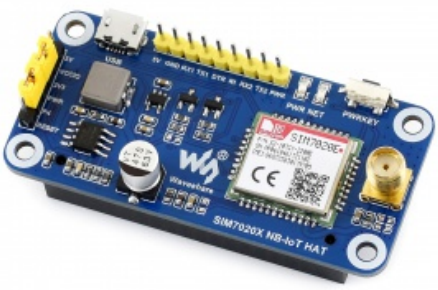
SIM7020E NB-IoT HAT

From Waveshare Wiki

Introduction

NB-IoT HAT for Raspberry Pi, Based on SIM7020E

More (http://www.waveshare.com/SIM7020E-NB-IoT-HAT.htm)



Primary Attribute

Category: Modules, NB-IoT, GPS/GSM, Raspberry Pi

Brand: Waveshare

Website

International: Waveshare website (http://www.waveshare.com/SIM7020E-NB-IoT-HAT.htm)

Chinese: 官方中文站点 (http://www.waveshare.net/shop/SIM7020E-NB-IoT-HAT.htm)

Onboard Interfaces

RPi	UART

Related Products

- L76X GPS HAT
- L76X GPS Module
- UART GPS NEO-7M-C (B)
- UART GPS NEO-7M-C
- UART GPS NEO-6M (B)
- UART GPS NEO-6M-C
- UART GPS NEO-6M
- NEO-7M-C
- NEO-6M-C
- NEO-M8T GNSS TIMING HAT
- MAX-7Q GNSS HAT
- MAX-M8Q GNSS HAT
- [Retired] NEO-6M
- GSM/GPRS/GPS Shield (B)
- GSM/GPRS/GNSS HAT
- SIM800C GSM/GPRS HAT
- SIM8200EA-M2 5G HAT
- SIM8202G-M2 5G HAT
- SIM7000E NB-IoT HAT
- **SIM7020E NB-IoT HAT**
- SIM7080G Cat-M/NB-IoT HAT

User Manual

Overview

This is an NB-IoT (NarrowBand-Internet of Things) HAT for Raspberry Pi, controlled via serial AT commands, supports communication protocols like LWM2M/COAP/MQTT, etc. Due to the advantages of low delay, low power, low cost, and wide coverage, it is the ideal choice for IoT applications such as intelligent instruments, asset tracking, remote monitoring, and so on.

Features

- Raspberry Pi connectivity, compatible with any revision
- Supports communication protocols such as LWM2M/COAP/MQTT/TCP/UDP/HTTP/HTTPS, etc.
- Onboard USB interface, for power supply OR debugging
- Breakout UART control pins, to connect with host boards like Arduino/STM32
- Onboard voltage translator, 3.3V by default, allows to be switched to 5V via onboard jumper
- SIM card slot, supports NB-IoT specific card
- 2x LED indicators, easy to monitor the working status
- Baudrate: 300bps~921600bps (115200bps by default)
- Control via AT commands (V.25TER, 3GPP TS 27.007, and SIMCOM AT Commands)
- Comes with development resources and manual (examples for Raspberry Pi/Arduino/STM32/Python)

Specification

Communication

- Band
  - FDD-LTE B1/B3/B5/B8/B20/B28
- Data rate
  - Uplink≤62.5Kbps
  - Downlink≤26.15Kbps
- SMS
  - Text mode and PDU mode (depends on the NB card)

General

- Power supply: 5V

- Logic level: 5V/3.3V (3.3V by default)
- Overall current (idle mode): ~18mA
  - Single module current (VBAT=3.3V):
  - Idle mode: 5.6mA
  - Sleep mode: 0.4mA
  - PSM mode: 5uA
  - eDRX mode: 70uA (eDRX=655.36s)
- Dimension: 30.5mm x 65.0mm

- SIM7600CE-T 4G HAT
- SIM7600E-H 4G HAT
- SIM7600A-H 4G HAT
- SIM7600G-H 4G HAT
- SIM7600CE-CNSE 4G DTU
- [Retired] GSM/GPRS/GPS Shield

