CodeZoo CATM1 Hands-On

- Raspberry Pi (with PPP)-

version 1.1(2022. 07. 01)

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1. Linux PPP 구조

Figure 8-1. Scenario for the use of PPP.

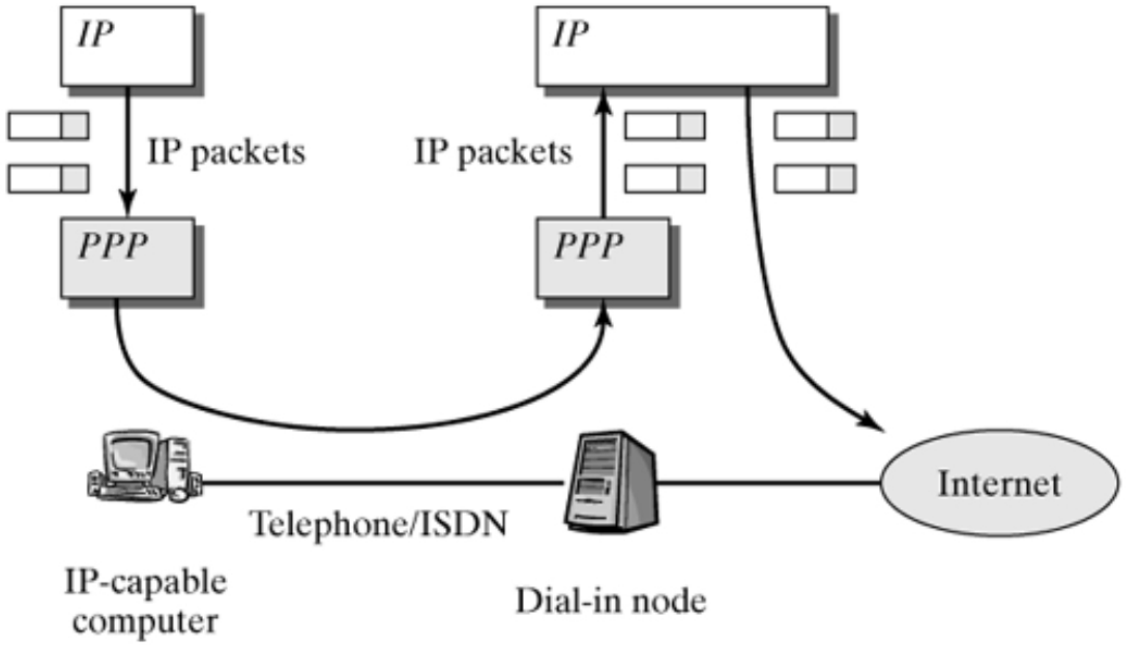
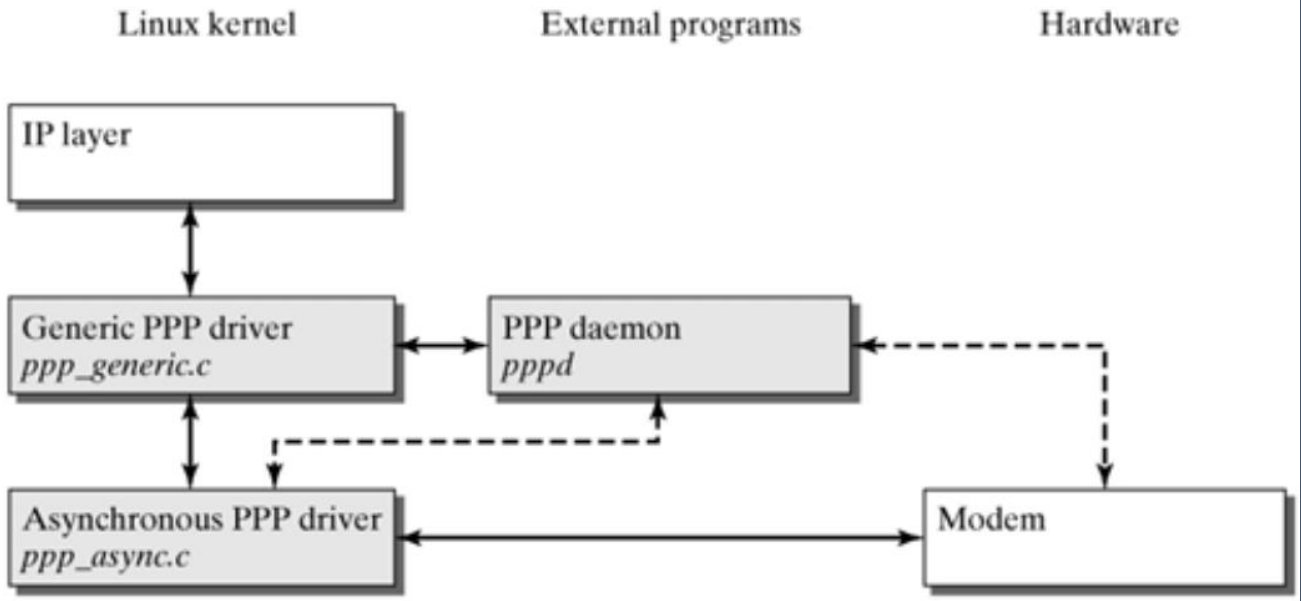


Figure 8-3. Interaction of the PPP components.



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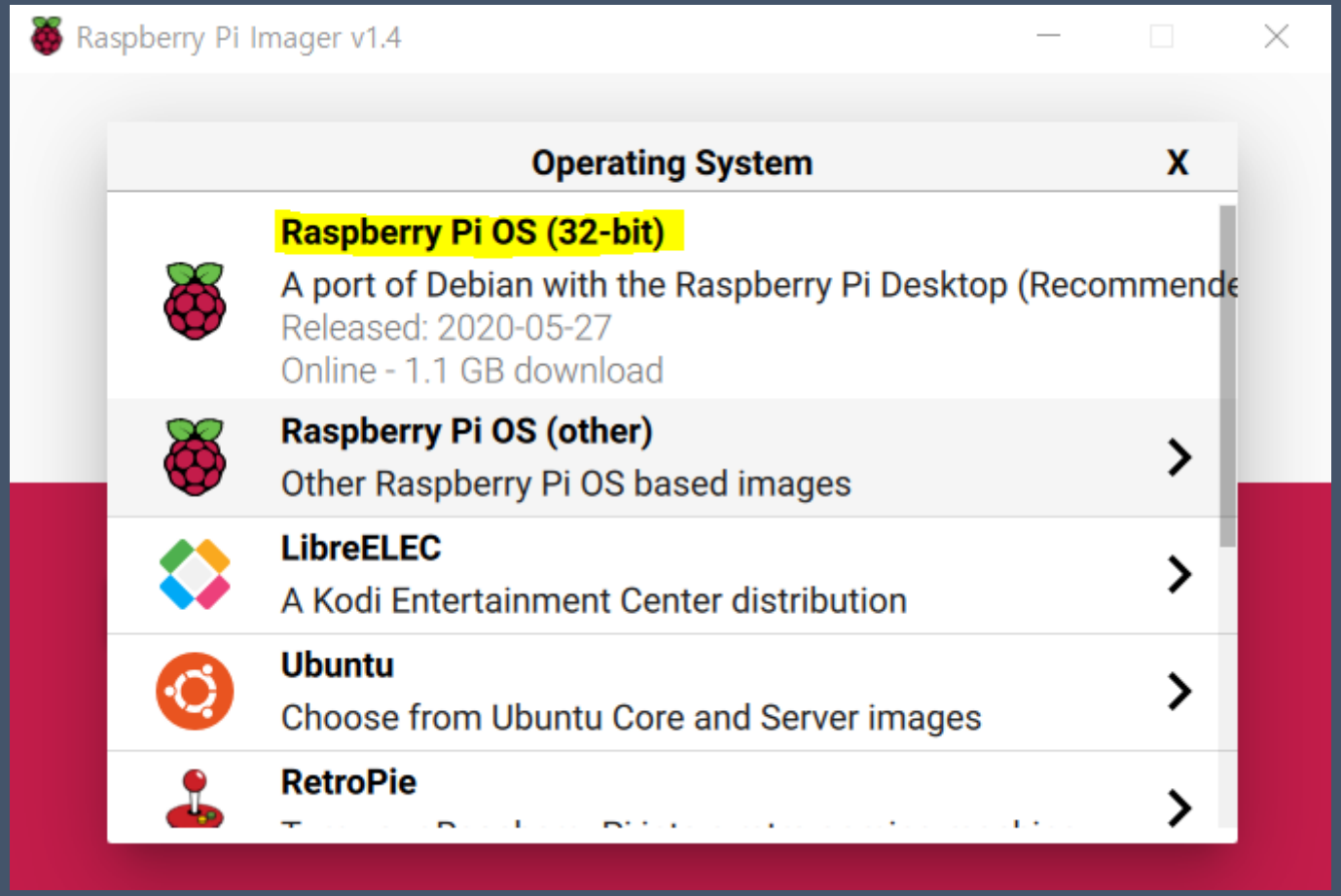
2. CAT.M1 실습 (Raspberry Pi OS install)



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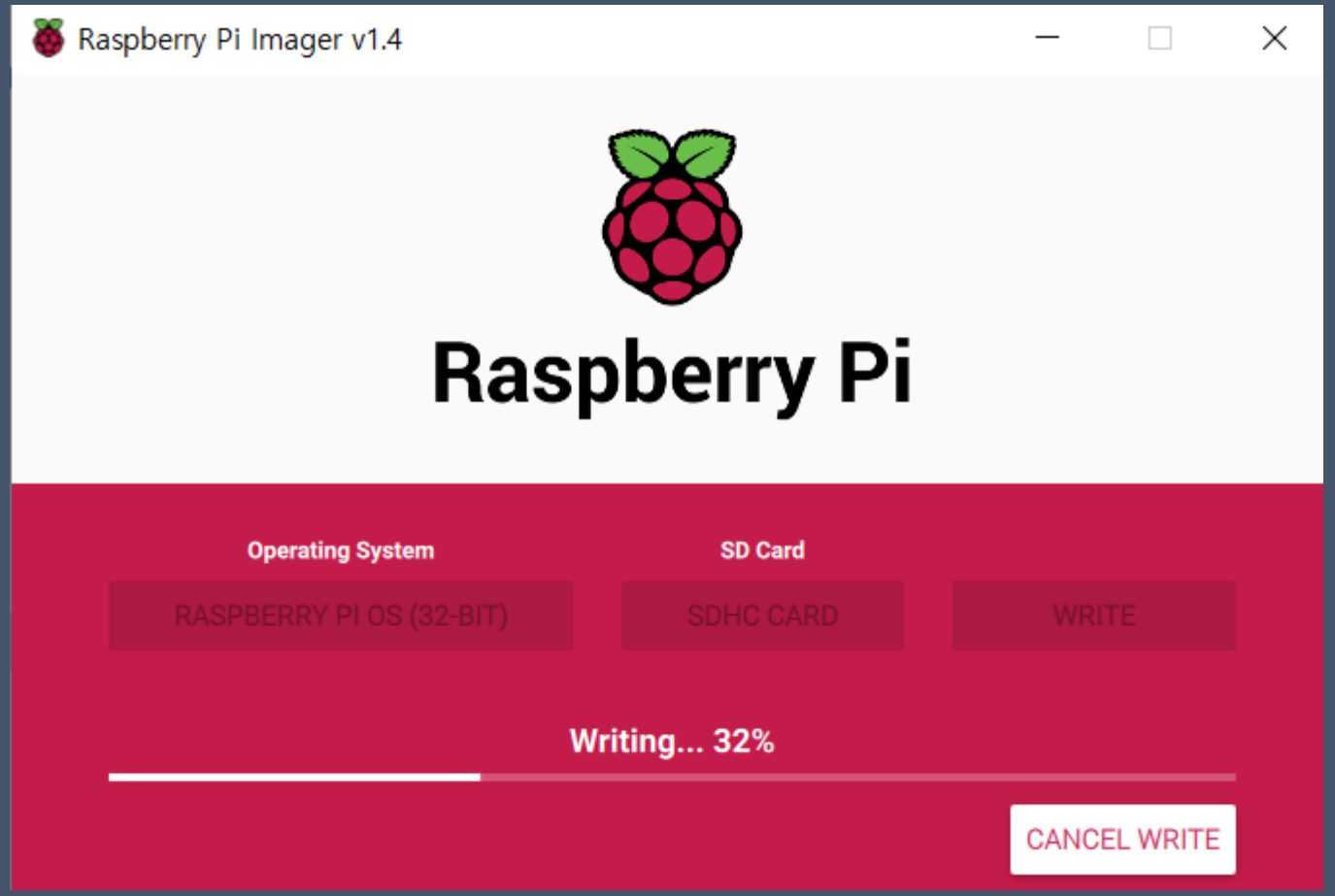

