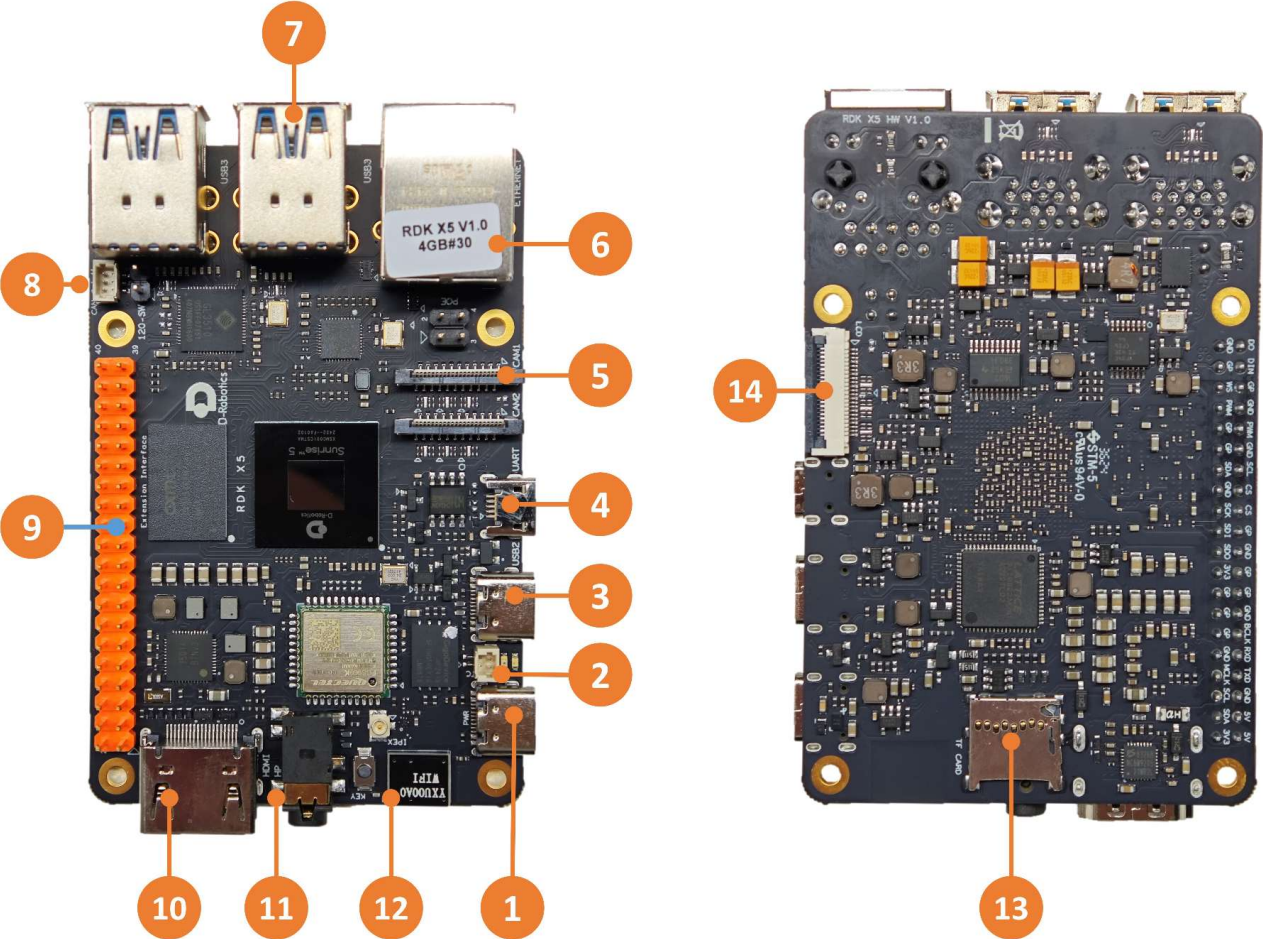# RDK X5 User Manual

Interface Overview

RDK X5 provides interfaces such as Ethernet, USB, camera, LCD, HDMI, CANFD, and 40PIN, facilitating the development and testing of image multimedia and deep learning algorithm applications. The layout of the development board interfaces is as follows:

Number	Function	Number	Function	Number	Function
1	Power Supply Interface (USB Type C)	2	RTC Battery Interface reserve	3	Easy Connection Port (USB Type C Debug Serial Port
4	Debug Serial Port (Micro USB)	5	2 MIPI Camera Interfaces reserve	6	Gigabit Ethernet Port,
7	4 USB 3.0 Type A Interfaces	8	CAN FD High-Speed Interface reserve	9	40PIN Interface reserve

Number	Function	Number	Function	Number	Function
10	HDMI Display Interface	11	Multi-standard Compatible Headphone Interface	12	On-board Wi-Fi Antenna
13	TF Card Interface (Bottom)	14	LCD Display Interface (MIPI DSI) reserve		

Power Supply Interface

The development board provides one USB Type C interface (Interface 1) as the power supply interface, which requires a power adapter supporting **5V/5A** to power the development board. After connecting the power adapter to the development board, the **development board's green power indicator light and orange indicator light turn on**, indicating that the development board is powered normally.

