK EE
ES FI GB GR HK HU IE IS IT LT
LU LV NL NO NZ PL PT SE SI SK
US USE USL USX FR BE CN ID KR MY
TH TW ZA IL SG JP ILO PH IN

COUNTRY CODE ? [Quit] (Default US) : KR
```

- 5) Select running mode as "1. Station".

```
SYSMODE(WLAN MODE) ?
    1. Station
    2. Soft-AP
MODE ? [1/2/Quit] (Default Station) : 1
```

- 6) Select legacy-AP to connect and input index number and password. (if required)

```
[ STATION CONFIGURATION ]
=====
[NO] [SSID]                                [SIGNAL] [CH] [SECURITY]
-----
[ 1] SG-AppleExtreme                        -45   1 WPA2
-----
[M] Manual Input
[Enter] Rescan
=====

Select SSID ? (1~01/Manual/Quit) : 1

PSK-KEY(ASCII characters 8~63 or Hexadecimal characters 64) ? [Quit]
[123456789|123456789|123456789|123456789|123456789|123456789|1234]
:1234567890
```

- 7) Confirm Configuration.

```
=====
SSID      : SG-AppleExtreme
AUTH      : WPA/WAP2
ENCRYPTION: TKIP/AES(CCMP)
PSK KEY   : 1234567890
KEY TYPE  : ASCII
Hidden AP : Not connect
=====
WIFI CONFIGURATION CONFIRM ? [Yes/No/Quit] : y
```

- 8) Select IP address mode.
 - Automatic: DHCP Client mode
 - Static IP: Static IP address mode

```
Network Connection Type ? [Automatic IP/Static IP/Quit] : a
```

- 9) Select DPM mode. → No

```
FCI Dynamic Power Management ? [Yes/No/Quit] : n
```

```
Factory Resetting....
```

```
Configuration OK
```

- 10) Station mode is ready.

```
System Mode : Station Only (0)

>>> Start FC9000 supplicant ...
>>> PRADA supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : aa:ff:01:18:2a:00
>>> sta0 interface add OK
>>> Start STA mode...
>>> Selected BSS 4c:32:75:c4:fd:20 ssid='SG-AppleExtreme' (-31)
[MAC DRV] TX POWER INDEX (-1 --> 3) Changed Event
[MAC DRV] PT Power = 0x3
associating with AP with corrupt beacon and probe response
>>> Network Interface (wlan0) : UP
>>> Associated with 4c:32:75:c4:fd:20
<wpa_supp_proc_3_of_4> RX message 3 of 4-Way Handshake from 4c:32:75:c4:fd:20 (v
er=2)
[wpa_supp_send_4_of_4] Sending EAPOL-Key 4/4

-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND

Assigned addr   : 10.0.1.2
netmask        : 255.255.255.0
gateway        : 10.0.1.1
DNS addr       : 10.0.1.1

DHCP Server IP : 10.0.1.1
Lease Time     : 24h 00m 00s
Renewal Time   : 12h 00m 00s

[PRADA]
```

5.2. Enable DPM Mode

- 1) Repeat step 1~8 in station mode setup procedure.

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- 2) Select DPM mode. → Yes

```
FCI Dynamic Power Management ? [Yes/No/Quit] : y

Factory Resetting....

Configuration OK

Reboot...
```

- 3) Confirm IP address of FCM9000S STA mode after rebooting.

```
-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
    Assigned addr   : 10.0.1.2
        netmask    : 255.255.255.0
        gateway    : 10.0.1.1
        DNS addr   : 10.0.1.1

    DHCP Server IP  : 10.0.1.1
    Lease Time      : 24h 00m 00s
    Renewal Time    : 20h 00m 00s
```

- 4) Confirm "DPM Power-Down" message of FCM9000S STA mode.

```
>>> Start DPM Power-Down !!!
>>> OK Power-Down !!!
```

5.3. Disable DPM Mode

Once "DPM Power-Down" message is shown, key input is not possible because the UART interface is down during DPM mode but this is a normal operation. To exit this state and start over with "setup", please follow the instructions as below.

- 1) Copy the string "dpm hold" to clipboard. (i.e. you can open a Notepad and type in "dpm hold" and select the command string and Ctrl+c)
- 2) Turn off with the H/W RTC Power switch (SW2)
- 3) Turn on with the H/W RTC Power switch
- 4) Before ">>> Start DPM Power-Down !!!" message is printed on console,
 - Right mouse click. (to paste "dpm hold" string)
 - Press ENTER key.

- 5) If you did step 3 to 4 quickly and successfully enough, "DPM Sleep Manage HOLD ..." message will be shown.