Interfaces

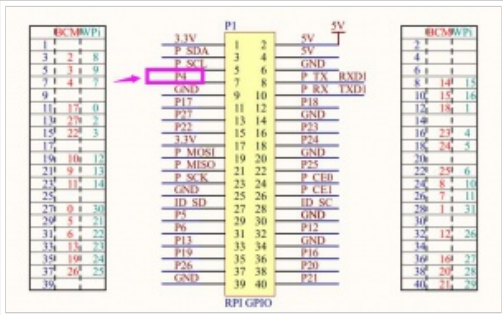
PIN	Description
5V	5V power inut
GND	Ground
RX1	Data receive of Serial port 1
TX1	Data send of Serial port 1
DTR	Sleep Control, High: Sleep; Low: Wake up (need to be set with "AT+CSCLK=1")
RI	Interrupt PIN, High by default. It becomes Low (120ms) when message received or URC reported) (need to be set with "AT+CFGRI=1")
RX2	Data receive of Serial port 2
TX2	Data send of Serial port 2
PWR	Power control
RESET	Reset

Jumpers

Jumpers	Descriptions
VCCIO	Set the operating voltage to 3.3V or 5V
PWR	Set the power control, set to controllable by P4 (BCM) pin of Raspberry Pi by default

Indicators

LEDs	Descriptions
PWR	On: The module is powered on
NET	On(64ms)&OFF(800ms): Internet isn't registered On(64ms)&OFF(3000ms): Internet is registered On(64ms)&OFF(300ms): Data are transmitting OFF: Power off or PSM Sleep Mode



Raspberry Pi 40PIN GPIO

Working with Windows PC

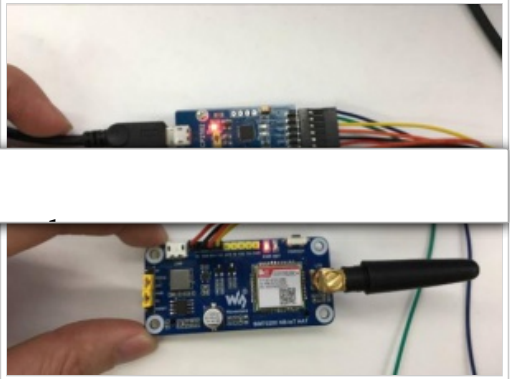
Hardware connection

The external components required:

- A special sim card which supported NB-IoT
- A USB to TTL module (Recommend CP2102 USB to UART Module (https://www.waveshare.com/cp2102-usb-uart-board-micro.htm))

Connection:

1. Insert sim card to the backside card slot, connect LTE antenna (The **LTE antenna** must be rotated to the outside of the board)
2. Connect CP2102 module to UART1 (or UART2) of SIM7020E NB-IoT HAT(SIM7020 hereafter), and connect to your PC by USB cable
3. Power on SIM7020. （PWR:On ; NET: OFF）
4. Press PWRKEY buttons for about 1s (NET: Blinking)
5. Download the serial assistance software and open it. Set it 115200 8N1, and check the newline options
6. Click Extend to get the pre-configure commands. Testing



Hardware connection

Quick testing

Herein we list some common commands which can be used to quick test the SIM7020.