Please do not use the computer's USB interface to power the development board, as this may cause the development board to **abnormally power off, repeatedly restart** due to insufficient power supply.

Debug Serial Port{#debug_uart}

The development board provides one debug serial port (Interface 4) to achieve serial port login and debugging functions. The parameter configuration of the computer's serial port tool is as follows:

- Baud rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

When connecting the serial port, a Micro-USB cable is required to connect Interface 4 of the development board with the PC.

Under normal circumstances, users need to install the CH340 driver on their computer the first time they use this interface. Users can search for the keyword `CH340 serial port driver` to download and install it.

Wired Network Port

The development board provides one gigabit Ethernet interface (Interface 6), supporting 1000BASE-T and 100BASE-T standards, and defaults to static IP mode with the IP address `192.168.127.10`. To confirm the development board's IP address, you can log in to the device via the serial port and use the `ifconfig` command to view the configuration of the `eth0` network port.

HDMI Display Interface{#hdmi_interface}

The development board provides one HDMI (Interface 10) display interface, supporting up to 1080P resolution. The development board outputs the Ubuntu system desktop (Ubuntu Server version displays the logo icon) through the HDMI interface on the monitor. Additionally, the HDMI interface also supports real-time display of camera and network stream images.

USB Display Interface

The development board has implemented multi-channel USB interface expansion through hardware circuits to meet users' needs for multi-channel USB device access, with the following interface descriptions:

Interface Type	Interface Number	Interface Quantity	Interface Description
USB 3.0 Type C	Interface 3	1 channel	USB Device mode, used to connect to the host for ADB, Fastboot, system burning, and other functions
USB 3.0 Type A	Interface 7	4 channels	USB Host mode, used to connect USB 3.0 peripherals

Connecting a USB Flash Drive

The development board's USB Type A interface (Interface 7) supports USB flash drive functionality, can automatically detect the connection of a USB flash drive, and mount it by default, with the default mount directory being `/media/sda1`.

Connecting a USB Serial Port Converter Board

The development board's USB Type A interface (InterfaceHere is the translation of the Chinese parts into English, while retaining the original format and content:

| --- | ------ | ------- | ------- | ------- | | 1 | IMX219 | 800W | | | | 2 | OV5647 | 500W | | |

Camera modules are connected to the development board via FPC cables. Note that the blue side should be facing up when inserting the cable into the connector at both ends.

After installation, users can use the `i2cdetect` command to confirm whether the module's I2C address can be detected normally.

Important note: It is strictly forbidden to plug and unplug the camera while the development board is powered on, as this can easily damage the camera module.

Micro SD Interface

The development board provides one Micro SD card interface (Interface 13). It is recommended to use a storage card with a capacity of at least 8GB to meet the installation requirements of the Ubuntu operating

/

system and related functional packages.

The development board prohibits hot-swapping TF storage cards during use, as this can cause system operation anomalies and even damage the file system of the storage card.

CANFD Interface

The RDK X5 development board provides a CANFD interface, which can be used for CAN and CAN FD communication. For specific information, please refer to the CAN Usage section.

1.2.2 RDK X5

Before using the RDK X5 development board, the following preparations are required.

Flashing Preparation

Power Supply

The RDK X5 development board is powered through the USB Type C interface, and a power adapter supporting **5V/3A** is required to power the development board.

Please do not use the computer's USB interface to power the development board, otherwise, it will cause the development board to **abnormally power off, repeatedly restart** and other abnormal situations due to insufficient power supply.

For more problem handling, you can refer to the Common Questions section.

Storage

The RDK X5 development board uses a Micro SD memory card as the system boot medium, and it is recommended to use a storage card with a capacity of at least 8GB to meet the storage space requirements of the Ubuntu system and application software.

Display

The RDK X5 development board supports the HDMI display interface, and by connecting the development board to the monitor with an HDMI cable, it supports graphical desktop display.

Network Connection

The RDK X5 development board supports both Ethernet and Wi-Fi network interfaces, and users can achieve network connection functionality through either interface.