```
>>> Start FC9000 supplicant ...
>>> PRADA supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : aa:ff:01:18:2a:00
>>> sta0 interface add OK
>>> Start STA mode...
dpm hold
- DPM Sleep Manager HOLD ...
[PRADA] RTC switched to XTAL

DHCP Server IP   : 10.0.1.1
Lease Time       : 24h 00m 00s
Renewal Time     : 20h 00m 00s

[PRADA]
```

- 6) You may need to repeat step 3 to 4 several times to get key input working.
7) Run "setup" again to configure your board with different parameters.

5.4. Setup Soft-AP Mode

- 1) Boot FCM9000S and run "setup" on console.

```
[PRADA]
[PRADA] setup
```

- 2) Stop all services for the setting → Yes

```
Stop all services for the setting.
Are you sure ? [Yes/No] : y
```

- 3) Select Country Code (Type the national code as two characters)

```
[ FC9000 EASY SETUP ]

Country Code List:
AT AU BR CA CH CY CZ DE DK EE
ES FI GB GR HK HU IE IS IT LT
LU LV NL NO NZ PL PT SE SI SK
US USE USL USX FR BE CN ID KR MY
TH TW ZA IL SG JP ILO PH IN
COUNTRY CODE ? [Quit] (Default US) : KR
```

- 4) Select running mode as "2. Soft-AP" (depending on the SDK package, you may see fewer options)

```
SYSMODE(WLAN MODE) ?
  1. Station
  2. Soft-AP
MODE ? [1/2/Quit] (Default Station) : 2
```

- 5) Input AP SSID / Channel number / Security mode
- SSID (Service set identifier): String (alphabet / Unicode / number)

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- Channel: Running channel number
- Security: Default is "OPEN" mode for easy setup

```
[ SOFT-AP CONFIGURATION ]

SSID(NETWORK NAME) ? : bright-ap

CHANNEL ? [1~13, Auto:0/Quit] (Default Auto) : 1

AUTHENTICATION ?
  1. OPEN
  2. WEP(Unsupported)
  3. WPA-PSK
  4. WPA2-PSK (Recommend)
  5. WPA/WPA2-PSK
AUTHENTICATION ? [1/3/4/5/Quit] : 1

=====
SSID: bright-ap
CHANNEL: 1
AUTH: OPEN
=====
WIFI CONFIGURATION CONFIRM ? [Yes/No/Quit] : y
```

6) Input IP-address of Soft-AP. (This address will be used as "default gateway address")

- IP address / Subnet mask / Default gateway / DNS address
- "Enter" key without new input address will be set as default value

```
IP ADDRESS ? [Quit] (Default 10.0.0.1) :

SUBNET ? [Quit] (Default 255.255.255.0) :

GATEWAY ? [Quit] (Default 10.0.0.1) :

DNS ? [Quit] (Default 8.8.8.8) :

=====
[WLAN1]
IP ADDRESS    10.0.0.1
SUBNET        255.255.255.0
GATEWAY       10.0.0.1
DNS           8.8.8.8
=====
NETWORK CONFIGURATION CONFIRM ? [Yes/No/Quit] : y
```

7) Configure DHCP server.

```

DHCP SERVER LEASE IP Count(MAX 10) ? [Quit] (Default 10) :
DHCP SERVER LEASE TIME(60 ~ 86400 SEC) ? [Quit] (Default 1800) :
=====
DHCP SERVER
Start IP   10.0.0.2
END IP    10.0.0.11
DNS       8.8.8.8
LEASE TIME 1800
=====
DHCP SERVER CONFIGURATION CONFIRM ? [Yes/No/Quit] : y
  
```

8) Confirm Soft-AP configuration.

```

DHCP SERVER CONFIGURATION ? [Yes/No/Quit] : y

DHCP SERVER LEASE IP Count(MAX 10) ? [Quit] (Default 10) :
DHCP SERVER LEASE TIME(60 ~ 86400 SEC) ? [Quit] (Default 1800) :
=====
DHCP SERVER
Start IP   10.0.0.2
END IP    10.0.0.11
DNS       8.8.8.8
LEASE TIME 1800
=====
DHCP SERVER CONFIGURATION CONFIRM ? [Yes/No/Quit] : y

Factory Reseting....

Configuration OK

Reboot...
  
```

9) Search Wi-Fi AP on your Window-PC, Tablet, Smart Phone or other Wi-Fi station device.

```

>>> Start Soft-AP mode...
OK
[fc9k_acs_find_ideal_chan] ACS: Ideal channel is 1
[MAC DRV] TX POWER INDEX (-1 --> 3) Changed Event
[MAC DRV] PT Power = 0x3
>>> Network Interface (wlan1) : UP

Soft-AP is Ready (aa:ff:01:18:2a:01)
AP-STA-CONNECTED 28:b2:bd:bc:d2:ca
  
```