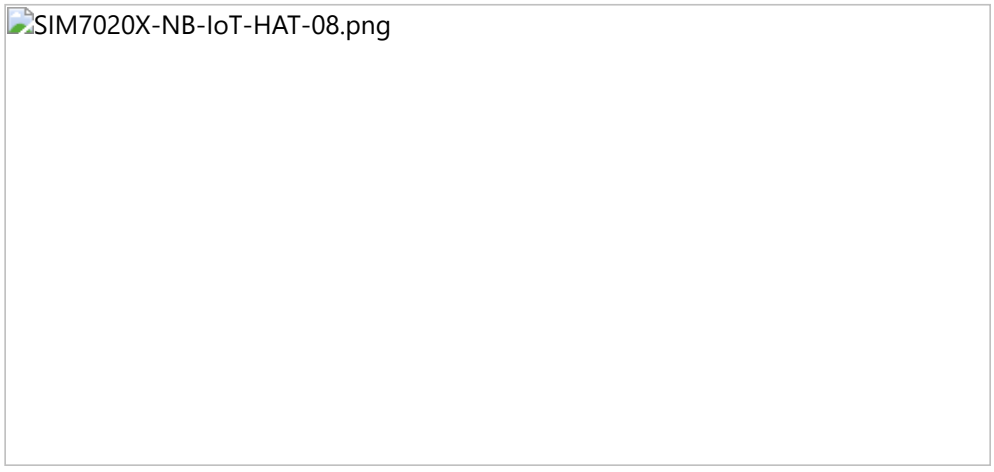
Command	Description	Return
AT	Check module status	OK
ATE	ATE1:Echo Mode On; ATE0: Echo Mode Off	OK
AT+CSQ	Check Internet Signals Quality	OK
AT+CGMR	Check Firmware Version	OK
AT+CGREG?	Check Internet register status	OK
AT+CGACT?	Check PDP status	OK
AT+COPS?	Check Internet Information	OK
AT+CGCONTRDP	Check Internet status	OK
AT+CFUN=0	Turn off RF	OK
AT*MCGDEFCONT	Set APN, e,g: AT*MCGDEFCONT="IP","3GNET"	OK
AT+CFUN=1	Turn On RF	OK

```
AT
OK
AT+CPIN?
+CPIN: READY

OK
AT+CSQ
+CSQ: 20,0

OK
AT+CGREG?
+CGREG: 0,2

OK
AT+CGREG?
+CGREG: 0,1

OK
AT+CGACT?
+CGACT: 1,1

OK
AT+COPS?
+COPS: 0,2,"46000",9

OK
AT+CGCONTRDP
+CGCONTRDP: 1,5,"3GNET","100.90.251.126.255.255.255.0"

OK
AT+CFUN=0
+CPIN: NOT READY

OK
AT*MCGDEFCONT="IP","3GNET"
OK
AT+CFUN=1
OK

+CPIN: READY
AT+CGMR
1752B07SIM7020C

OK
AT+CPIN?
+CPIN: READY

OK
AT+CSQ
+CSQ: 20,0

OK
AT+CGREG?
+CGREG: 0,2

OK
AT+CGREG?
+CGREG: 0,2

OK
AT+CGREG?
+CGREG: 0,1

OK
AT+CGACT?
+CGACT: 1,1

OK
```

TCP/IP Communication

SIM7020 cannot support transparent and server mode.

TCP/IP of SIM7020 is multiple client structure, supports up to 5 sockets (like TCP or UDP)

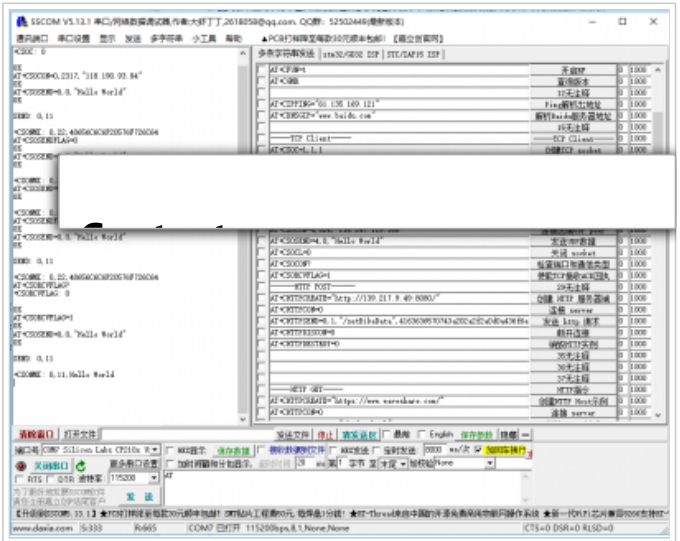


Connect modules and test network connection by following instruction above before TCP/IP communicating.

For more information about TCP, UDP, DNS, etc. Please refer to SIM7020 Series_TCPIP_Application_Note

【TCP Client】

Commands	Description	Return
AT+CSOC=1,1,1	Create TCP socket, <socket_id>=0	OK
AT+CSOCON=0,2317,"118.190.93.84"	Connect to remote server	OK
AT+CSOSEND=0,0,"Hello World"	Send data	OK
AT+CSOCL=0	Close socket	OK
AT+CSOSENDFLAG	Enable Send ACK	OK
AT+CSORCVFLAG	Enable receive ACK	OK
AT+CSOCON?	Check communication port and type	OK