System Flashing

The RDK suite currently provides an Ubuntu 22.04 system image, which supports Desktop desktop graphical interaction.

RDK X5 Module comes with a pre-flashed test version system image. To ensure the use of the latest version of the system, it is recommended to refer to this document to complete the flashing of the latest version system image.

Image Download {#img_download}

Click **Download Image** to enter the version selection page, select the corresponding version directory, and enter the 3.0.0 version system download page.

After downloading, extract the Ubuntu system image file, such as `ubuntu-preinstalled-desktop-arm64.img`

Version Description:

- Version 3.0: Based on the RDK Linux open source code package, it supports the entire series of hardware such as RDK X5 Pi, X3 modules, etc.

- desktop: Ubuntu system with desktop, which can be operated with an external screen and mouse
- server: Ubuntu system without desktop, which can be operated remotely through serial port or network

System Flashing

Before flashing the Ubuntu system image, the following preparations are needed:

- Prepare a Micro SD card with a capacity of at least 8GB
- SD card reader
- Download the image flashing tool balenaEtcher (can be downloaded here)

balenaEtcher is a PC-side bootable disk creation tool that supports multiple platforms such as Windows/Mac/Linux. The process of creating an SD boot card is as follows:

1. Open the balenaEtcher tool, click the `Flash from file` button, and select the extracted `ubuntu-preinstalled-desktop-arm64.img` file as the flashing image
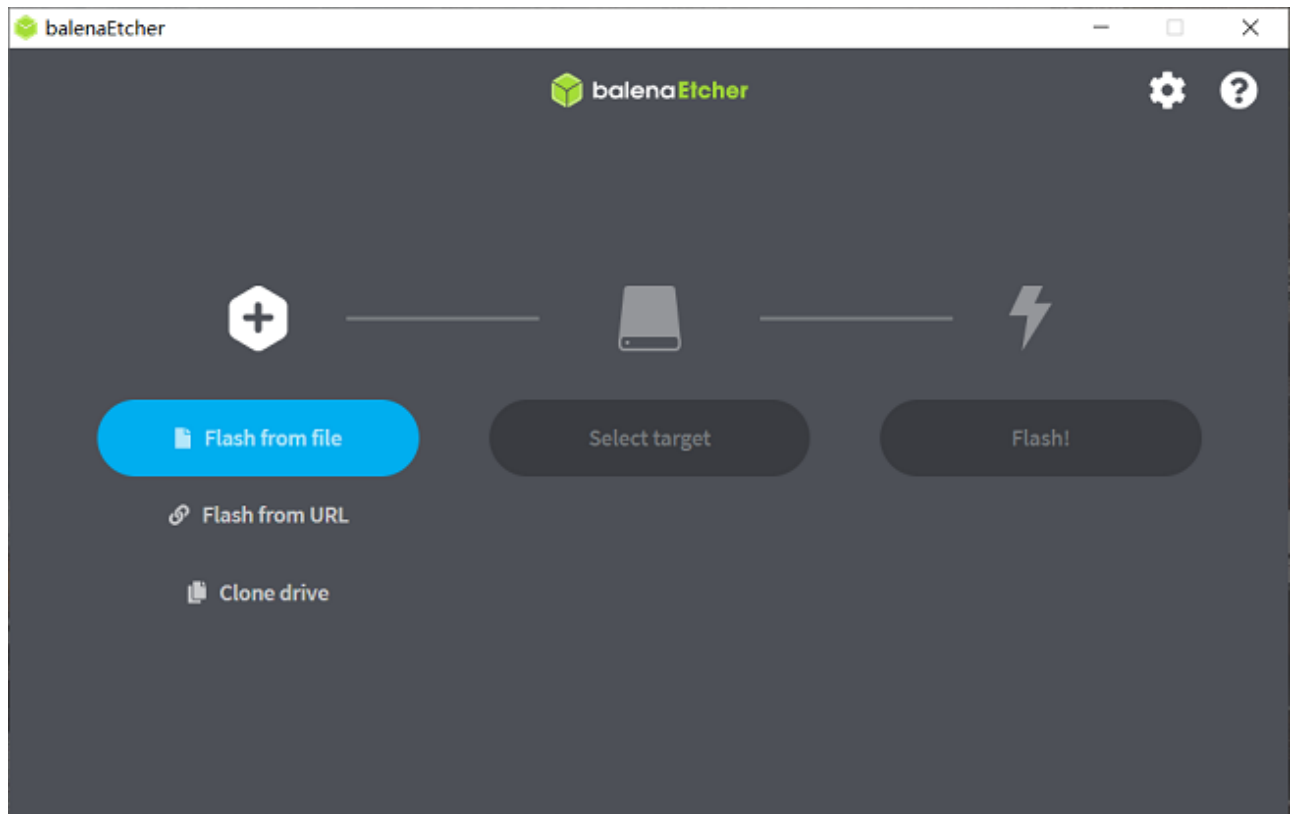
2. Click the `Select target` button, and select the corresponding Micro SD memory card as the target storage device
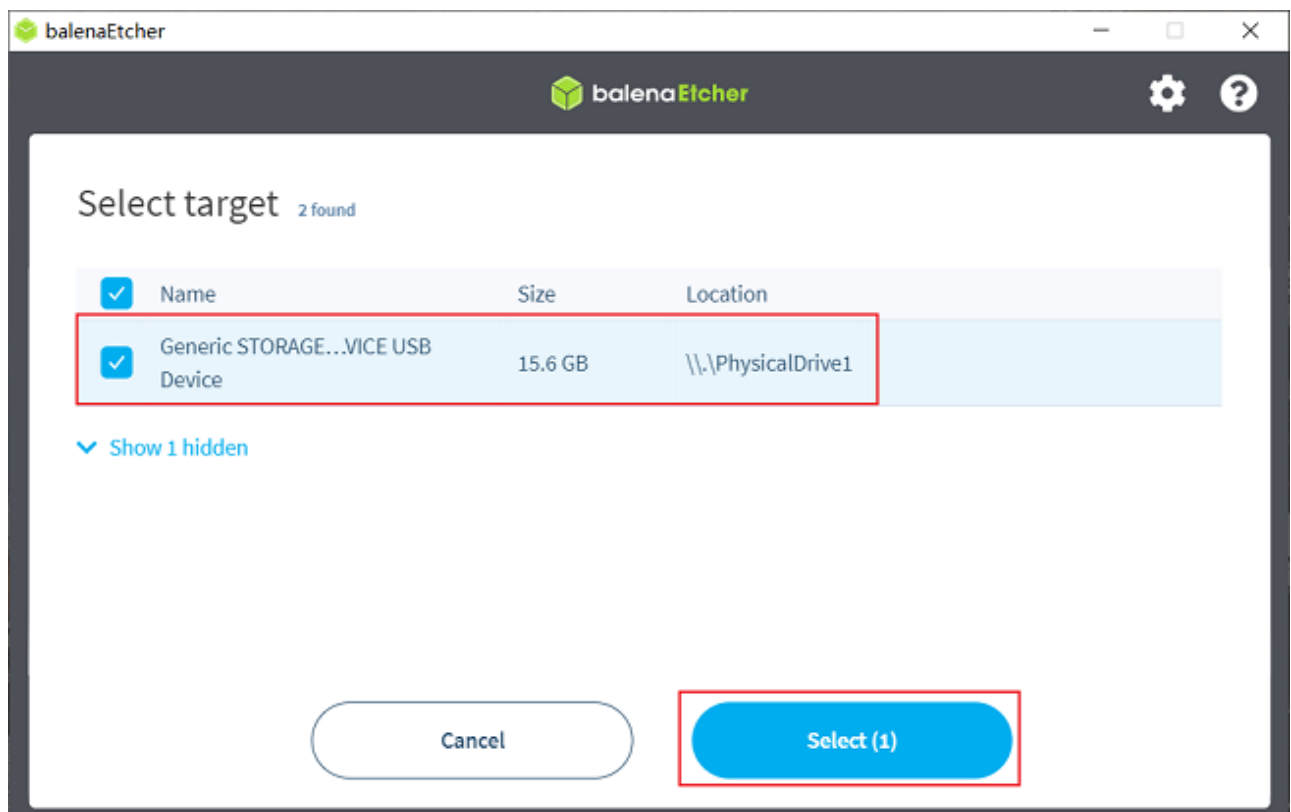
3. Click the `Flash` button to start flashing. When the tool prompts `Flash Complete`, it indicates that the image flashing is complete. You can close balenaEtcher and remove the storage card
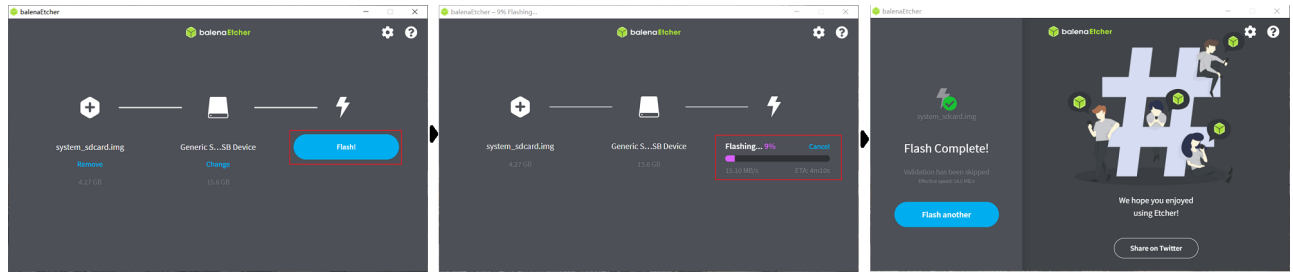
Boot System Please translate the parts in Chinese into English, while retaining the original format and content:

First, ensure the development board is powered off, then insert the prepared memory card into the development board's Micro SD card slot, connect the development board to the display via an HDMI cable, and finally power on the development board.

When the system starts for the first time, it will perform the default environment configuration, which lasts about 45 seconds. After the configuration is complete, the Ubuntu system desktop will be output on the display.

- **Green** Indicator Light: Lit indicates normal power-on of the hardware

If there is no display output after the development board is powered on for a long time (more than 2 minutes), it indicates that the development board has started abnormally. Debugging through a serial cable is required to check if the development board is functioning properly.

After the Ubuntu Desktop version system starts, it will output the system desktop on the display through the HDMI interface, as shown in the following figure:

Common Issues

Common issues when using the development board for the first time are as follows:

- **Power on without booting**: Please ensure to use the recommended adapter for [power supply] (#power supply); please ensure that the development board's Micro SD card has been burned with the Ubuntu system image
- **Hot-swapping memory cards during use**: The development board does not support hot-swapping Micro SD memory cards; if an error occurs, please restart the development board

Precautions

- Do not unplug any devices other than USB, HDMI, and network cables while powered
- The Type C USB interface of RDK X5 is only used for power supply
- Use a regular brand's USB Type C power cable, otherwise, power supply anomalies may occur, leading to abnormal power off issues of the system

For more problem handling, you can refer to the Common Issues section, and you can also visit the D-Robotics Developer Official Forum for help.

sidebar_position: 3

1.3 Getting Started Configuration

The introductory configuration method described in this section is only supported on development boards of the RDK X3, RDK X5, and RDK X3 Module models;

The system version must be at least `2.1.0`.

```
import Tabs from '@theme/Tabs';
import TabItem from '@theme/TabItem';
```

Connecting to Wi-Fi

Use the Wi-Fi management tool in the upper right corner of the menu bar to connect to Wi-Fi. As shown in the figure below, click on the Wi-Fi name you want to connect to, and then enter the Wi-Fi password in the pop-up dialog box.
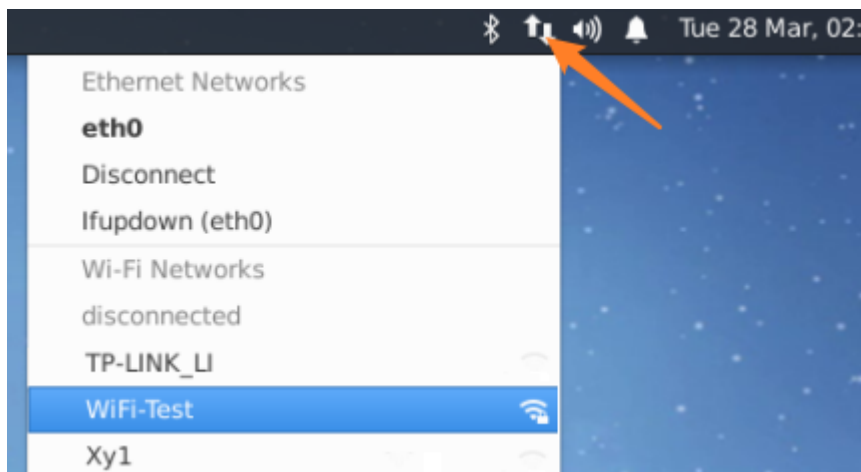
Use the srpi-config tool to connect to Wi-Fi.