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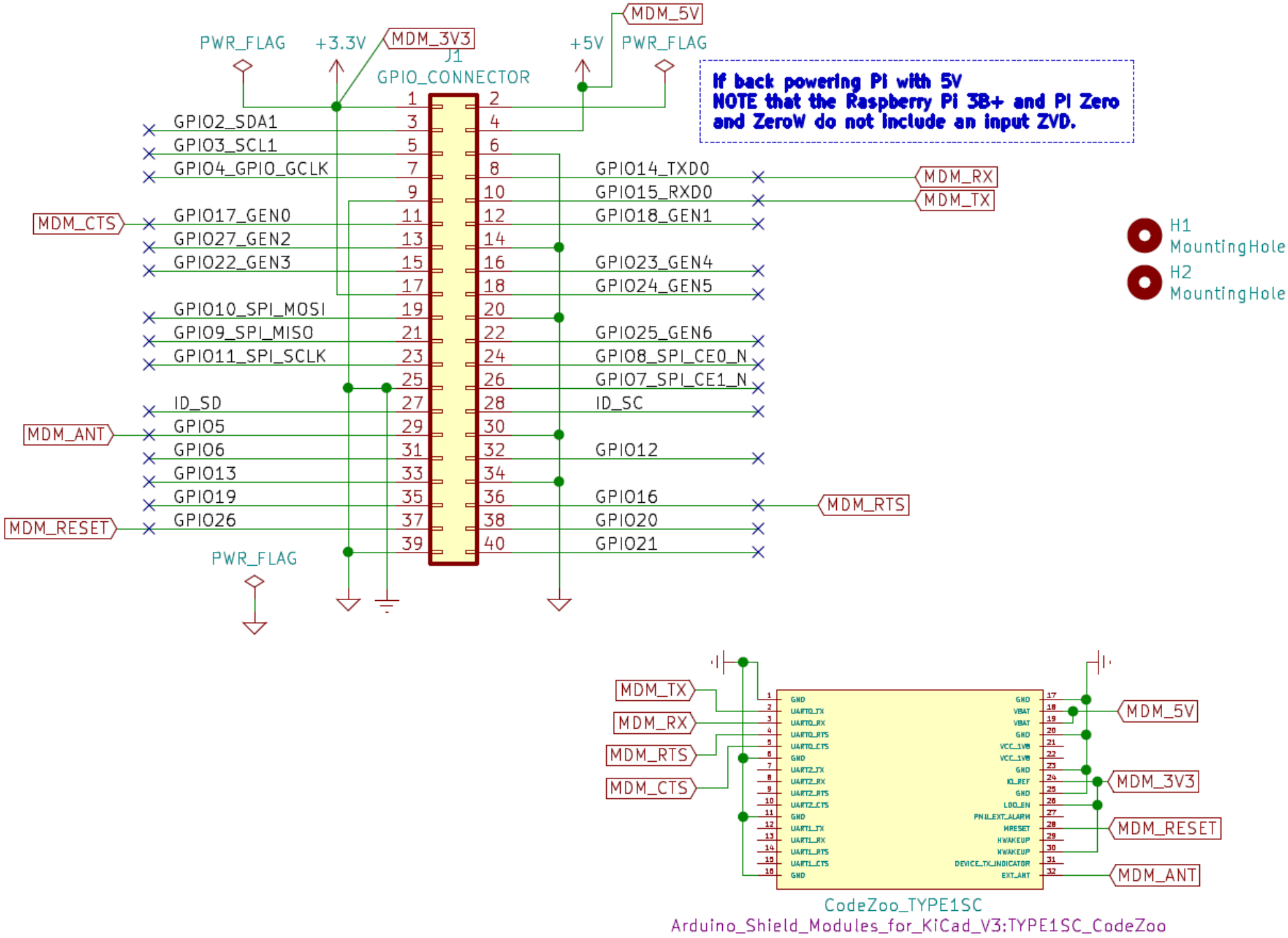
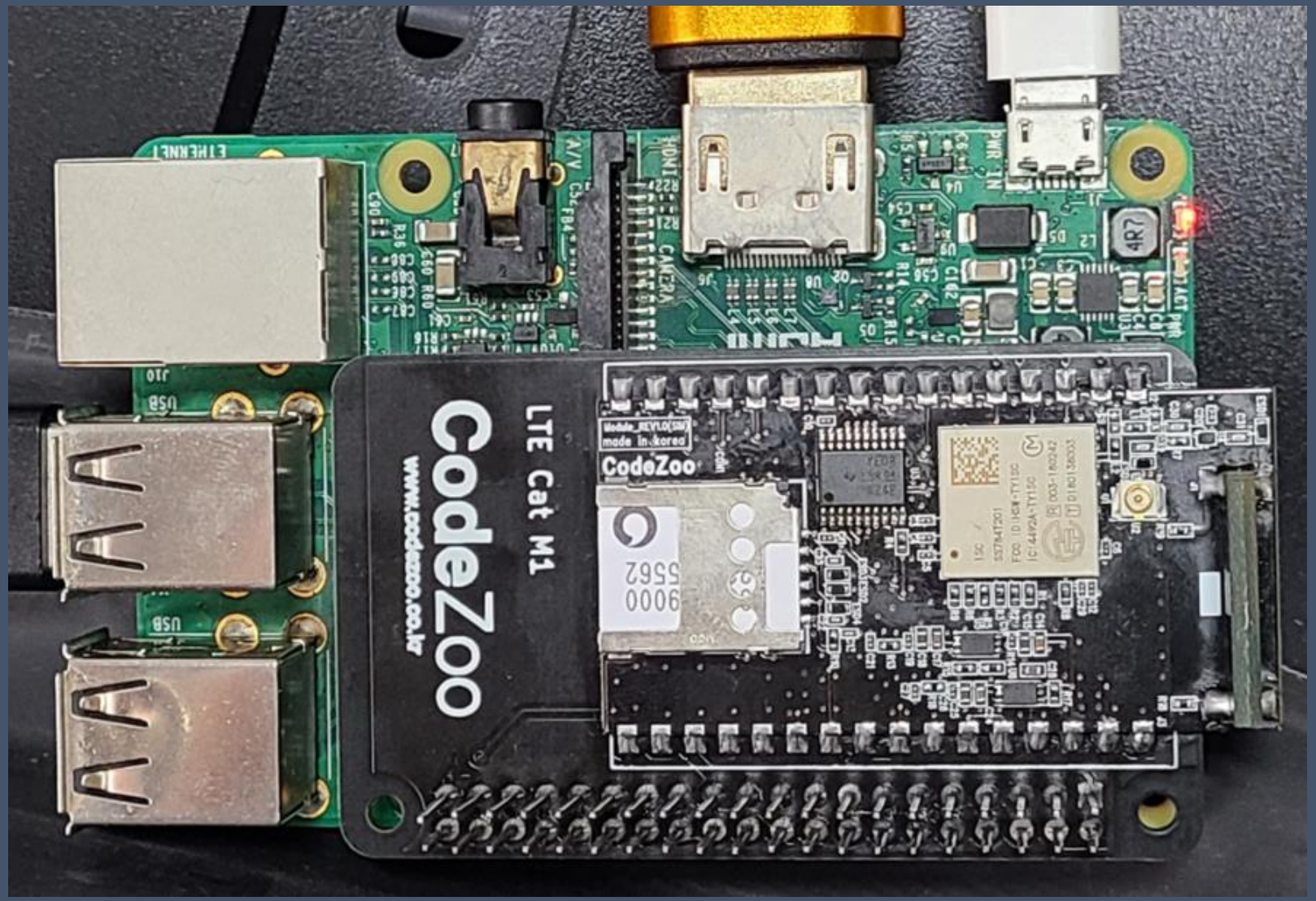
3. CAT.M1 RPI HAT회로



3. CAT.M1 연결


LTE Cat M1
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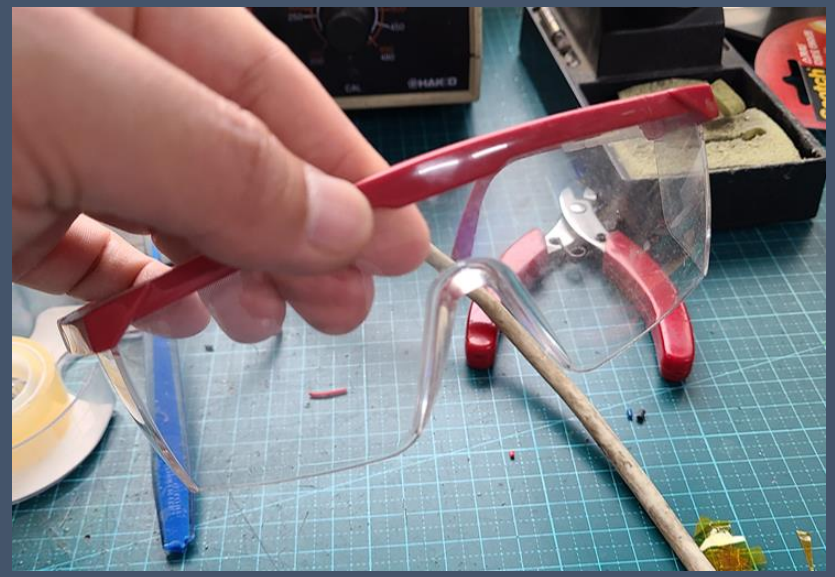
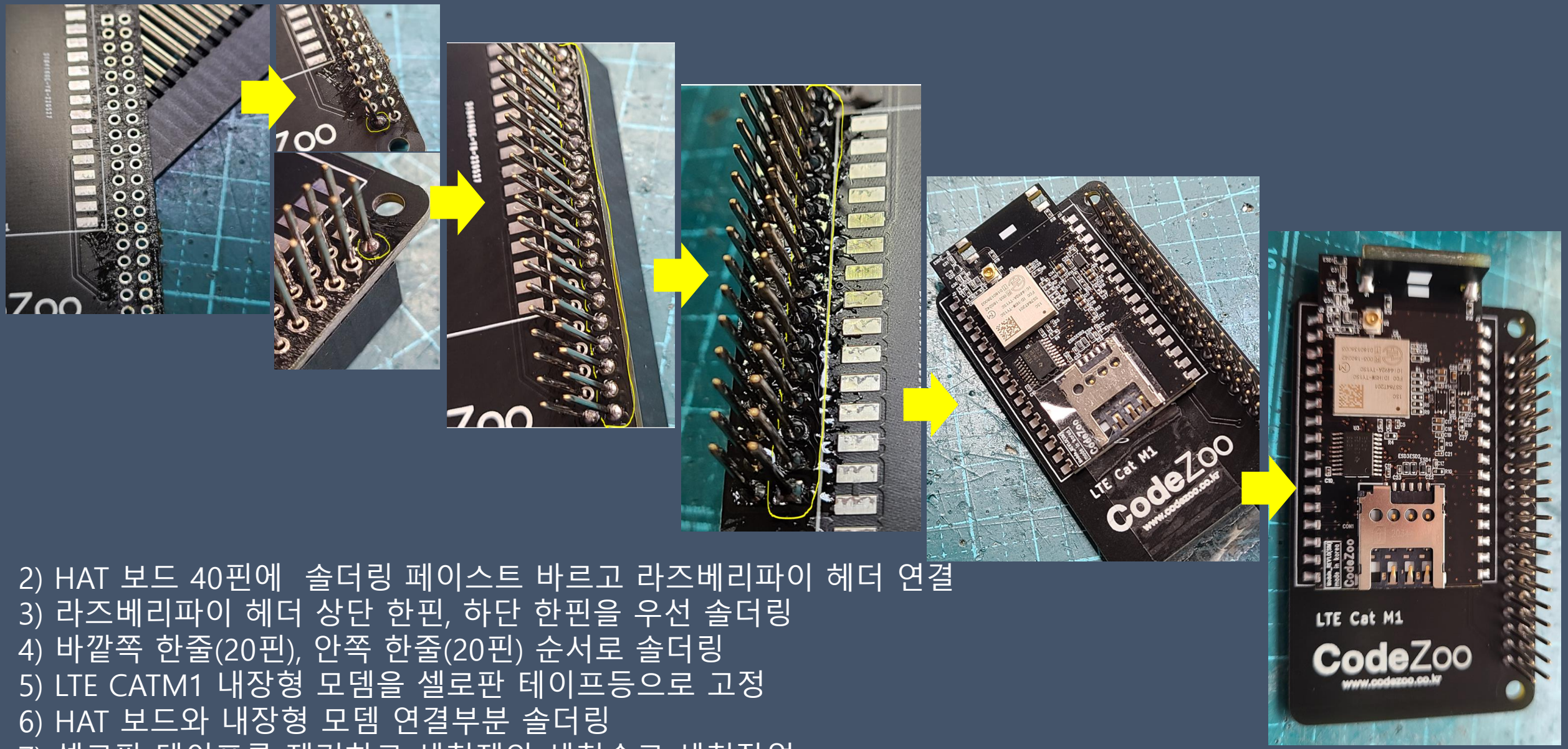
CodeZoo
ETHERNET
USB
USB
PWR IN
CAMERA
A/V
HDMI

3. CAT.M1 연결

1) 보호안경, 솔더링 페이스트, 친환경 세척제, PCB 세척솔 준비



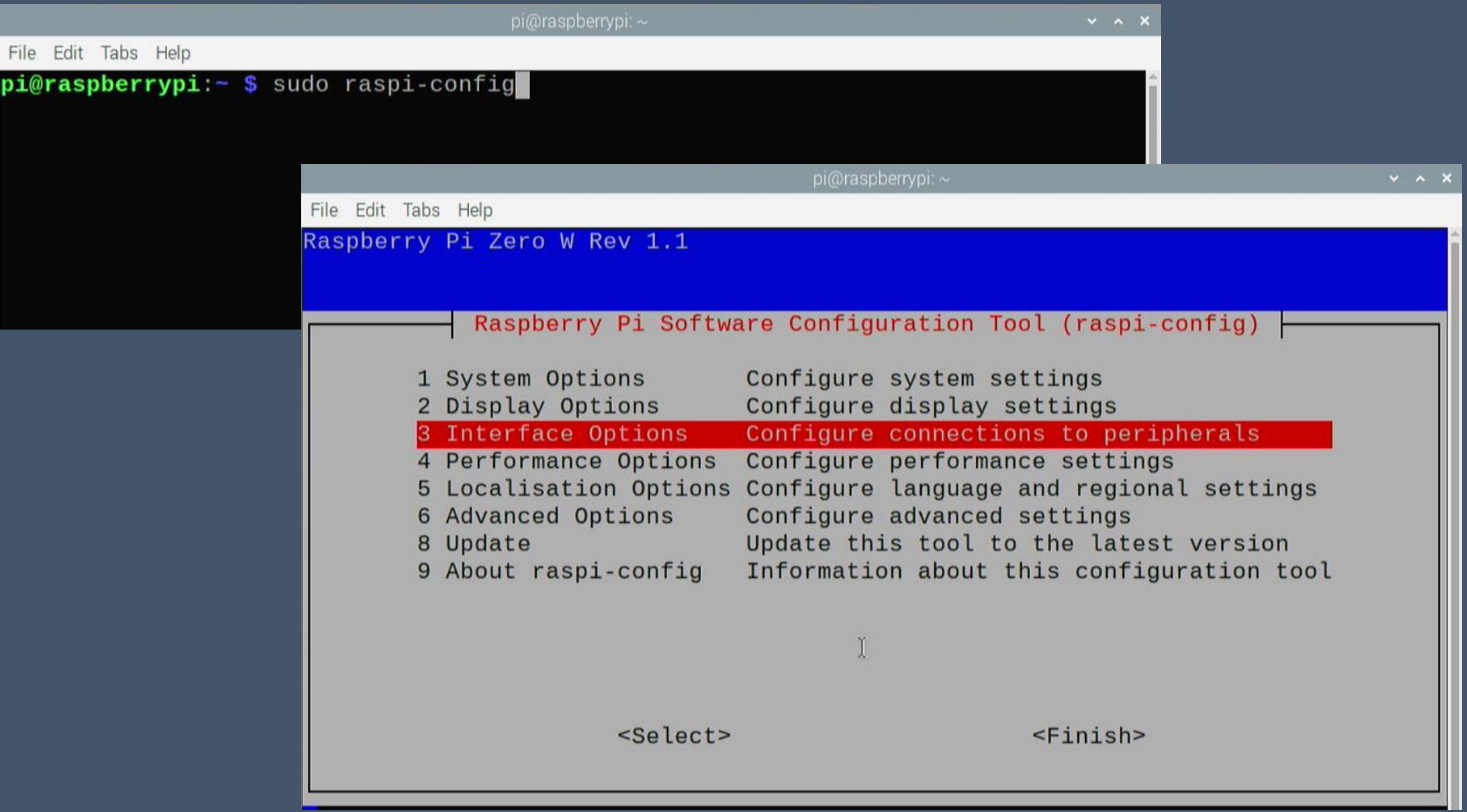
3. CAT.M1 연결



2) HAT 보드 40핀에 솔더링 페이스트 바르고 라즈베리파이 헤더 연결
3) 라즈베리파이 헤더 상단 한핀, 하단 한핀을 우선 솔더링
4) 바깥쪽 한줄(20핀), 안쪽 한줄(20핀) 순서로 솔더링
5) LTE CATM1 내장형 모뎀을 셀로판 테이프등으로 고정
6) HAT 보드와 내장형 모뎀 연결부분 솔더링
7) 셀로판 테이프를 제거하고 세척제와 세척솔로 세척작업