TCP client commands

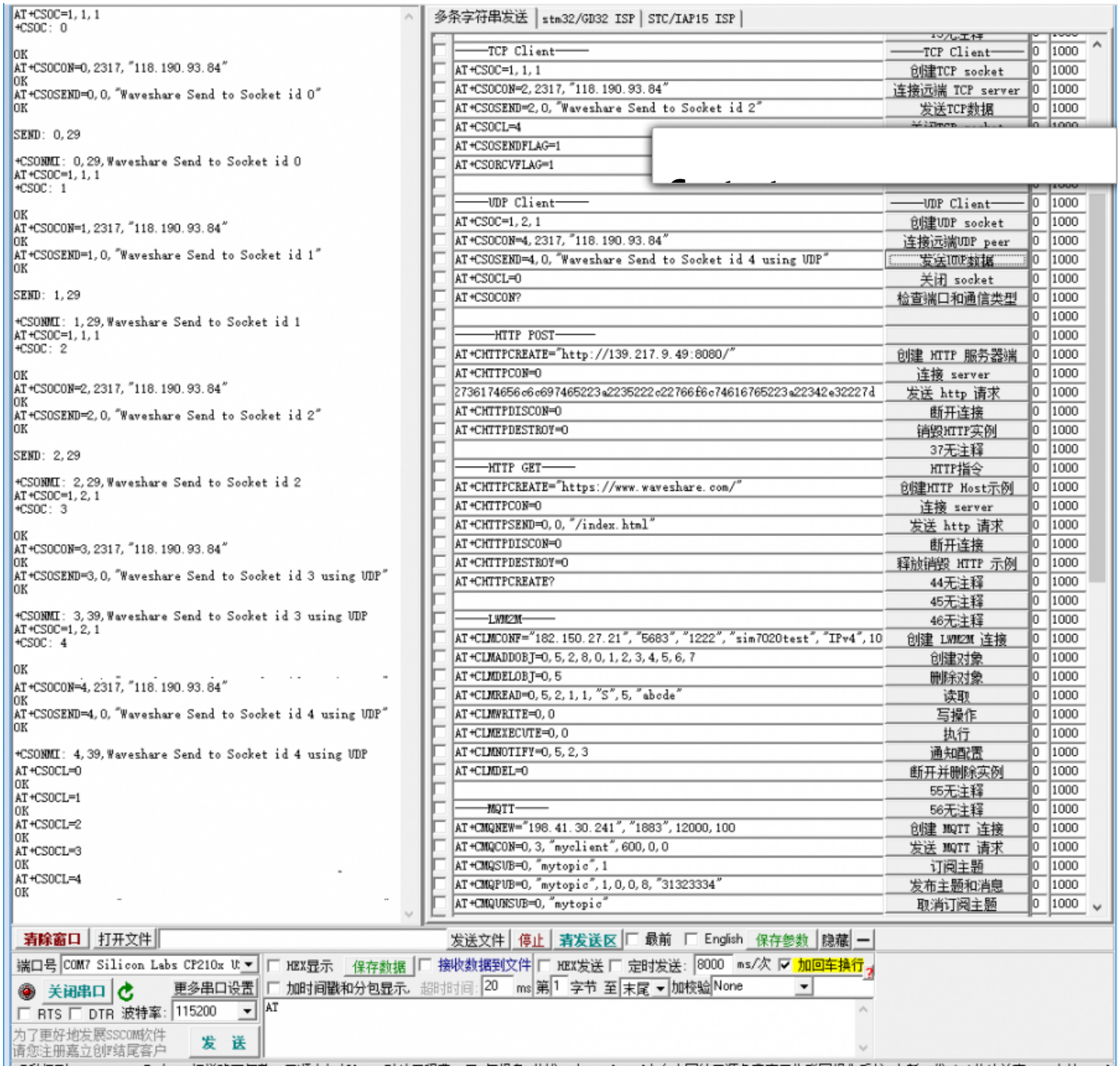
【UDP Client】

Commands	Descriptions	Return
AT+CSOC=1,2,1	Create UDP socket, <socket_id>=0	OK
AT+CSOCON=4,524,"116.247.119.165"	Connect remote server	
AT+CSOSEND=4,0,"Waveshare"	Send data	OK
AT+CSOCL=0	Close socket	OK
AT+CSOSENDFLAG	Enable send ACK	OK
AT+CSORCVFLAG	Enable receive ACK	OK
AT+CSOCON?	Check communication port and types	OK