Execute the `sudo srpi-config` command, select System Options -> Wireless LAN, and enter the Wi-Fi name (SSID) and password (passwd) as prompted.
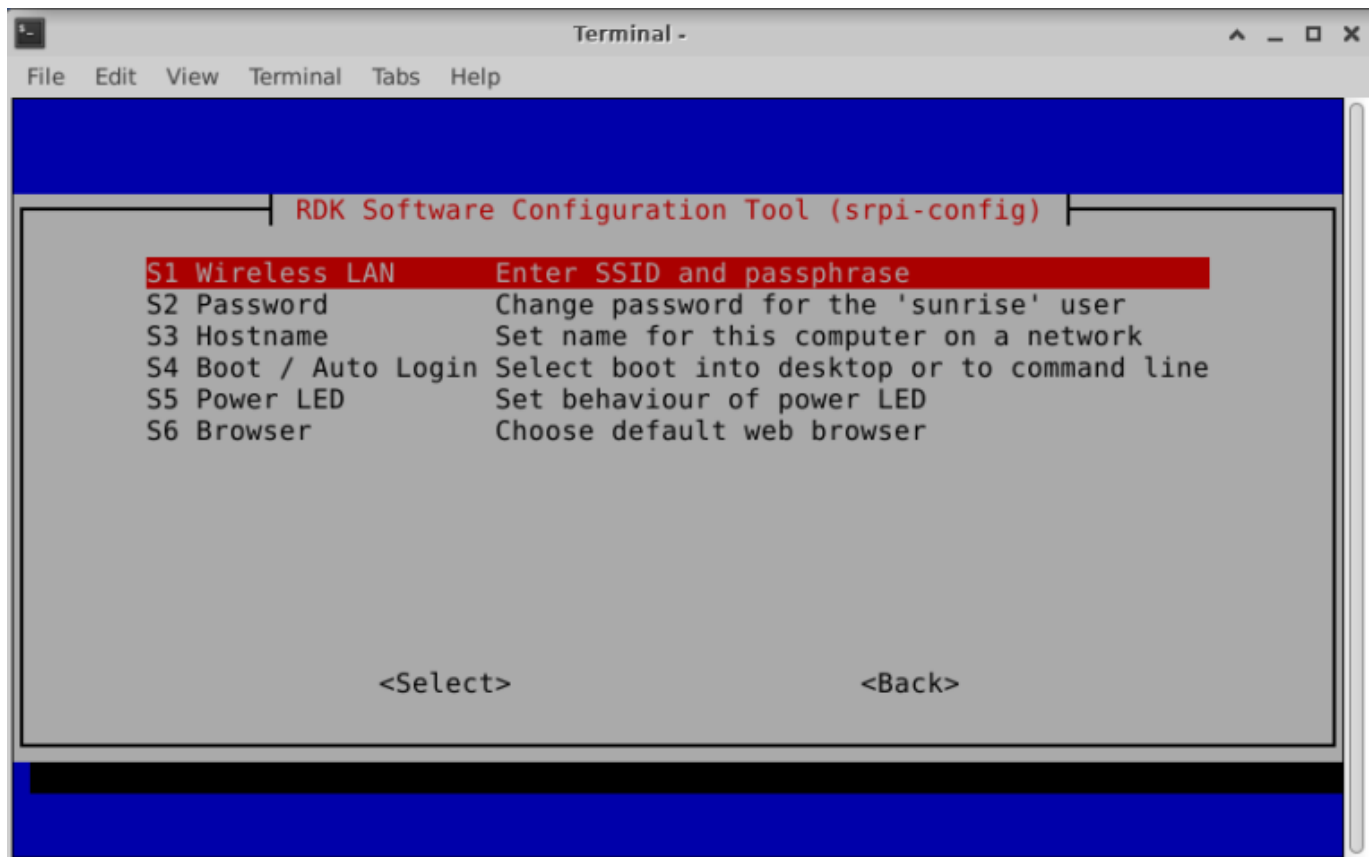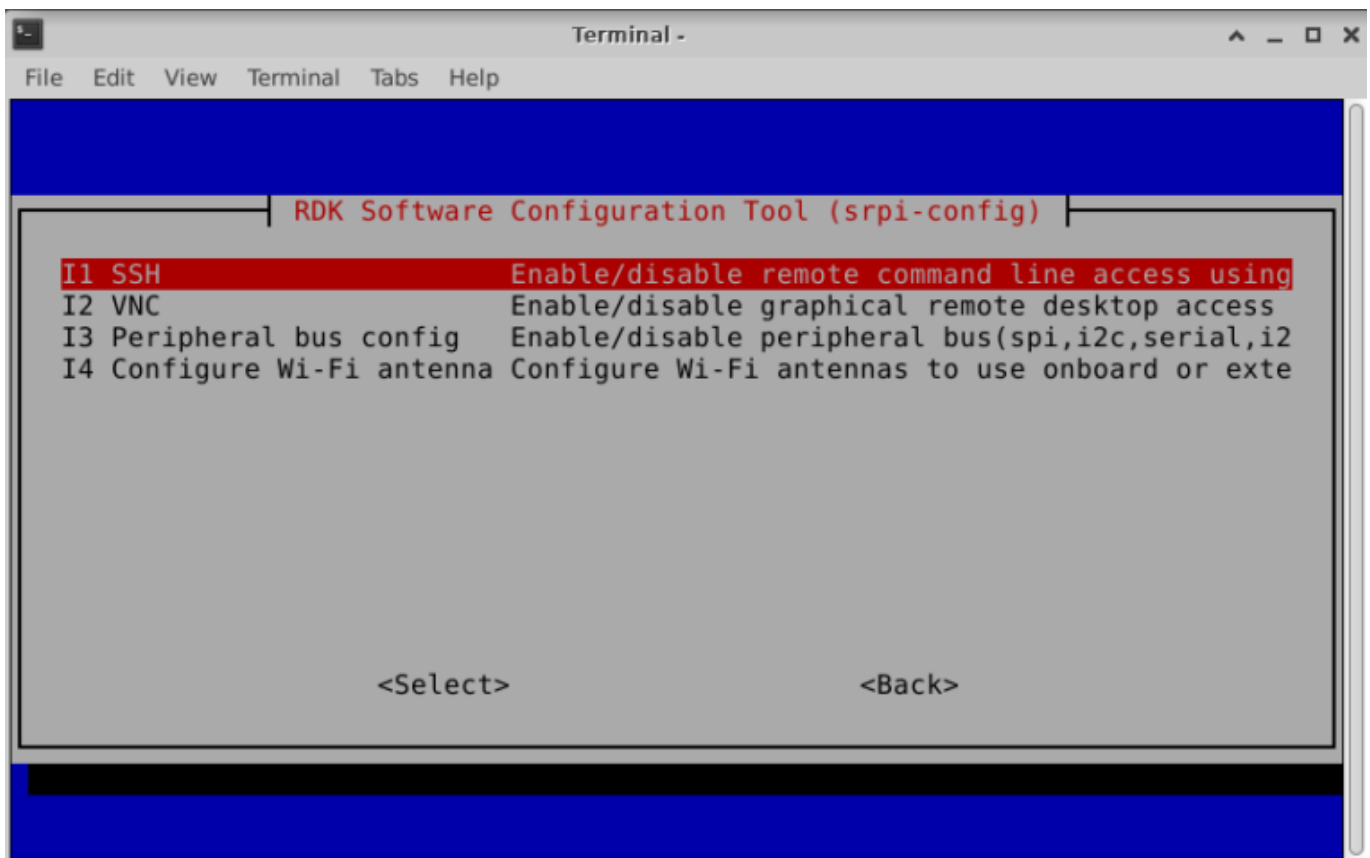