4. CAT.M1 PPP install

1) Serial (/dev/ttyS0) 활성화



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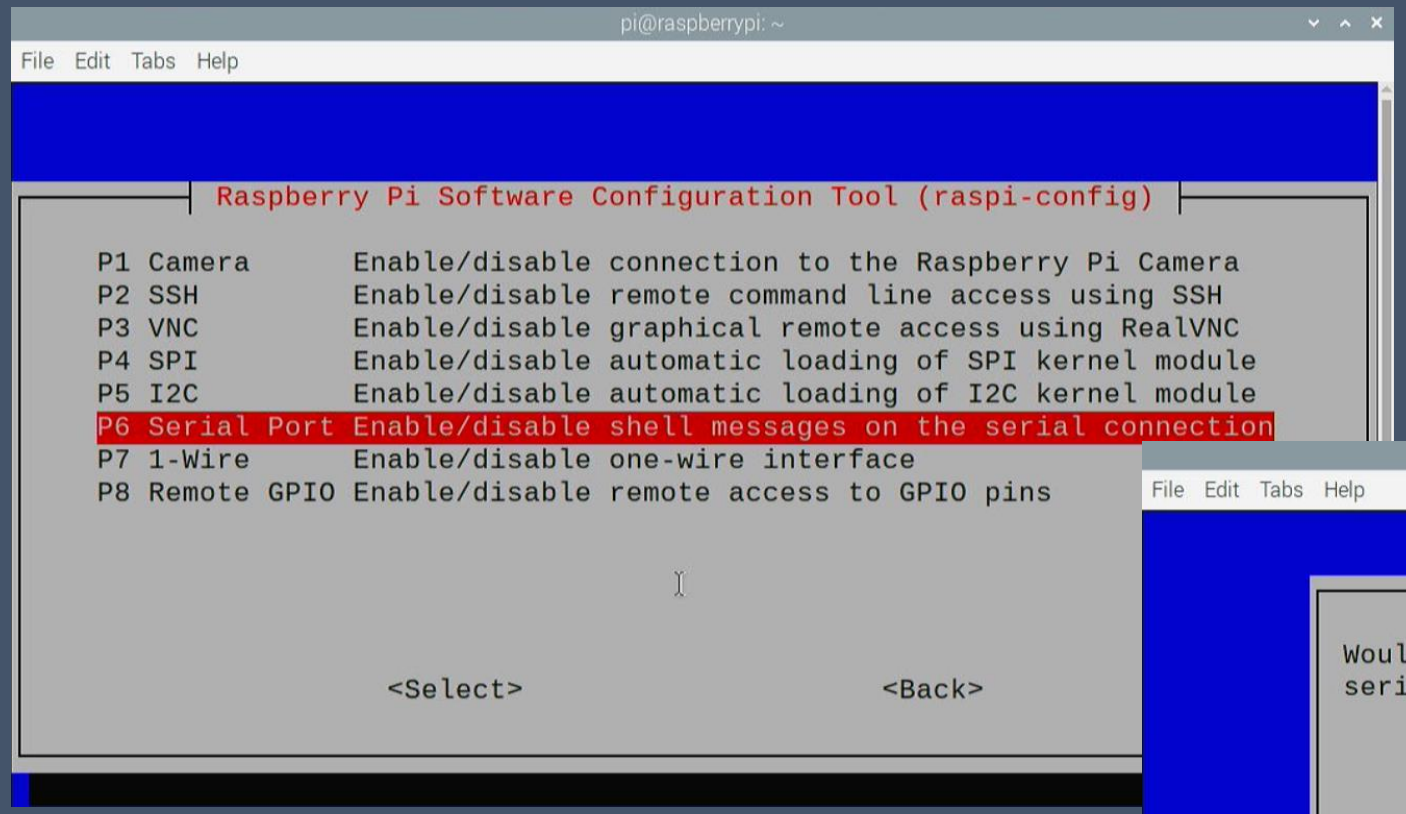
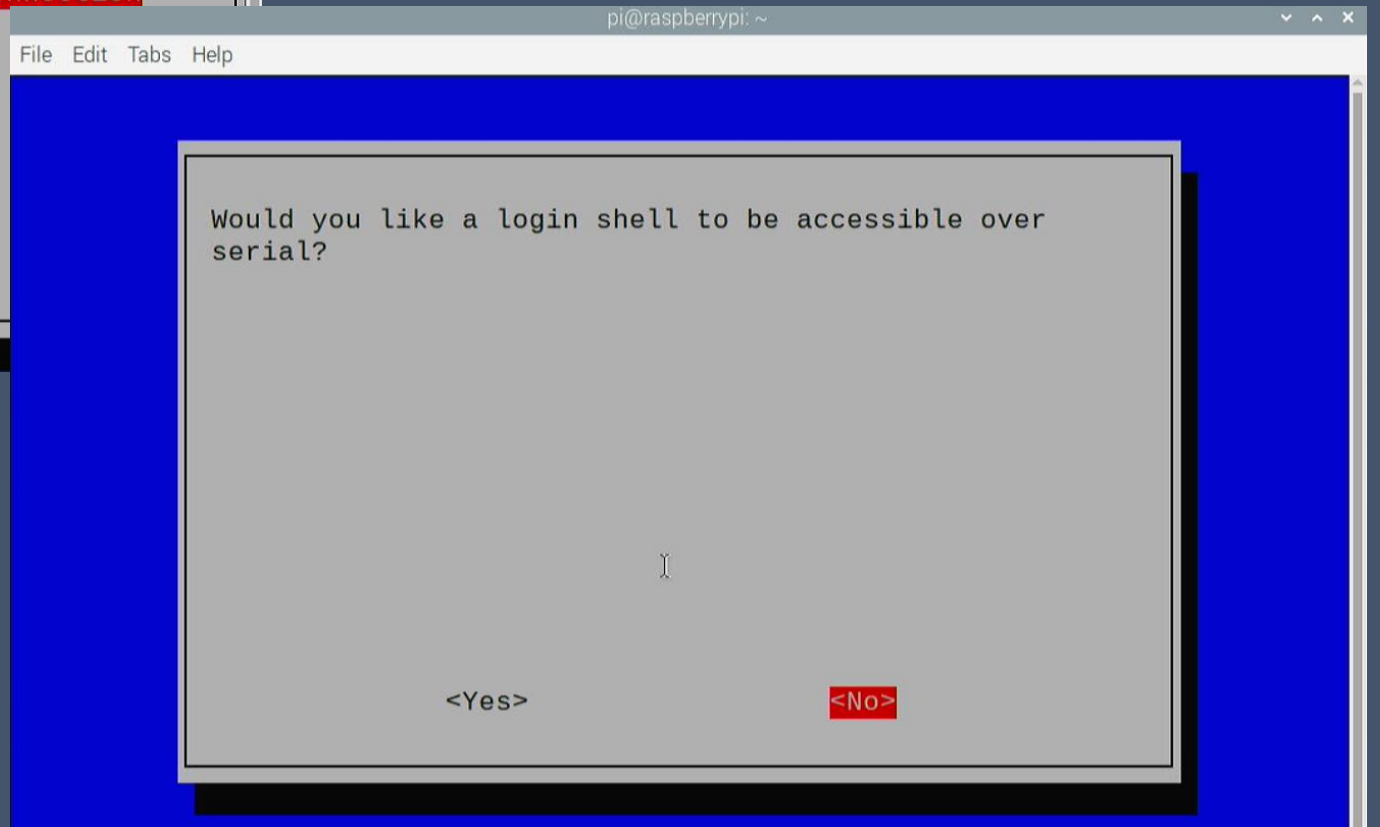
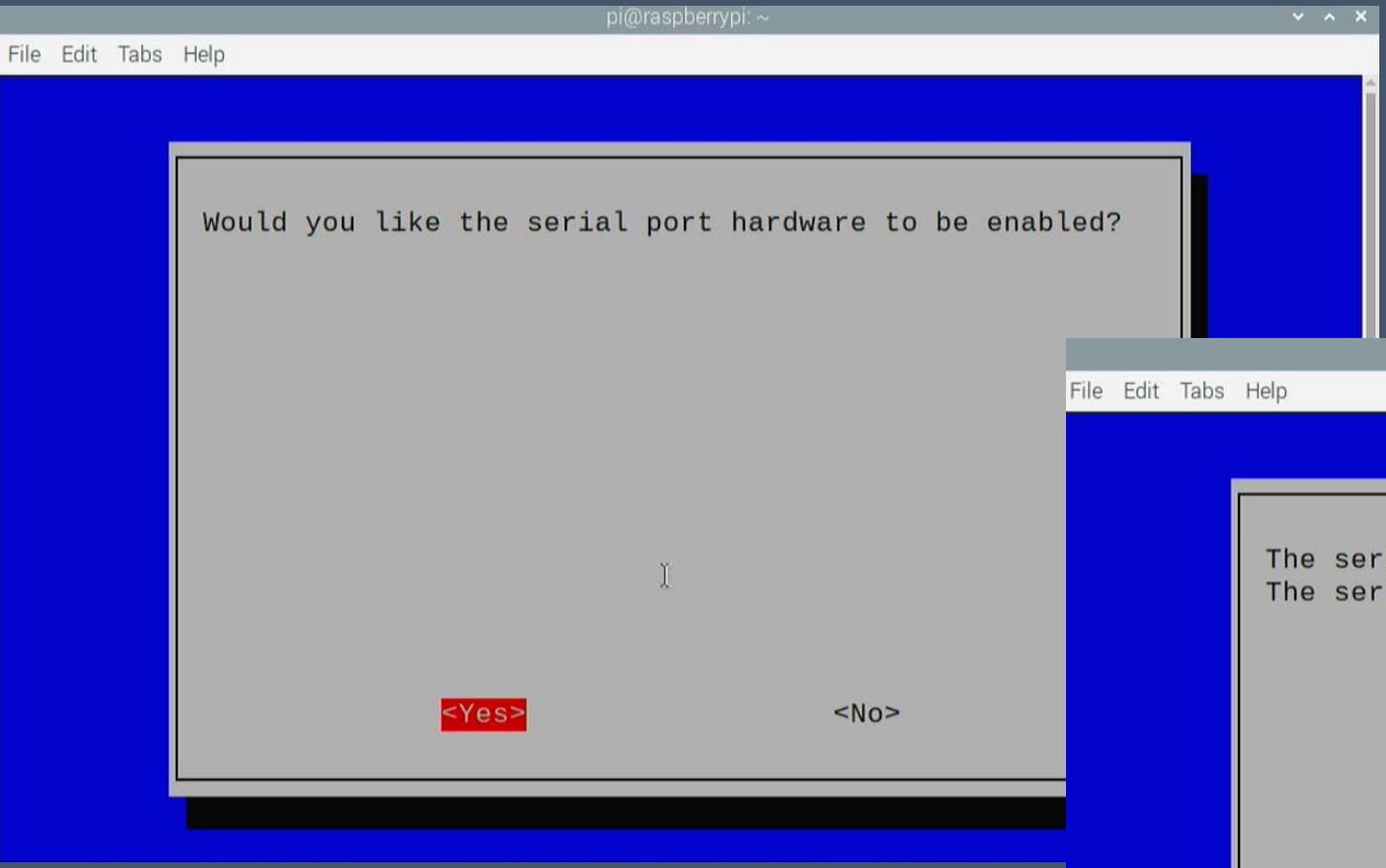
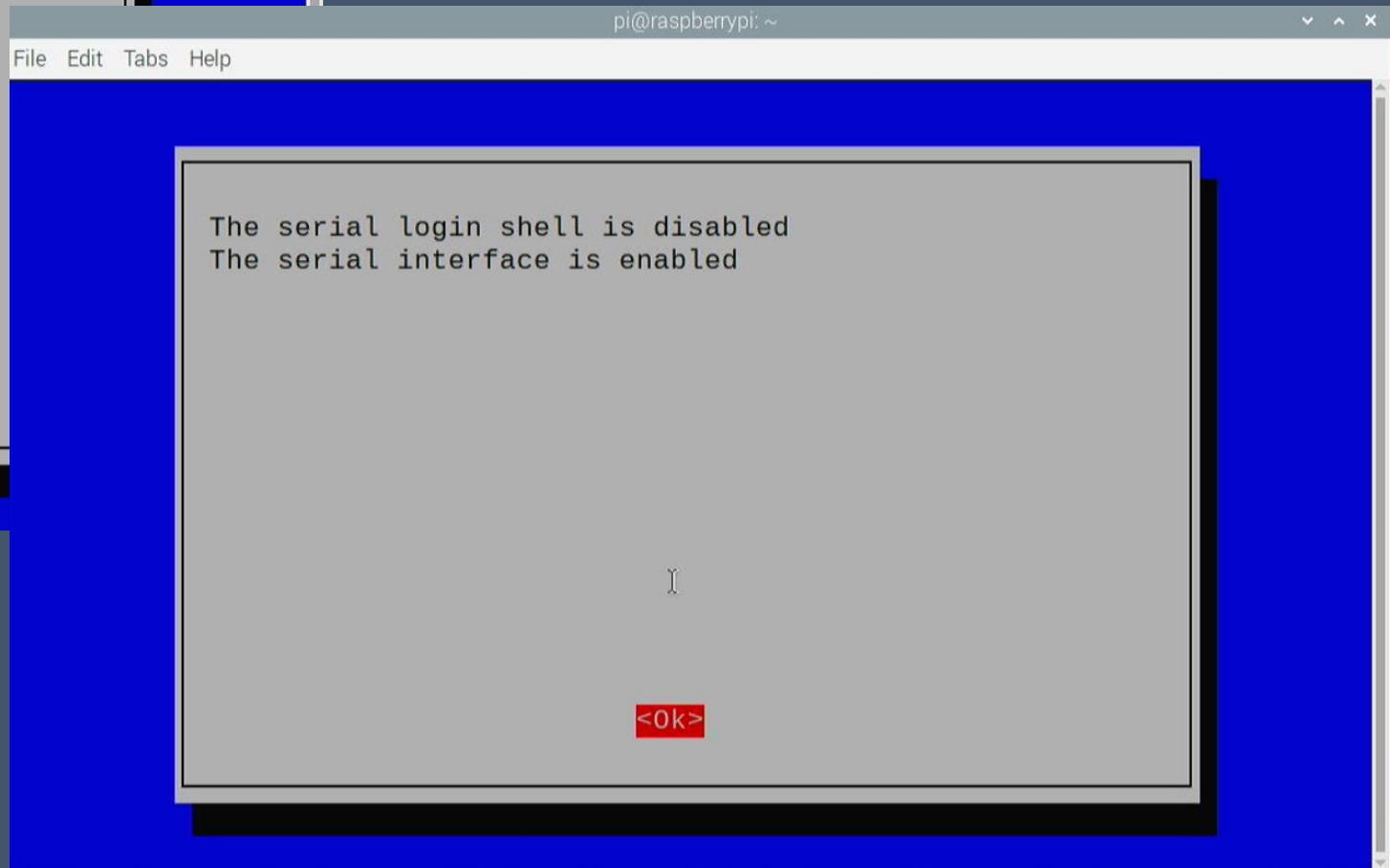
4. CAT.M1 PPP install