UDP client commands

【Multiple Scokets】

The image below shows you how to create five sockets communication at the same time using one SIM7020. Please refer to Commands of 【TCP Client】【UDP Client】



【DNS and Ping】

Functions of DNS and Ping are only available when network is acceasble

Commands	Description	Return
AT+CIPPING	Ping commands. e.g. AT+CIPPING="61.135.169.121"	OK
AT+CDNSGIP	DNS, e.g. AT+CDNSGIP="www.baidu.com"	OK

```
AT+CIPPING="61.135.169.121"
OK
+CIPPING: 1,61.135.169.121,13,53
+CIPPING: 2,61.135.169.121,11,53
+CIPPING: 3,61.135.169.121,10,53
+CIPPING: 4,61.135.169.121,13,53
```

```
AT+CDNSGIP="www.baidu.com"
OK

+CDNSGIP: 1,"www.baidu.com","111.13.100.91"
```

HTTP

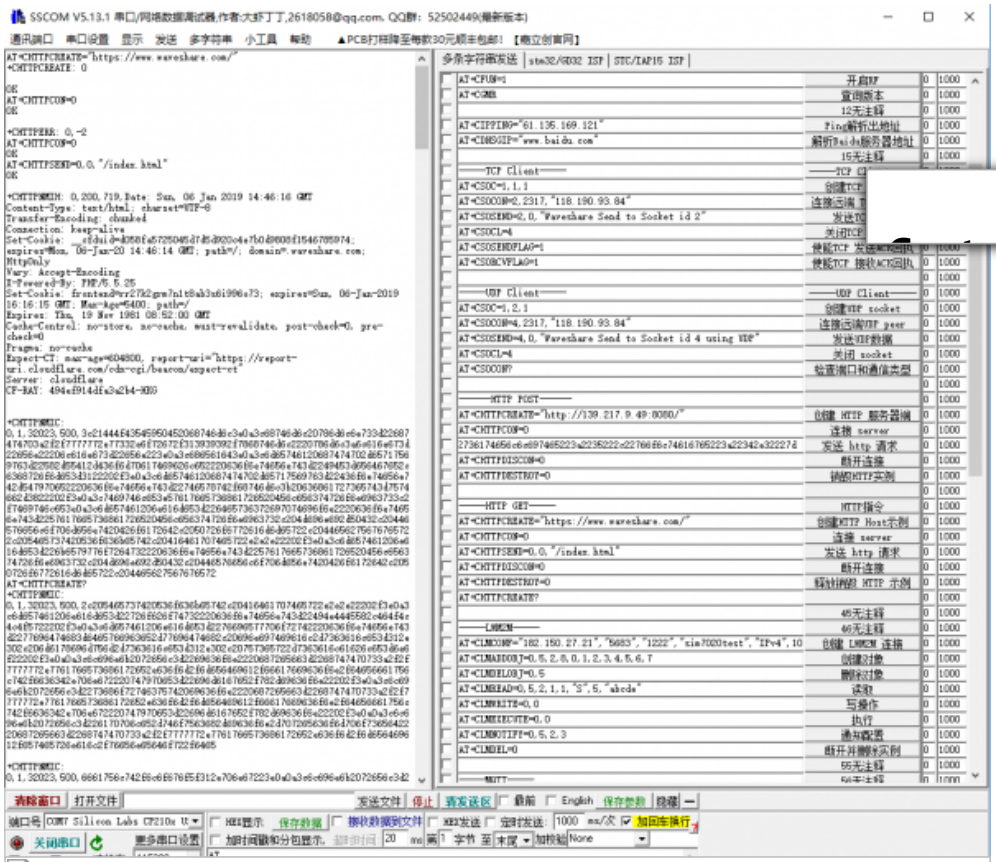
SIM7020 supports two types of HTTP communicating, HTTP GET and HTTP POST

For more information about AT commands of HTTP communication, please refer to SIM7020 Series_HTTP_Application_Note

【HTTP GET】

Commands	Description	Return
AT+CHTTPCREATE="https://www.waveshare.com/"	Create HTTP Host example	OK
AT+CHTTPCON=0	Connect to server	OK
AT+CHTTPSEND=0,0,"/index.html"	Send HTTP Request	OK
AT+CHTTPDISCON=0	Disconnect	OK
AT+CHTTPDESTROY=0	Release and clear HTTP example	OK
AT+CHTTPCREATE?	Check HTTP connecting status	OK

Note: Request time is a little long because of NB-IoT network when testing HTTP commands, please be patient.