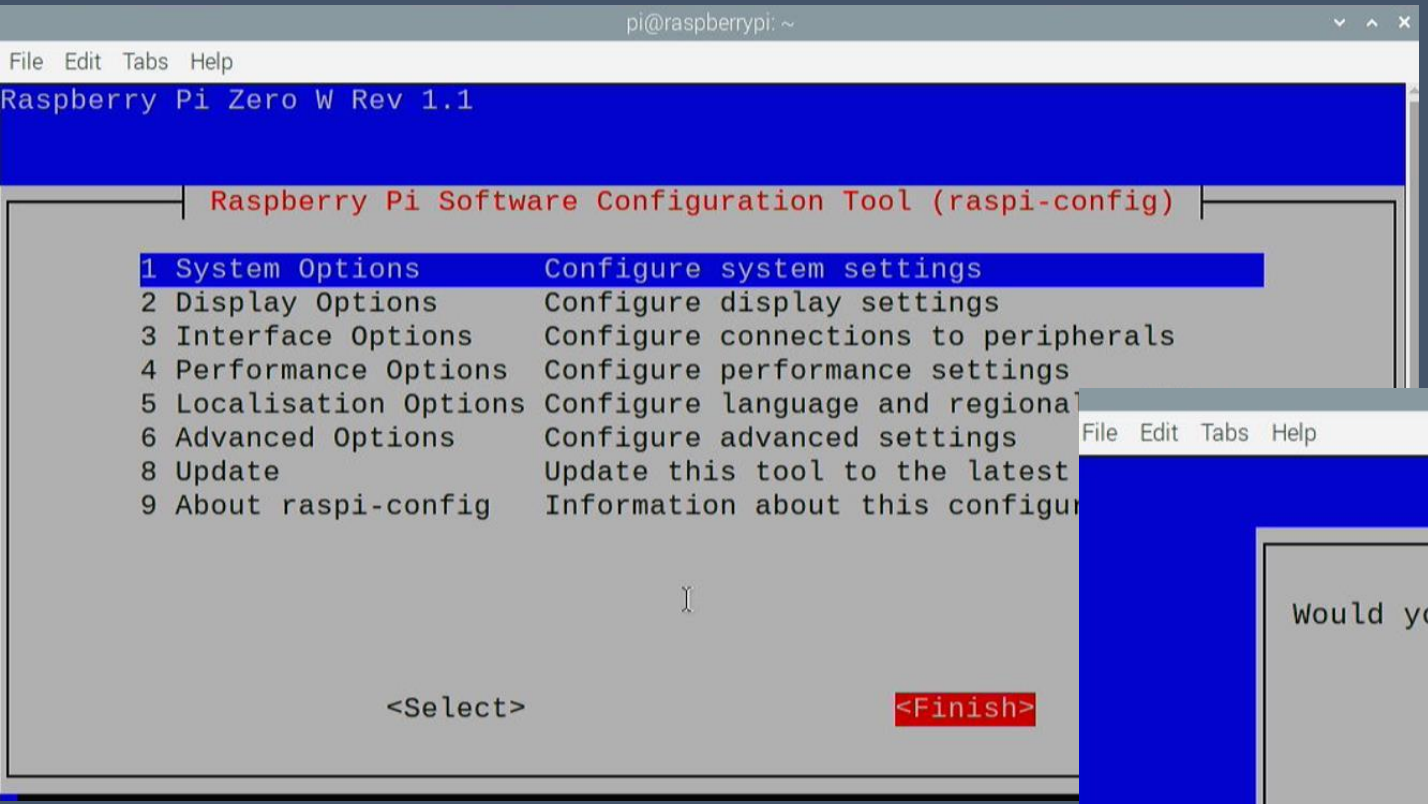


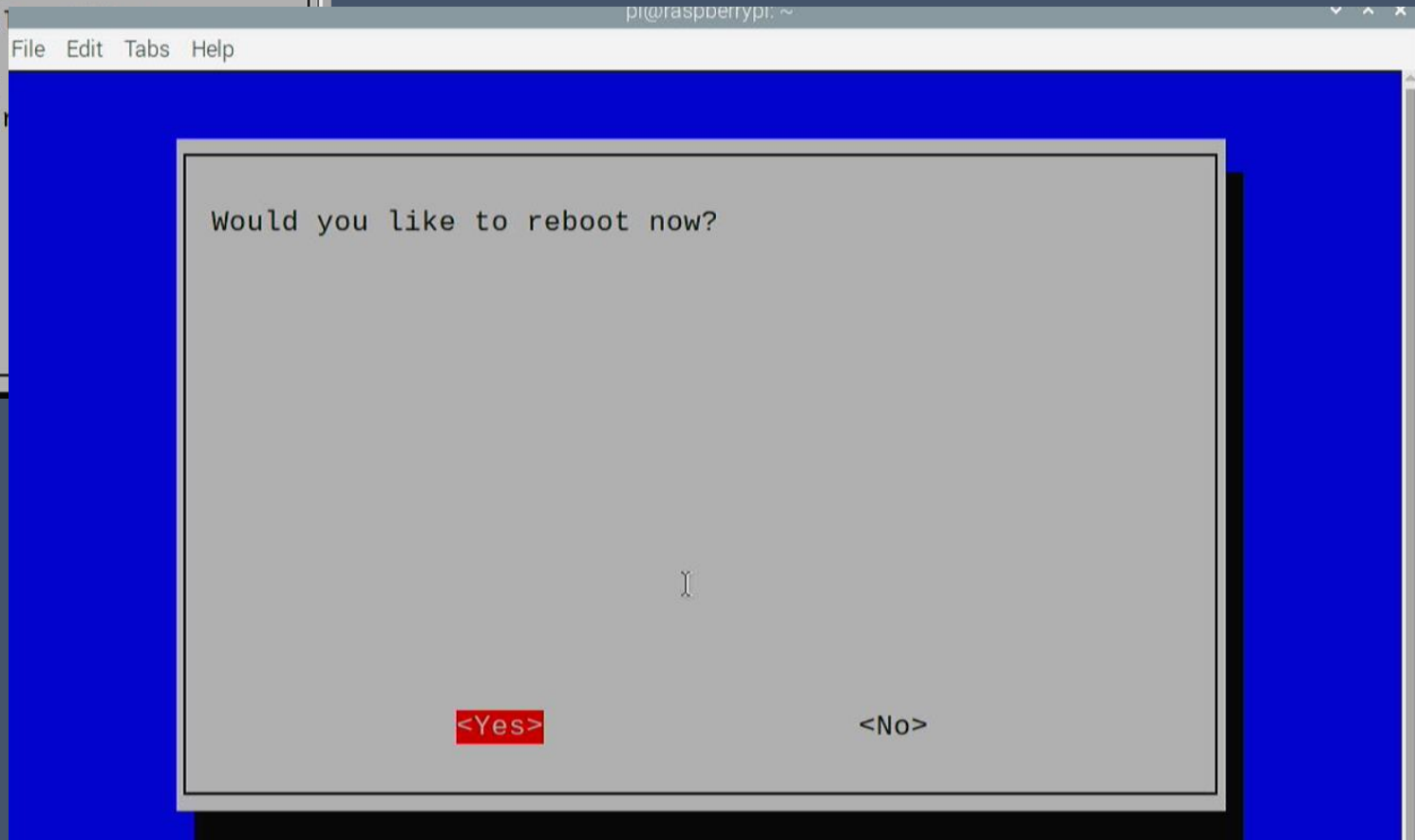
4. CAT.M1 PPP install



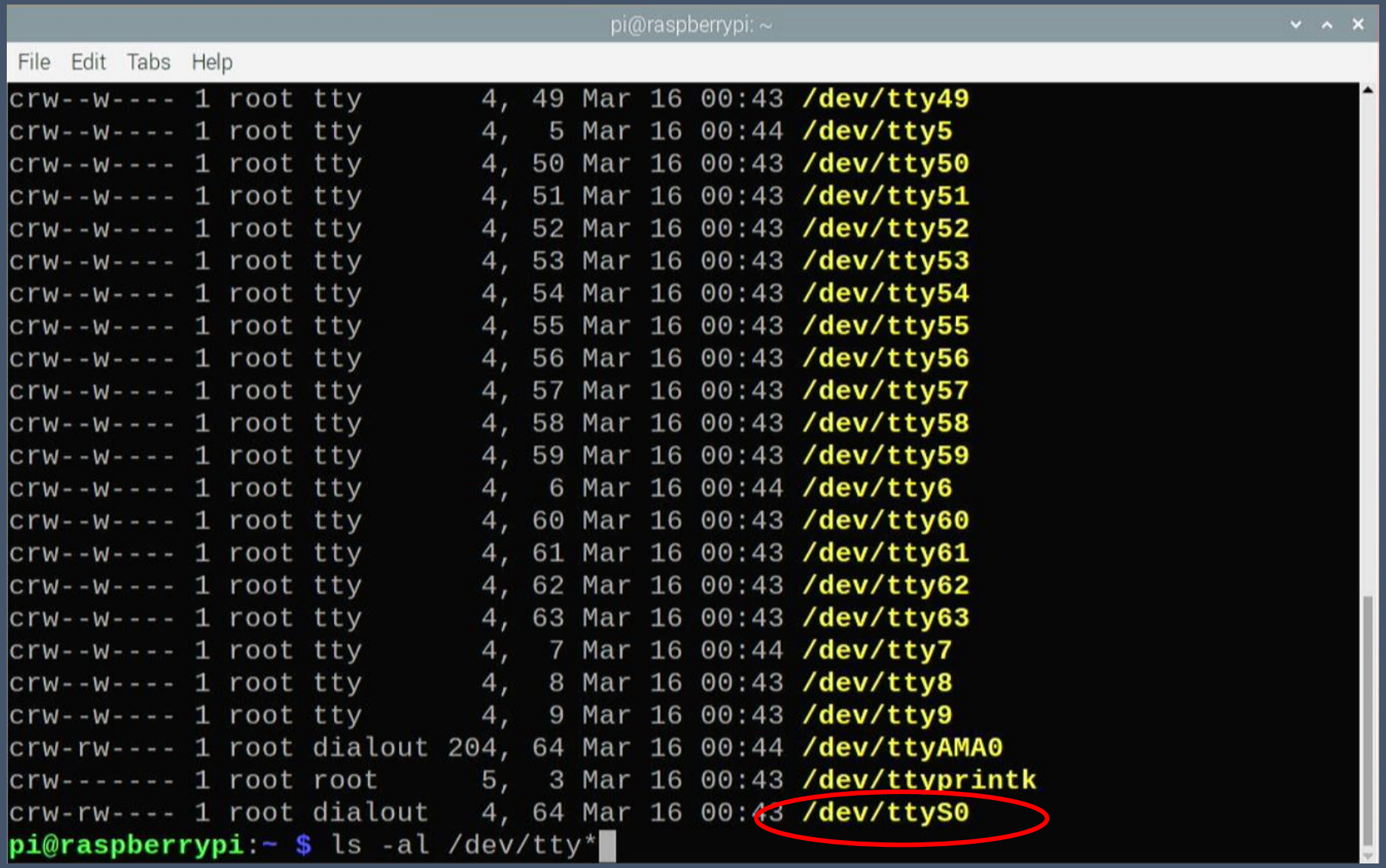


4. CAT.M1 PPP install



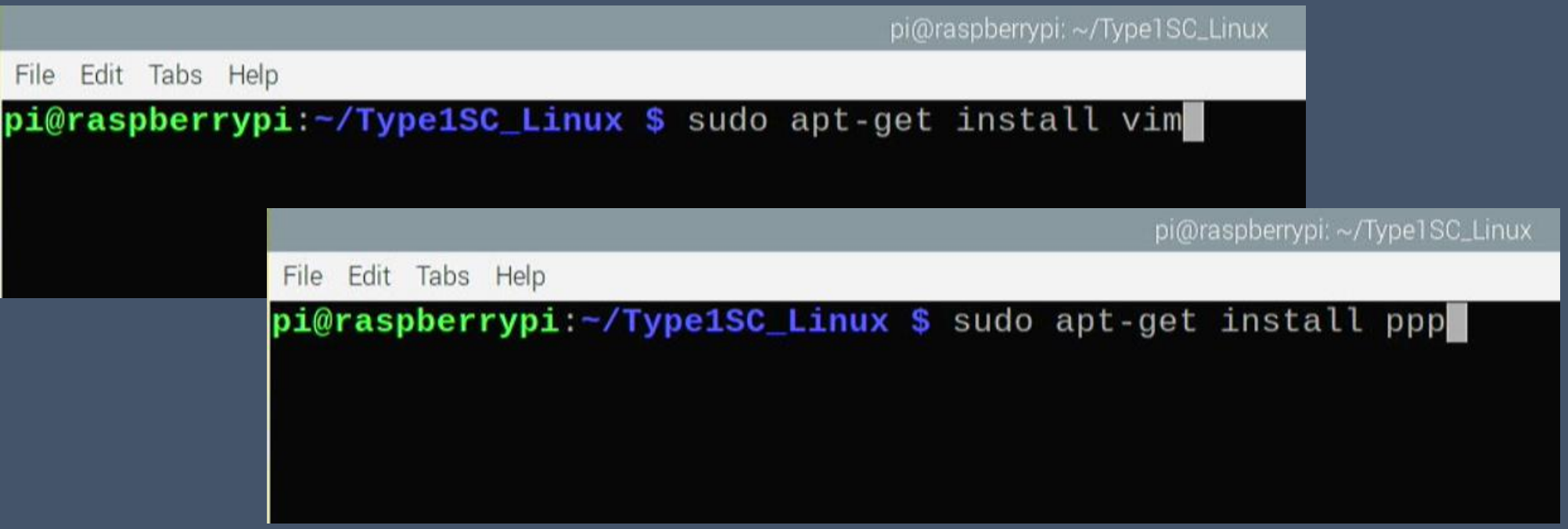


4. CAT.M1 PPP install



4. CAT.M1 PPP install

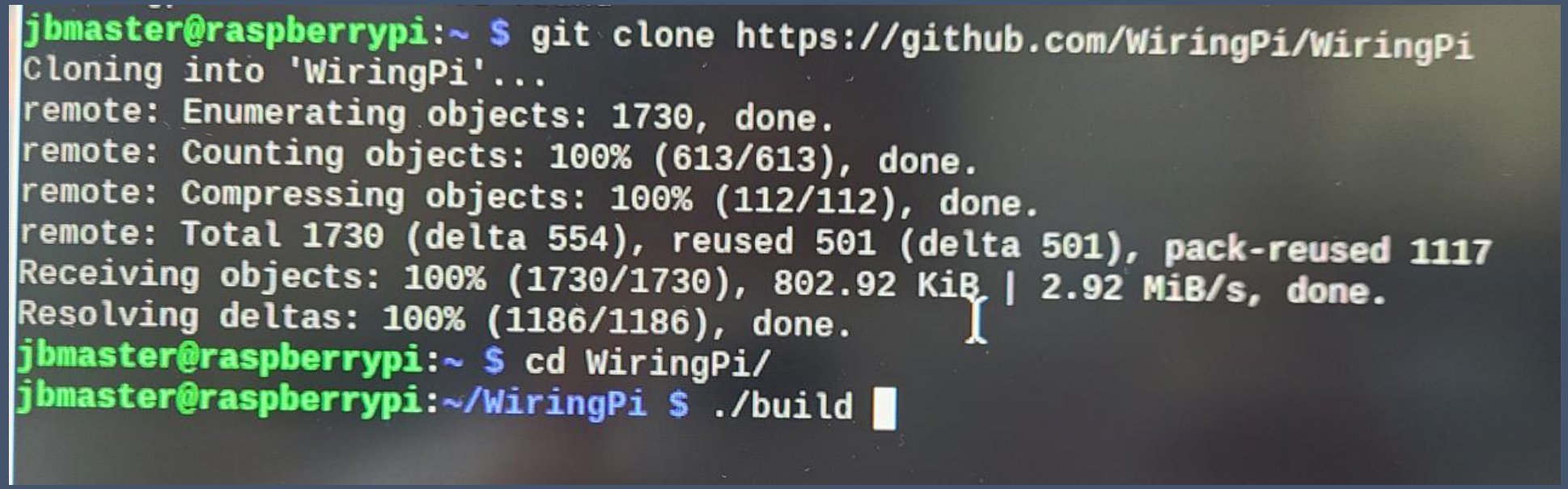
2) VIM, PPP 설치



4. CAT.M1 PPP install

3) WiringPi 설치 (2022. 1월 이후 Raspberry Pi OS를 설치한 경우)

git clone https://github.com/WiringPi/WiringPi
cd WiringPi
./build



4. CAT.M1 PPP install

4) raspberry pi rtscts 설정 프로그램 다운로드 및 코드수정, 빌드
git clone https://github.com/codezoo-ltd/rpirtscts.git

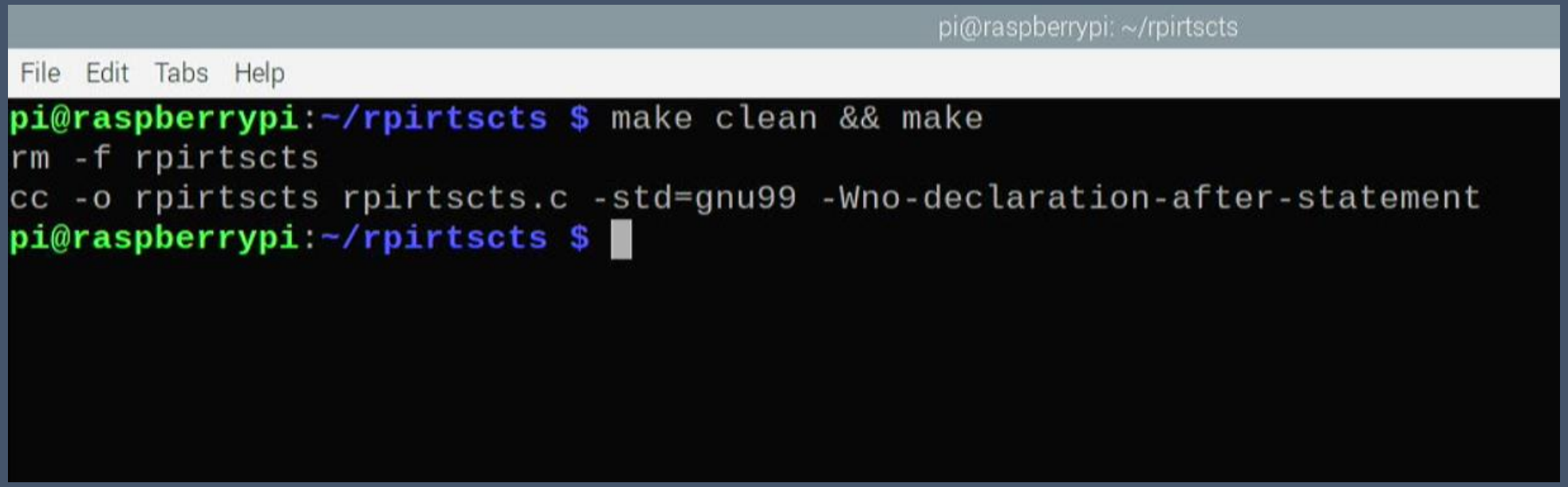
해당 프로그램은 모뎀을 사용하기 위해 라즈베리파이의 Serial CTS/RTS 기능을 활성화하고 모뎀 내장 or 외장 안테나 사용 설정 후 모뎀을 하드웨어 리셋 합니다.

₩>cd rpirtscts
₩>vi rpirtscts.c
(!) 외장 안테나를 사용할 경우, if(!system("gpio -g write 5 1")) 로 수정 합니다.

```
/* Type1SC Modem Using Internal Antenna */
if(!system("gpio -g mode 5 output"))
        printf("gpio5 output mode\n");
if(!system("gpio -g write 5 0"))        /*if "gpio -g write 5 1" then EXT Antenna ON */
        printf("EXT ANT OFF.\n");
if(!system("sleep 1"))
        printf("...\n");

/* Type1SC Modem Reset */
if(!system("gpio -g mode 26 output"))
        printf("gpio26 output mode\n");
if(!system("gpio -g write 26 0"))
        printf("Modem Reset.\n");
if(!system("sleep 1"))
        printf("Modem Reset..\n");
if(!system("gpio -g write 26 1"))
        printf("Modem Reset...\n");
if(!system("sleep 1"))
        printf("Modem Ready!!!\n");
```

4. CAT.M1 PPP install

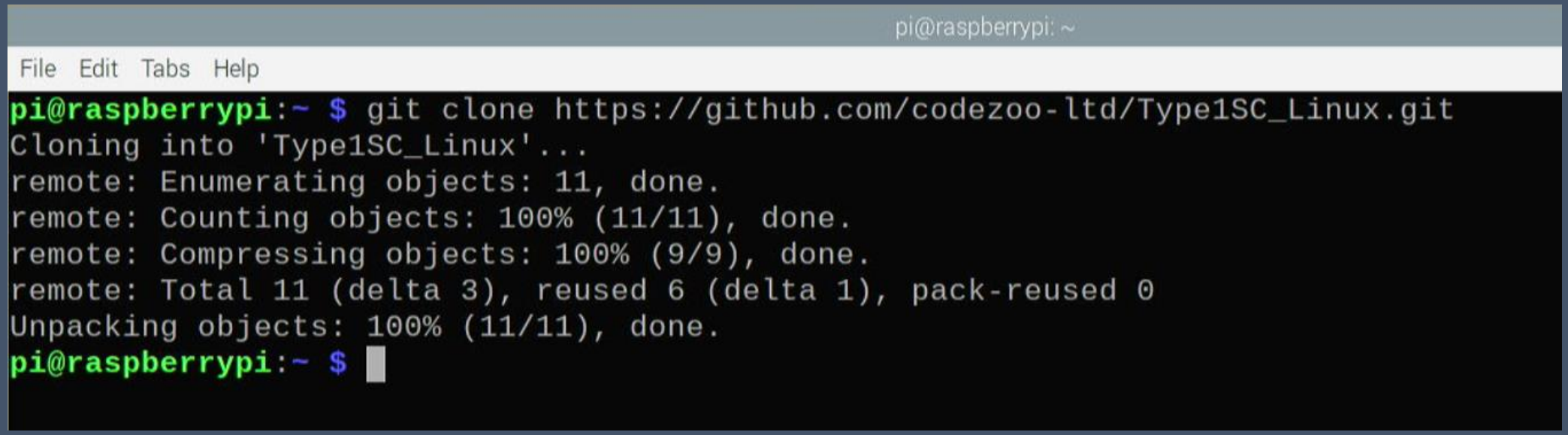
아래 명령어로 빌드 후 생성되는 rpirtscts 실행 파일을 사용합니다.
₩>make clean && make



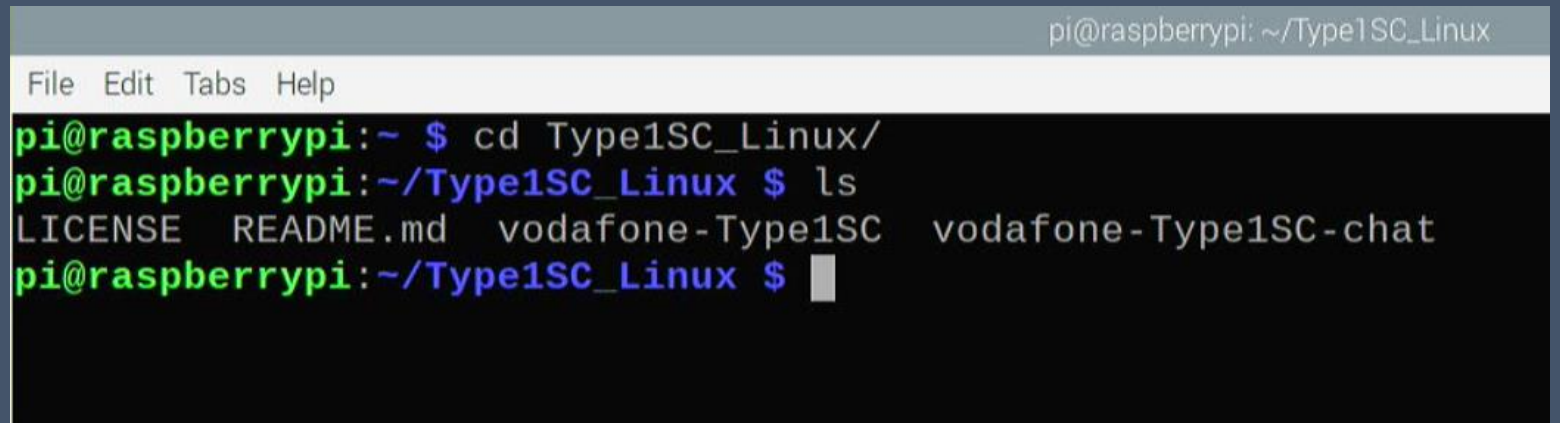
4. CAT.M1 PPP install

5) PPP 설정 스크립트 다운로드 및 수정, 설치

git clone https://github.com/codezoo-ltd/Type1SC_Linux.git



cd Type1SC_Linux



4. CAT.M1 PPP install

6) APN(Access Point Name) 설정 : vi vodafone-Type1SC-chat

```
#                CodeZoo LTE CATM1 Vodafone M
#
# Instructions
#       1.       If you want to use another A
#                Replace:
#                        [apn]
#                with your APN.
#       OK AT%APNN="[apn]"

TIMEOUT 5
ECHO ON
'' AT
OK AT%APNN="simplio.apn"
OK ATD*99***1#
CONNECT ''
```