SIM7020X-NB-IoT-HAT-15.png

MQTT

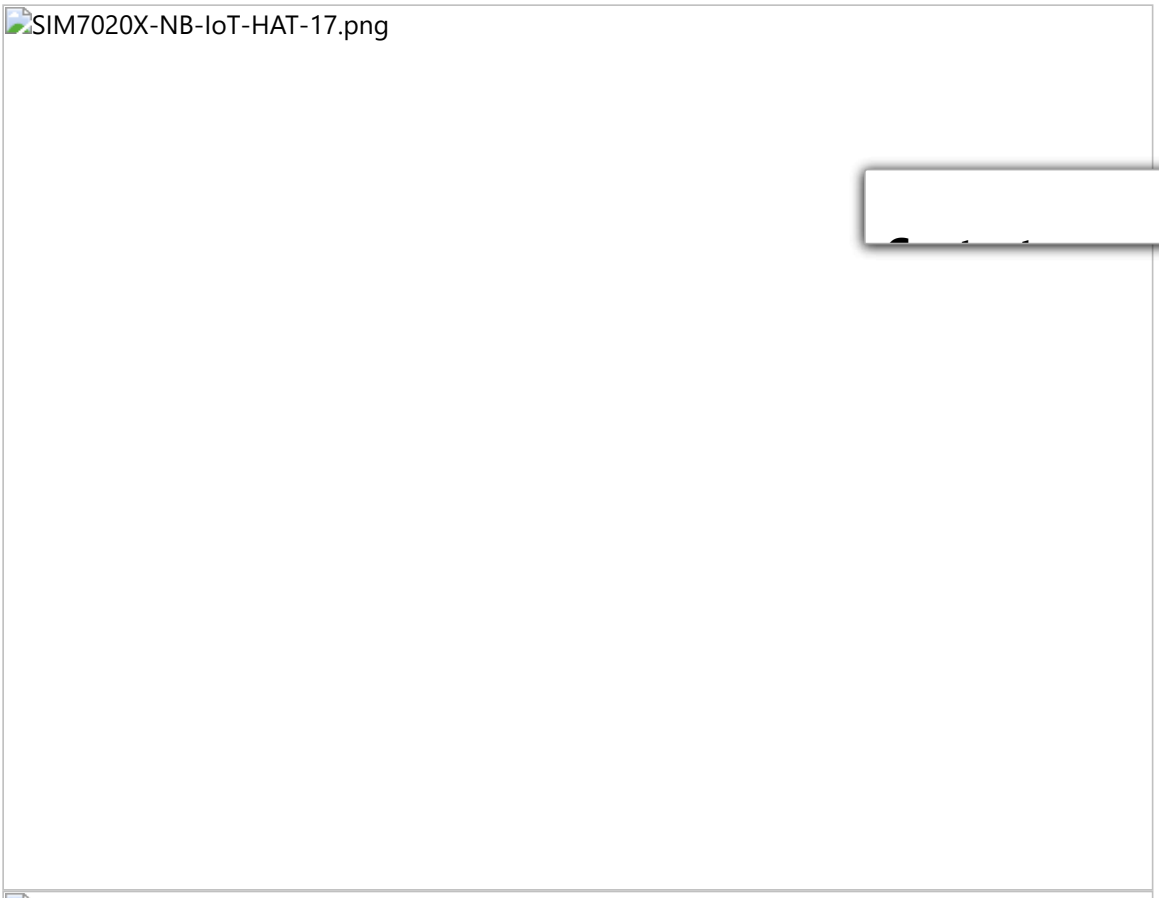
For more information about MQTT, please refer to SIM7020 Series_MQTT_Application_Note

【Subscribe and send message】

Herein show you how use MQTT by using MQTT test tool which is found online

Command	Description	Description	Return
AT+CMQNEW="198.41.30.241","1883",12000,100	Create MQTT connection	OK	
AT+CMQCON=0,3,"myclient",600,0,0	Send MQTT request		
AT+CMQSUB=0,"mytopic",1	Subscribe		
AT+CMQPUB=0,"mytopic",1,0,0,8,"31323334"	Publish theme and message	OK	
AT+CMQUNSUB=0,"mytopic"	Unsubscirbe	OK	
AT+CMQDISCON=0	Disconnect MQTT	OK	

Note: Request time is a little long because of NB-IoT network when testing HTTP commands, please be patient.



Working with Raspberry Pi

SIM7020X NB-IoT HAT is compatible with Raspberry Pi 40PIN GPIO, can directly plug to most types of Raspberry Pi. The used pins are as below:

SIM7020X NB-IoT HAT	Raspberry Pi
5V	5V
GND	GND
RXD	TXD (BCM:P14)
TXD	RXD(BCM: P15)
PWR	P7 (BCM: P4)

Software Setting

PWR is default shorted with P4 by jumpers. You need to initialize corresponding pins for properly working.

- Download demo code, copy SIM7020x folder to /home/pi/ of your Raspberry Pi
- Open Terminal, and execute:

```
chmod 777 sim7020_nbiot_hat_init
```

- Set script auto-executing:
  - Modify rc.local file:

```
sudo nano /etc/rc.local
```

  - Add the line in front of exit 1 as below

```
sh /home/pi/SIM7020X/sim7020_nbiot_hat_init
```

Serial Setting

To work with Raspberry Pi, you need to enable hardware serial and disable serial login shell function.

- Enter raspi-configure

```
sudo raspi-config
```

- Choose Interfacing Options->Serial->no->yes
- Open /boot/config.txt file, check if the line was added:

```
enable_uart=1
```

- Reboot

Testing with minicom

Connect SIM7020 to Raspbery Pi, install minicom to your Raspberry Pi:

```
sudo apt-get install minicom
```

Execute minicom -D /dev/ttyS0 to enter the minicom (ttyS0: Pi 3B/3B+, ttyAMA0: Zero/2B)

Demo codes

Download demo codes. Rename bcm2835 folder to SIM7020X and copy it to /home/pi of Raspberry Pi

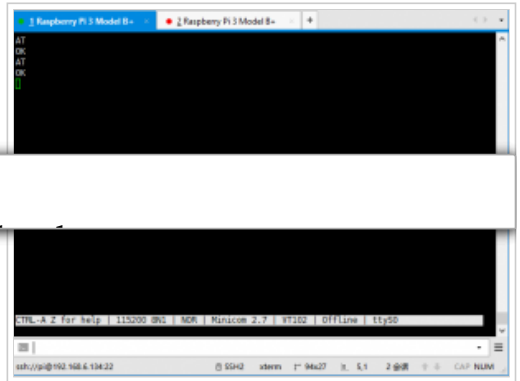
【Install BCM2835 libraries】

Enter SIM7020X/bcm2835 directory, install the libraries with commands:

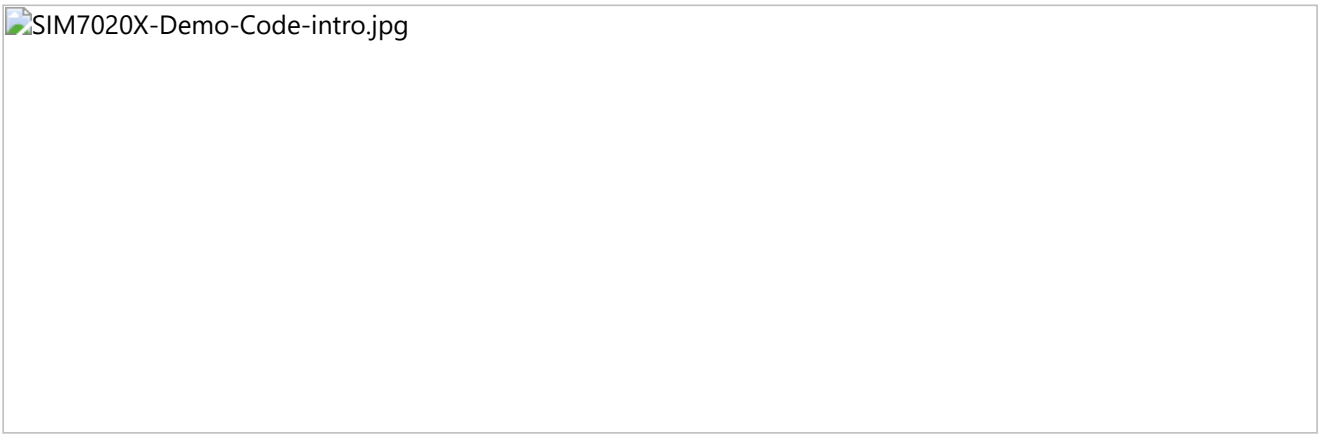
```
chmod +x configure && ./configure && sudo make check && sudo make install
```