사용하는 APN주소를 입력 합니다.
AT%APNN="사용하는 APN주소"

7) ppp스크립트 복사
sudo cp –rf vodafone-Type1SC* /etc/ppp/peers/

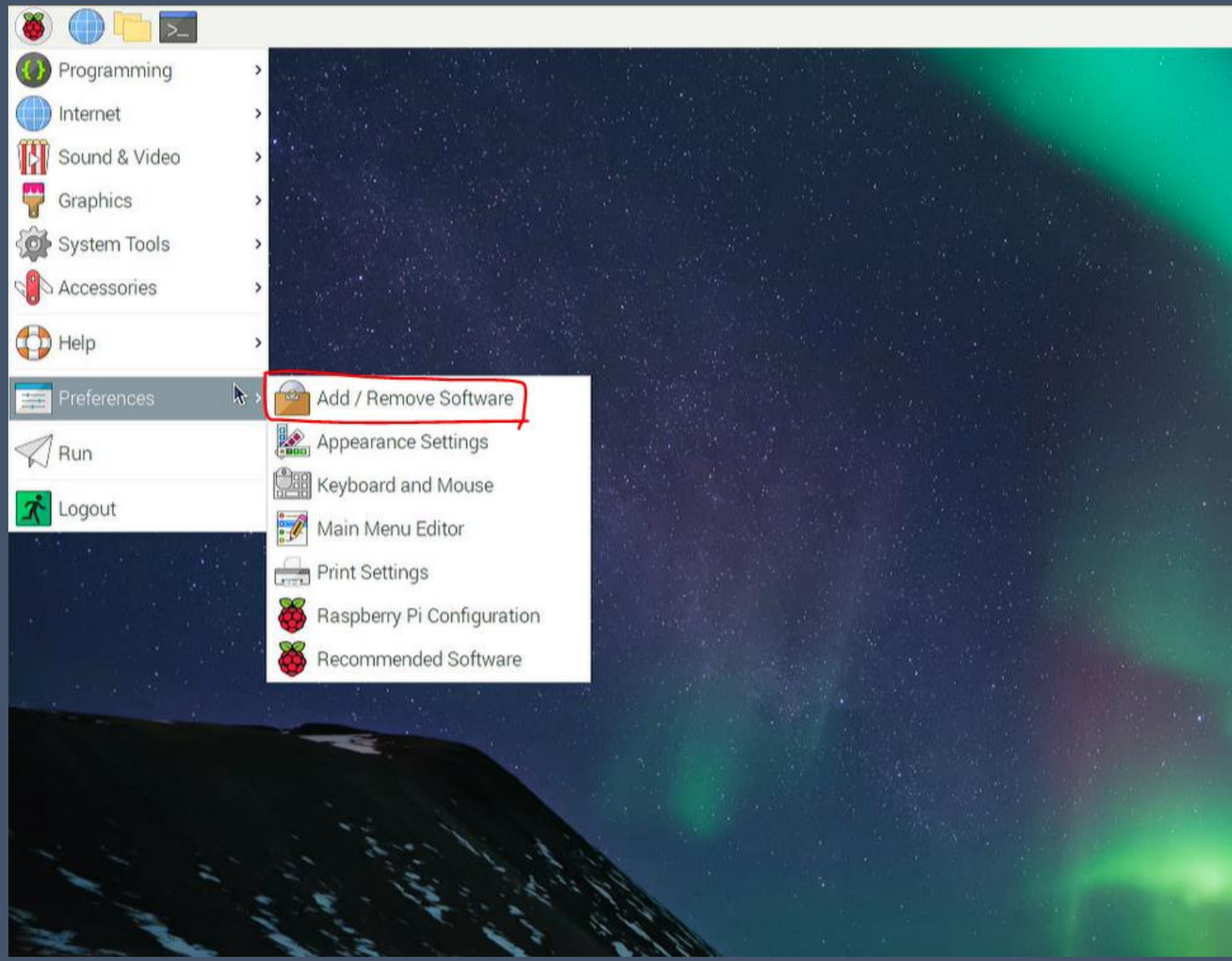
```
pi@raspberrypi: ~/Type1SC_Linux
File  Edit  Tabs  Help
pi@raspberrypi:~/Type1SC_Linux $ sudo cp -rf vodafone-Type1SC* /etc/ppp/peers/
pi@raspberrypi:~/Type1SC_Linux $
```