【Compile and run】

The files tree:



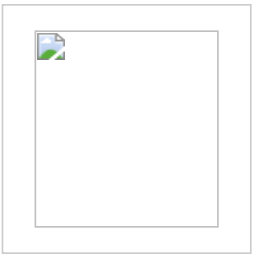
minicom debugging




```
cd /home/pi/SIM7020X/examples/AT
sudo make clean && sudo make && sudo ./main
```

Expectre result:

AT



TCP

UDP

Working with STM32

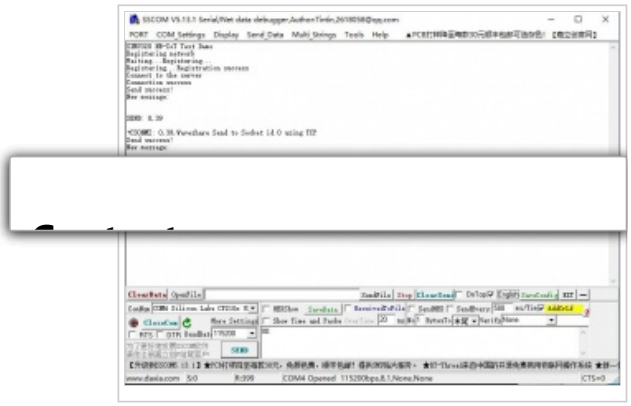
SIM7020X NB-IoT HAT is compatible with STM32 MCU. The used pins are as below （Waveshare Open103V STM32F103V）:

SIM7020X NB-IoT HAT	STM32F103V
5V	5V
GND	GND
RXD	PA2 (对应USART2的TX)
TXD	PA3 (对应USART2的RX)

Coming soon...

Resources

- Schematic
- Source code



Tools

- sscom (with SIM7020 AT commands)
- MQTT test tool

SIM7020 Datasheets

- SIM7020E_SPEC_EN_190424.pdf
- File:SIM7020 Series_AT Command Manual_V1.03.pdf
- File:SIM7020G Hardware Design_V1.00.pdf
- File:SIM7020 Series MQTT Application Note.pdf
- File:SIM7020 Series_MQTT(S)_Application Note_V1.03.pdf
- File:SIM7020 Series_MQTT(S)_Application Note_V1.05.pdf
- File:SIM7020 Series_CoAP_Application Note_V1.02.pdf
- File:SIM7020 Series_FOTA_Application_Note_V1.01.pdf
- File:SIM7020 Series_HTTP_Application Note_V1.02.pdf
- File:SIM7020 Series_TCPIP_Application_Note_V1.02.pdf
- File:SIM7020 Series_Low Power Mode_Application Note_V1.03.pdf
- File:SIM7020 Series_TLS_Application Note_V1.01.pdf
- File:SIM7020 Series_NVRAM_Application Note_V1.01.pdf
- File:SIM7020 Series_SNTP_Application Note_V1.01.pdf
- More... (https://www.simcom.com/product/SIM7020X.html)

FAQ

Question:

Is possible to change the IMEI ID of SIM7020E?

Answer: [Collapse]

Yes,you can change IMEI ID by sending the at command: AT+SIMEI

See the picture below:

```
AT+CGMR
1752B07SIM7020E

OK
AT+GSN=?
OK
AT+GSN
868333030179705

OK
AT+SIMEI=868333030179704
OK
AT+GSN
868333030179704

OK
AT+SIMEI=868333030179705
OK
AT+GSN
868333030179705

OK
```

Please contact us by Email/Skype/WeChat for technology support.Our response may be delay, you can just leave your questions, we will reply to you as soon as possible in working time.

service@waveshare.com

service@waveshare

09:00 - 18:00 (UTC+8 Monday to Staturday)

Categories: Modules | NB-IoT | GPS/GSM