4. CAT.M1 PPP install

8) CATM1 모뎀 설정을 위한 GtkTerm 설치

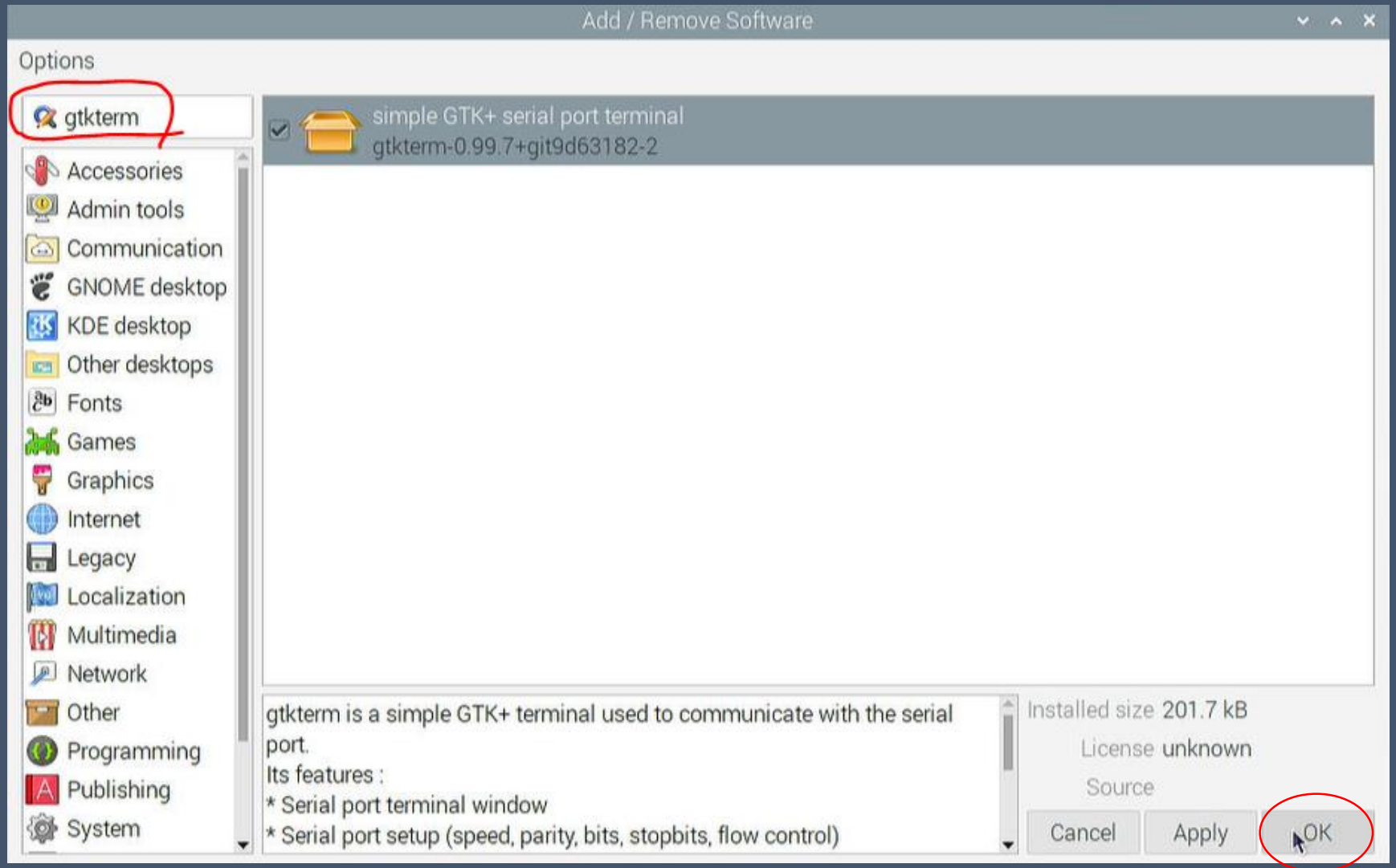
- 라즈베리파이 와이파이 또는 이더넷 연결

- Preferences --> Add/Remove Software 선택

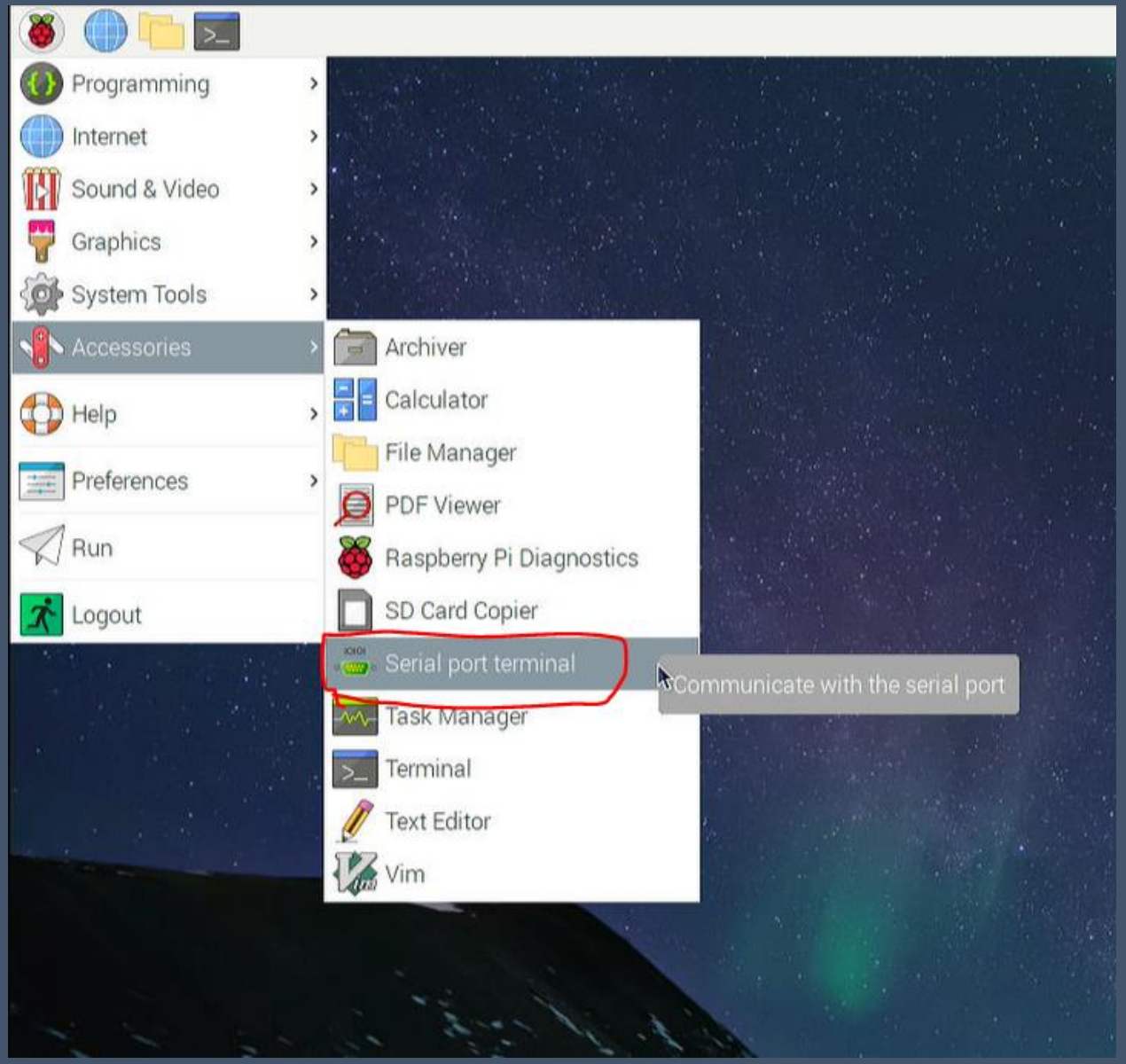


4. CAT.M1 PPP install

9) gtkterm 검색 및 설치



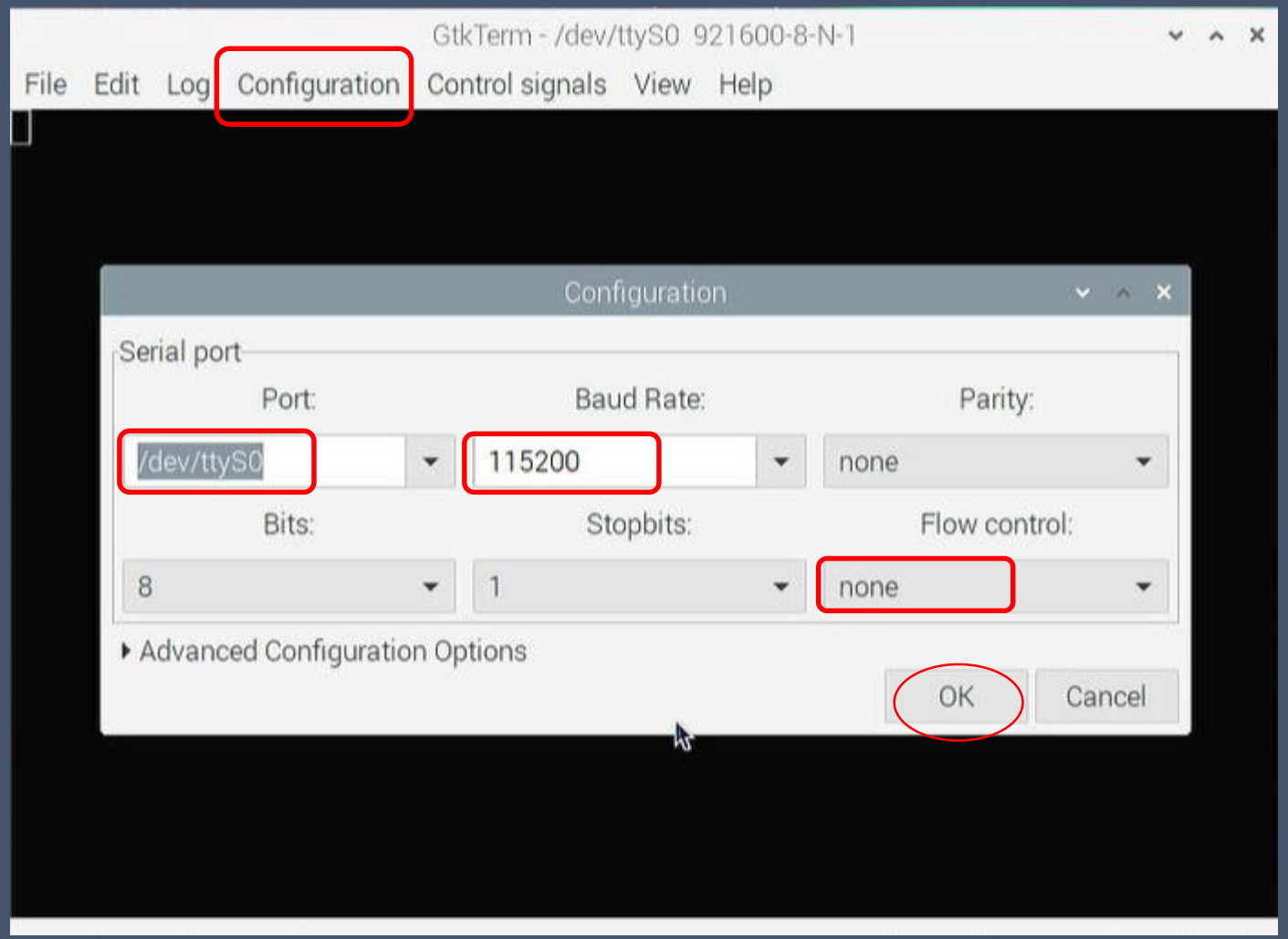
5. CAT.M1 PPP 동작, 모뎀 초기 설정 (AT Command)



1) 터미널 실행 후,
rpirtscts 프로그램 경로 이동 후 실행
₩>cd rpirtscts
₩>sudo ./rpirtscts on

2) Serial port terminal 실행
Accessories --> Serial port terminal 실행

5. CAT.M1 PPP 동작, 모뎀 초기 설정 (AT Command)



3) Configuration 실행

4) 아래와 같이 설정
- Port : /dev/ttyS0
- BaudRate : 115200
- Flow control : none

5) OK를 누른다

5. CAT.M1 PPP 동작, 모뎀 초기 설정 (AT Command)

6) GtkTerm에서 아래 명령을 실행 한다. 명령을 입력하고 엔터키를 눌러서 OK를 확인한다.

//망접속 해제
AT+CFUN=0

//자동접속 모드 설정
at%setacfg=modem_apps.Mode.AutoConnectMode,true

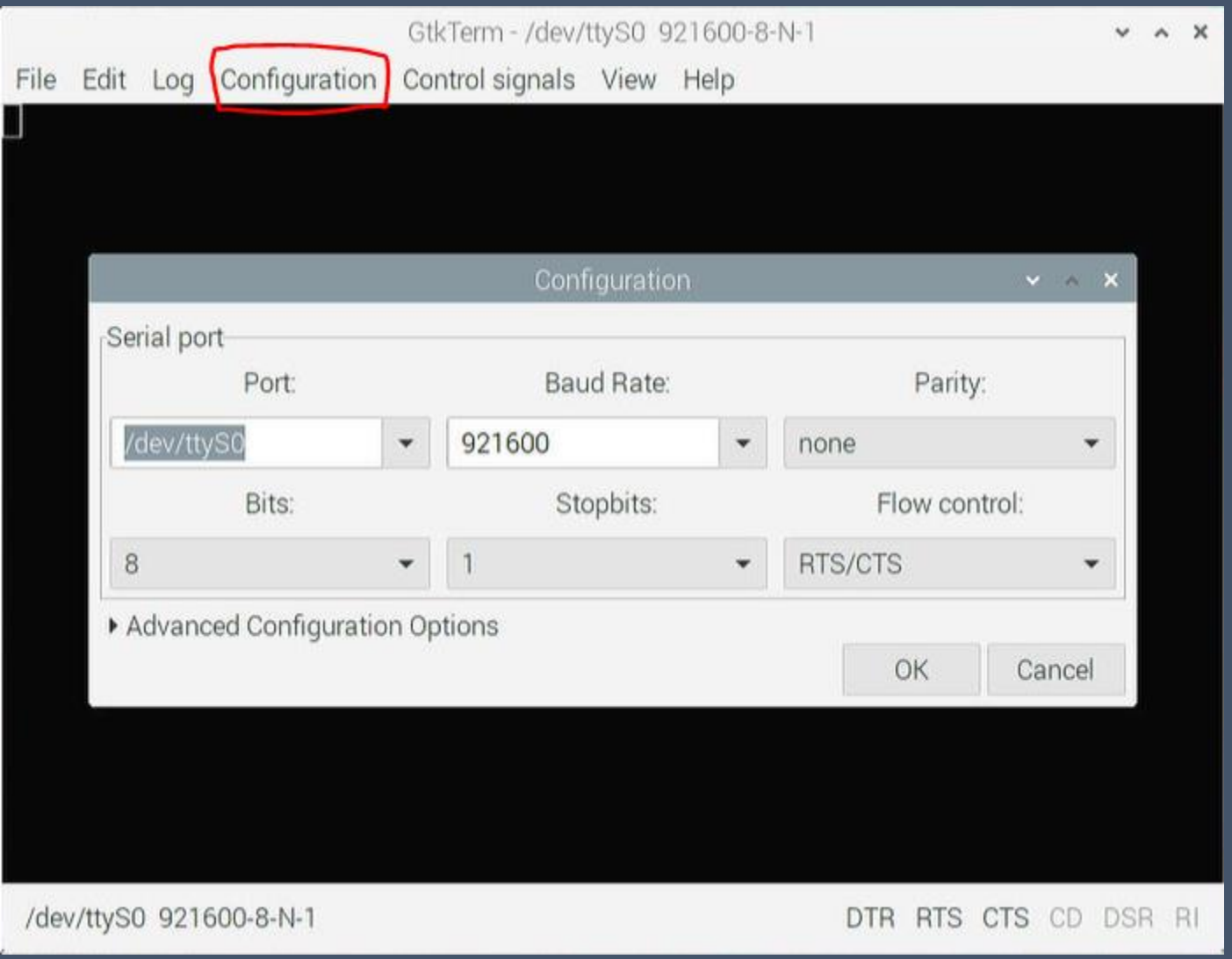
//APN설정 (심카드에서 제공하는 APN주소 입력)
AT%APNN="simplio.apn"

//H/W CTS/RTS 기능 켜기
AT&K3

//Baudrate 921600으로 설정하기
AT+IPR=921600

GtkTerm을 종료하고 라즈베리파이 시스템 재부팅!!

5. CAT.M1 PPP 동작, 모뎀 초기 설정 확인(AT Command)



7) 모뎀 초기값 다시 확인
- 터미널 실행 후,
rpirtscts 프로그램 경로 이동 후 실행
₩>cd rpirtscts
₩>sudo ./rpirtscts on
- Serial port terminal 실행
Accessories --> Serial port terminal 실행
- Configuration 설정값 변경
- Port : /dev/ttyS0
- BaudRate : 921600
- Flow control : RTS/CTS
- OK를 누른다.

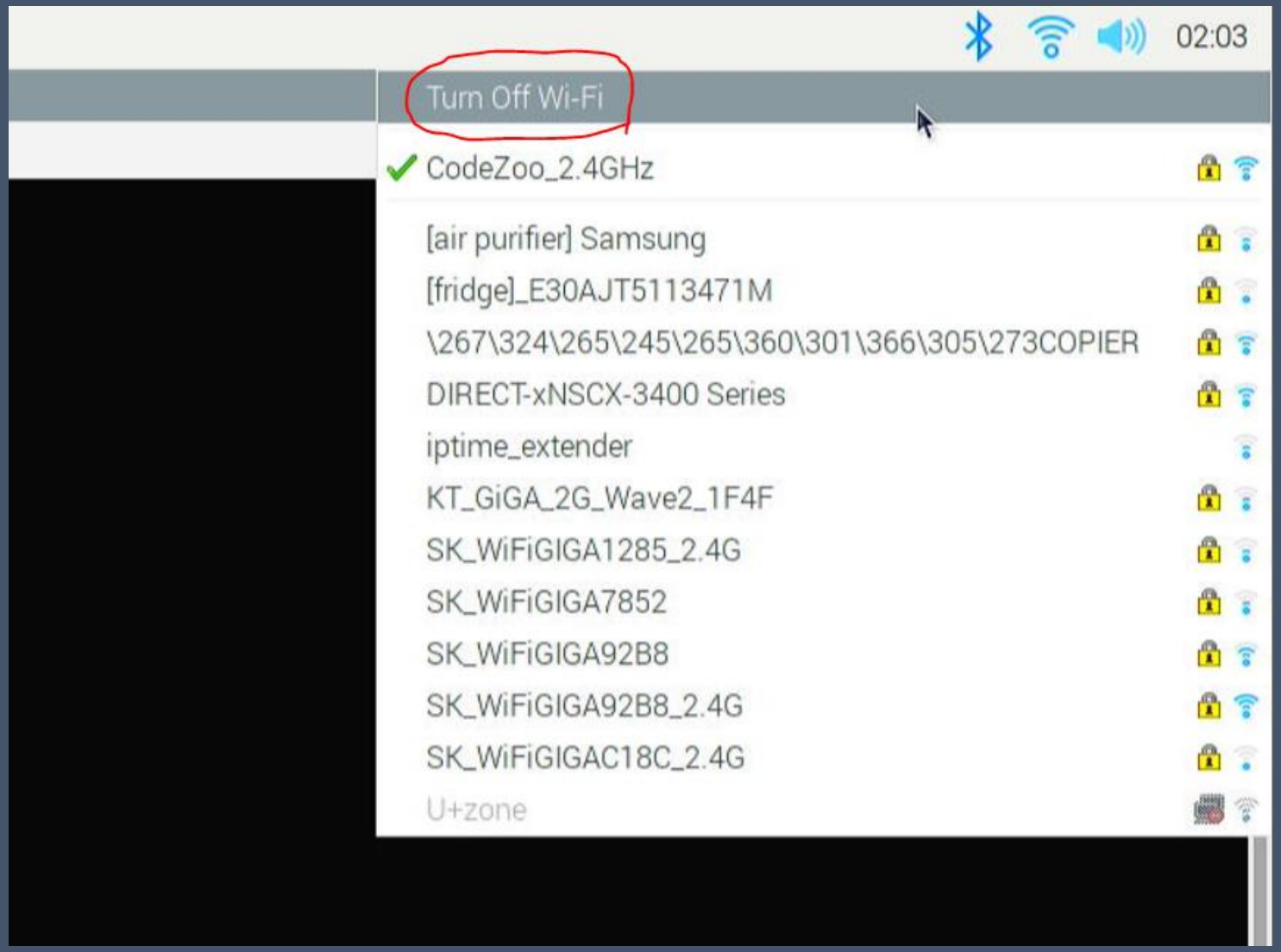
5. CAT.M1 PPP 동작, 모뎀 초기 설정 (AT Command)

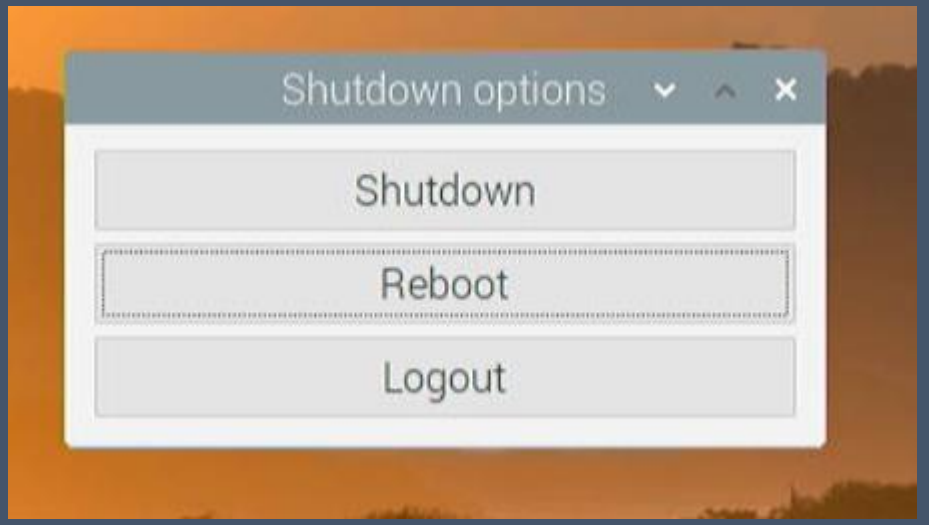
8) GtkTerm에서 아래 명령을 실행해서 설정값이 올바르게 저장되어 있는지 확인 합니다. 확인이 되었으면 다시 실행하지 않아도 됩니다. (명령어의 //부터는 주석이므로 입력하지 않습니다. 명령문 아랫줄은 결과 출력값)

```
AT%APNN?                  //APN설정 확인, 설정한 APN값이 출력되는지 확인
%APNN: simplio.apn

AT&K?                     //H/W CTS/RTS 활성화 여부 확인 0이면 비활성화, 3이면 활성화
&K:3

AT+IPR?                   //Baudrate 921600 확인
+IPR: 921600

at%getacfg=modem_apps.Mode.AutoConnectMode //망자동접속여부 확인
true

AT+CEREG?                 //망에 등록 되었는지 체크 (로밍일 경우 0,5  | 국내망인 경우 0,1)
+CEREG: 0,5

AT+COPS?                  //현재 오퍼레이터 확인 (오퍼레이터에 따라 값이 바뀜)
+COPS: 0,0,"DATA ONLY",7

AT%MEAS="8"               //무선감도 체크 (감도는 장소에 따라 수시로 바뀝니다)
%MEAS: Signal Quality: RSRP = -76, RSRQ = -6, SINR = 20, RSSI = -56
```

6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

1) Turn Off Wi-Fi 선택하고 시스템 재시작





6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

2) ifconfig 실행하여 현재 등록된 Network Device 확인

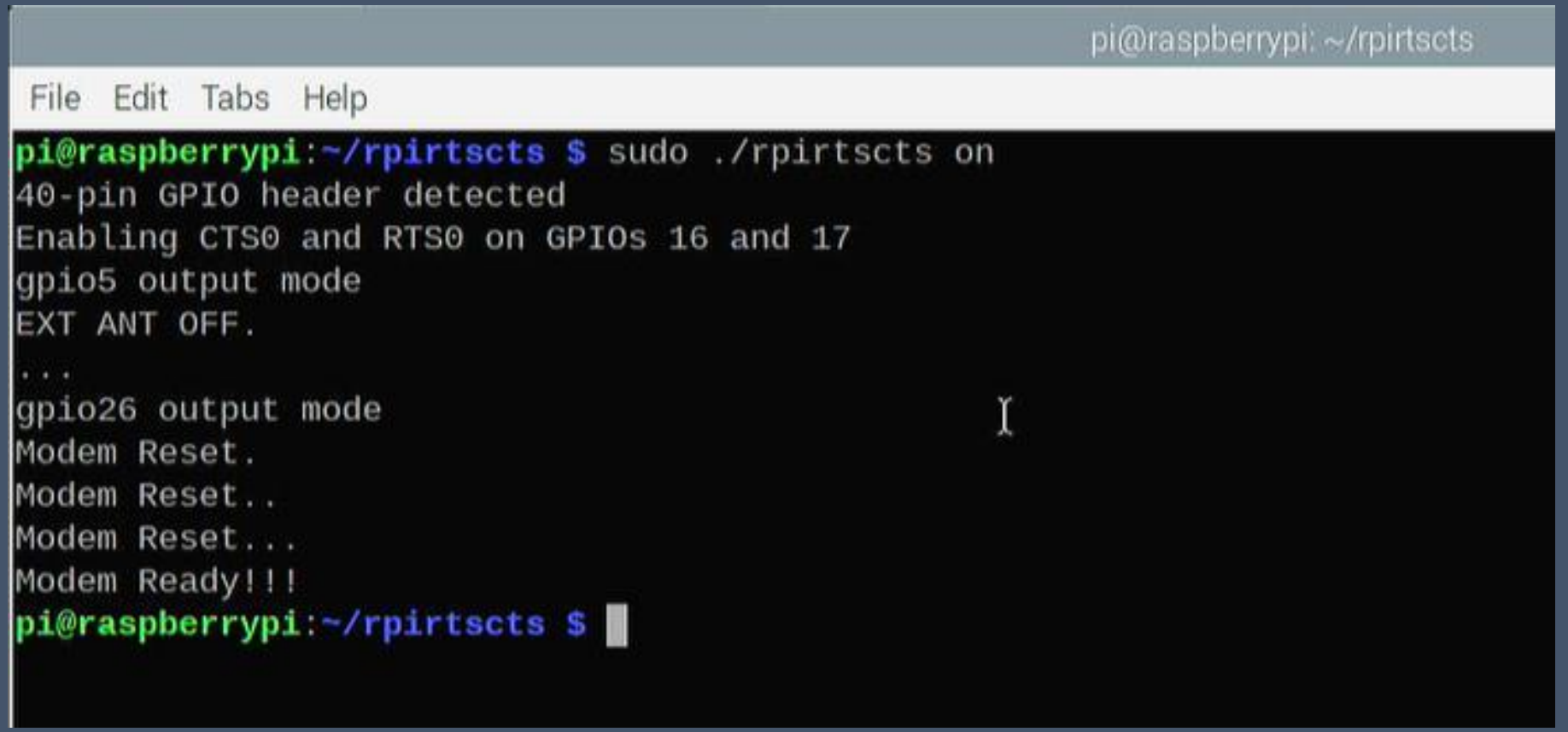
```
File  Edit  Tabs  Help
pi@raspberrypi:~ $ ifconfig
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

pi@raspberrypi:~ $
```

6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

3) 라즈베리파이 모뎀 하드웨어 설정

₩>cd rpirtscts

₩>sudo ./rpirtscts on



6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

4) sudo pon vodafone-Type1SC

```
File  Edit  Tabs  Help
pi@raspberrypi:~/rpirtscts $ sudo pon vodafone-Type1SC
AT
OK
AT%APNN="simplio.apn"
OK
ATD*99***1#
CONNECT
Script /usr/sbin/chat -v -f /etc/ppp/peers/vodafone-Type1SC-chat finished (pid 1012), status = 0x0
Serial connection established.
using channel 1
Using interface ppp0
Connect: ppp0 <--> /dev/ttyS0
sent [LCP ConfReq id=0x1 <asyncmap 0x0> <magic 0xd46b190c> <pcomp> <accomp>]
rcvd [LCP ConfAck id=0x1 <asyncmap 0x0> <magic 0xd46b190c> <pcomp> <accomp>]
sent [LCP ConfReq id=0x1 <asyncmap 0x0> <magic 0xd46b190c> <pcomp> <accomp>]
rcvd [LCP ConfAck id=0x1 <asyncmap 0x0> <magic 0xd46b190c> <pcomp> <accomp>]
rcvd [LCP ConfReq id=0x1 <mru 1428> <asyncmap 0x0> <magic 0x4a5efa87> <pcomp> <accomp>]
sent [LCP ConfAck id=0x1 <mru 1428> <asyncmap 0x0> <magic 0x4a5efa87> <pcomp> <accomp>]
sent [LCP EchoReq id=0x0 magic=0xd46b190c]
sent [CCP ConfReq id=0x1 <deflate 15> <deflate(old#) 15> <bsd v1 15>]
sent [IPCP ConfReq id=0x1 <compress VJ 0f 01> <addr 0.0.0.0> <ms-dns1 0.0.0.0> <ms-dns2 0.0.0.0>]
rcvd [LCP EchoRep id=0x0 magic=0x4a5efa87]
rcvd [IPCP ConfReq id=0x1 <compress VJ 0f 01> <addr 10.0.0.1> <ms-dns1 10.105.16.254> <ms-dns2 10.105.144.254>]
sent [IPCP ConfRej id=0x1 <ms-dns1 10.105.16.254> <ms-dns2 10.105.144.254>]
rcvd [IPV6CP ConfReq id=0x1]
Unsupported protocol 'IPv6 Control Protocol' (0x8057) received
sent [LCP ProtRej id=0x2 80 57 01 01 00 04]
rcvd [CCP ConfReq id=0x1]
sent [CCP ConfAck id=0x1]
rcvd [CCP ConfRej id=0x1 <deflate 15> <deflate(old#) 15> <bsd v1 15>]
sent [CCP ConfReq id=0x2]
rcvd [IPCP ConfNak id=0x1 <addr 10.1.65.22> <ms-dns1 10.105.16.254> <ms-dns2 10.105.144.254>]
sent [IPCP ConfReq id=0x2 <compress VJ 0f 01> <addr 10.1.65.22> <ms-dns1 10.105.16.254> <ms-dns2 10.105.144.254>]
rcvd [IPCP ConfReq id=0x2 <compress VJ 0f 01> <addr 10.0.0.1>]
sent [IPCP ConfAck id=0x2 <compress VJ 0f 01> <addr 10.0.0.1>]
rcvd [CCP ConfAck id=0x2]
rcvd [IPCP ConfAck id=0x2 <compress VJ 0f 01> <addr 10.1.65.22> <ms-dns1 10.105.16.254> <ms-dns2 10.105.144.254>]
not replacing default route to wlan0 [192.168.0.1]
local  IP address 10.1.65.22
remote IP address 10.0.0.1
primary   DNS address 10.105.16.254
secondary DNS address 10.105.144.254
```

CATM1 모뎀이 IP를 획득 했는지 확인

6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

5) ifconfig 실행하여 ppp0 Network Device 확인

```
pi@raspberrypi:~/rpirtscts $ ifconfig
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ppp0: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST>  mtu 1428
        inet 10.1.66.212  netmask 255.255.255.255  destination 10.0.0.1
        ppp  txqueuelen 3  (Point-to-Point Protocol)
        RX packets 12  bytes 526 (526.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 11  bytes 397 (397.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

pi@raspberrypi:~/rpirtscts $
```

6. CAT.M1 PPP 동작 테스트 (실제 사용 테스트)

6) nameserver 설정

₩>sudo sh -c 'echo "nameserver 8.8.8.8">>/etc/resolv.conf'

```
sudo sh -c 'echo "nameserver 8.8.8.8">>/etc/resolv.conf'
```

7. CAT.M1 PPP 동작 확인

1) 핑 테스트 10회

ping –c 10 www.google.com

```
pi@raspberrypi:~/rpirtscts $ ping -c 10 www.google.com
PING www.google.com (172.217.168.196) 56(84) bytes of data.
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=1 ttl=51 time=426 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=2 ttl=51 time=463 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=3 ttl=51 time=436 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=4 ttl=109 time=464 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=5 ttl=50 time=434 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=6 ttl=50 time=487 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=7 ttl=50 time=444 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=8 ttl=108 time=463 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=9 ttl=51 time=435 ms
64 bytes from ams16s32-in-f4.1e100.net (172.217.168.196): icmp_seq=10 ttl=51 time=465 ms

--- www.google.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 1005ms
rtt min/avg/max/mdev = 426.461/451.488/486.749/18.280 ms
pi@raspberrypi:~/rpirtscts $
```

7. CAT.M1 PPP 동작 확인

2) 파이썬 소켓 테스트 코드로 통신 테스트

₩>cd rpirtscts

₩>python3 ./python_echo_client.py

```
pi@raspberrypi:~/rpirtscts $ python3 ./python_echo_client.py
connecting to echo.mbedcloudtesting.comport 7
sending b'This is the message. It will be repeated.'
received b'This is the mess'
received b'age. It will be '
received b'repeated.'
closing socket
pi@raspberrypi:~/rpirtscts $
```

pi@raspberrypi: ~/work/python_echo_client

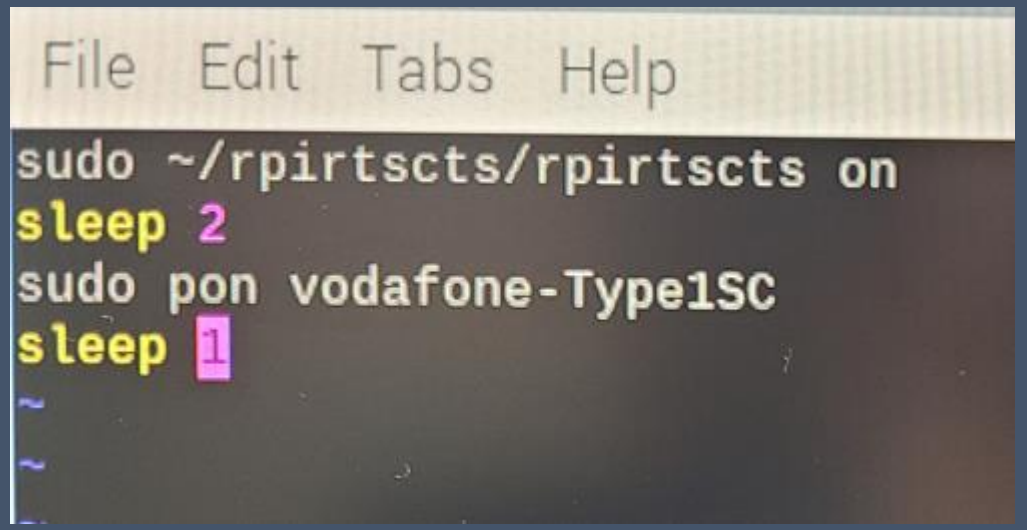
File Edit Tabs Help

pi@raspberr... pi@raspberr... pi@raspberr...

```
import socket
import sys

#Create a TCP/IP socket
sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

#Connect the socket to the port where the server is listening
server_address = ('echo.mbedcloudtesting.com', 7)
print('connecting to {}port {}'.format(*server_address))
sock.connect(server_address)

try:

    #Send data
    message = b'This is the message. It will be repeated.'
    print('sending {!r}'.format(message))
    sock.sendall(message)

    #Look for the response
    amount_received = 0
    amount_expected = len(message)

    while amount_received < amount_expected:
        data = sock.recv(16)
        amount_received += len(data)
        print('received {!r}'.format(data))

finally:
    print('closing socket')
    sock.close()
~
~
                                                    33,0-1        Bot
```

8. CAT.M1 PPP 모뎀, 라즈베리파이 부팅 후 자동 등록

1) bash_profile 스크립트 작성
₩>vi ~/.bash_profile
sudo ~/rpirtscts/rpirtscts on
sleep 2
sudo pon vodafone-Type1SC
sleep 1



2) bash_profile 스크립트 복사
₩>sudo cp -rf ~/.bash_profile /root/

3) 재부팅 후 자동으로 PPP모뎀이 연결된 것을 확인 할 수 있습니다.
₩>sudo reboot

```
pi@raspberrypi:~/rpirtscts $ ifconfig
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ppp0: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST>  mtu 1428
        inet 10.1.66.212  netmask 255.255.255.255  destination 10.0.0.1
        ppp  txqueuelen 3  (Point-to-Point Protocol)
        RX packets 12  bytes 526 (526.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 11  bytes 397 (397.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

pi@raspberrypi:~/rpirtscts $
```

FAQ. Ping Test 안될때

```
jbmaster@raspberrypi:~ $ ping www.google.com -c 10
ping: www.google.com: Temporary failure in name resolution
jbmaster@raspberrypi:~ $ sudo sh -c 'echo "nameserver 8.8.8.8">>/etc/resolv.conf
'
```

1) ping 테스트 할때 Temporary failure in name resolution 출력되고 테스트 진행이 되지 않으면 아래와 같이 nameserver를 다시 지정 합니다.

₩>sudo sh -c 'echo "nameserver 8.8.8.8">>/etc/resolv.conf'

- 끝 -

감사합니다.