Enabling SSH Service

The current system version defaults to enabling SSH login service, and users can use this method to enable or disable SSH service.
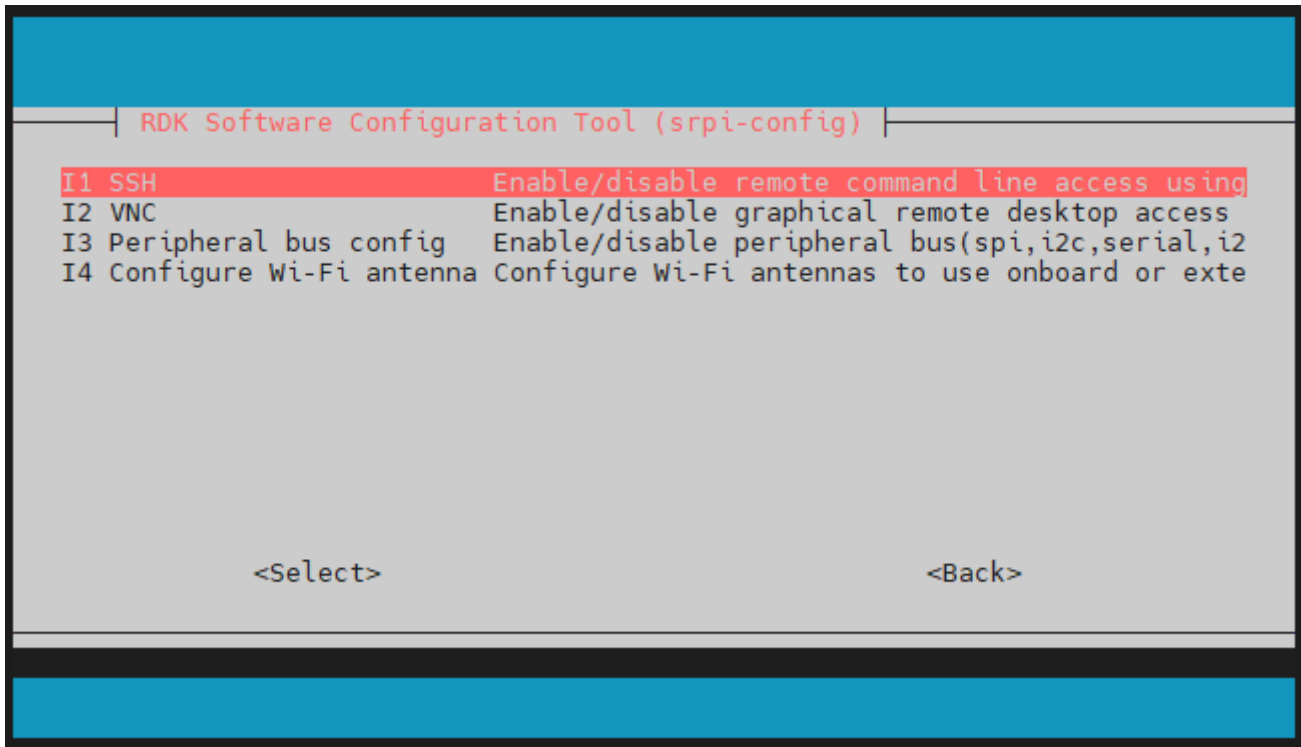
Find the `RDK Configuration` item in the menu bar and click to open.
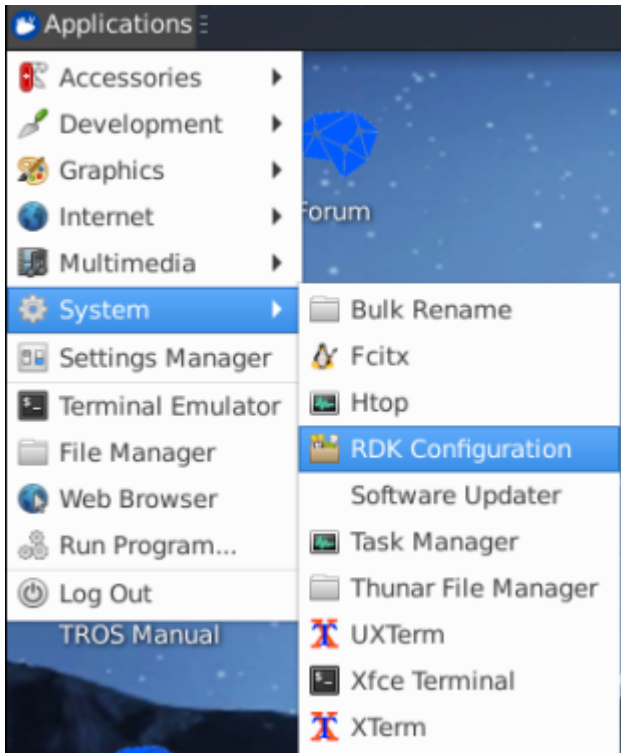
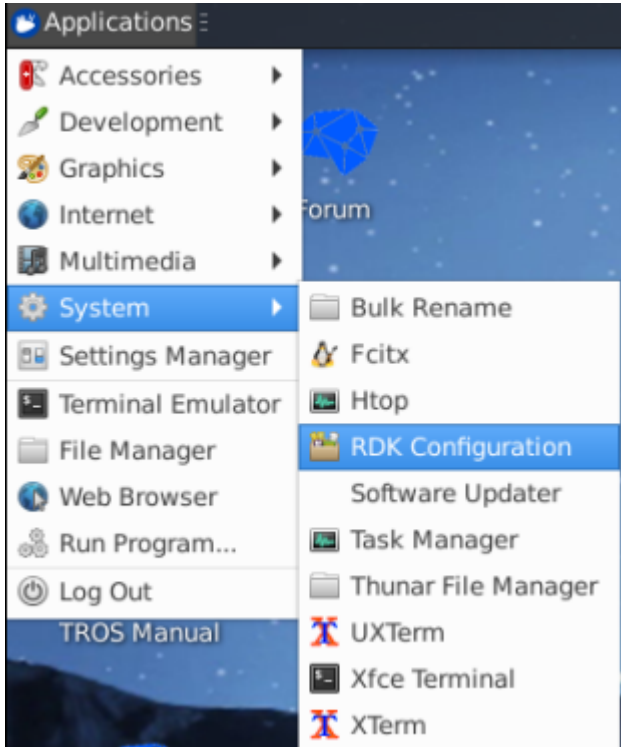Select Interface Options -> SSH item, and choose to enable or disable the SSH service as prompted.

Execute the `sudo srpi-config` command to enter the configuration menu. Select Interface Options -> SSH item, and choose to enable or disable the SSH service as prompted.
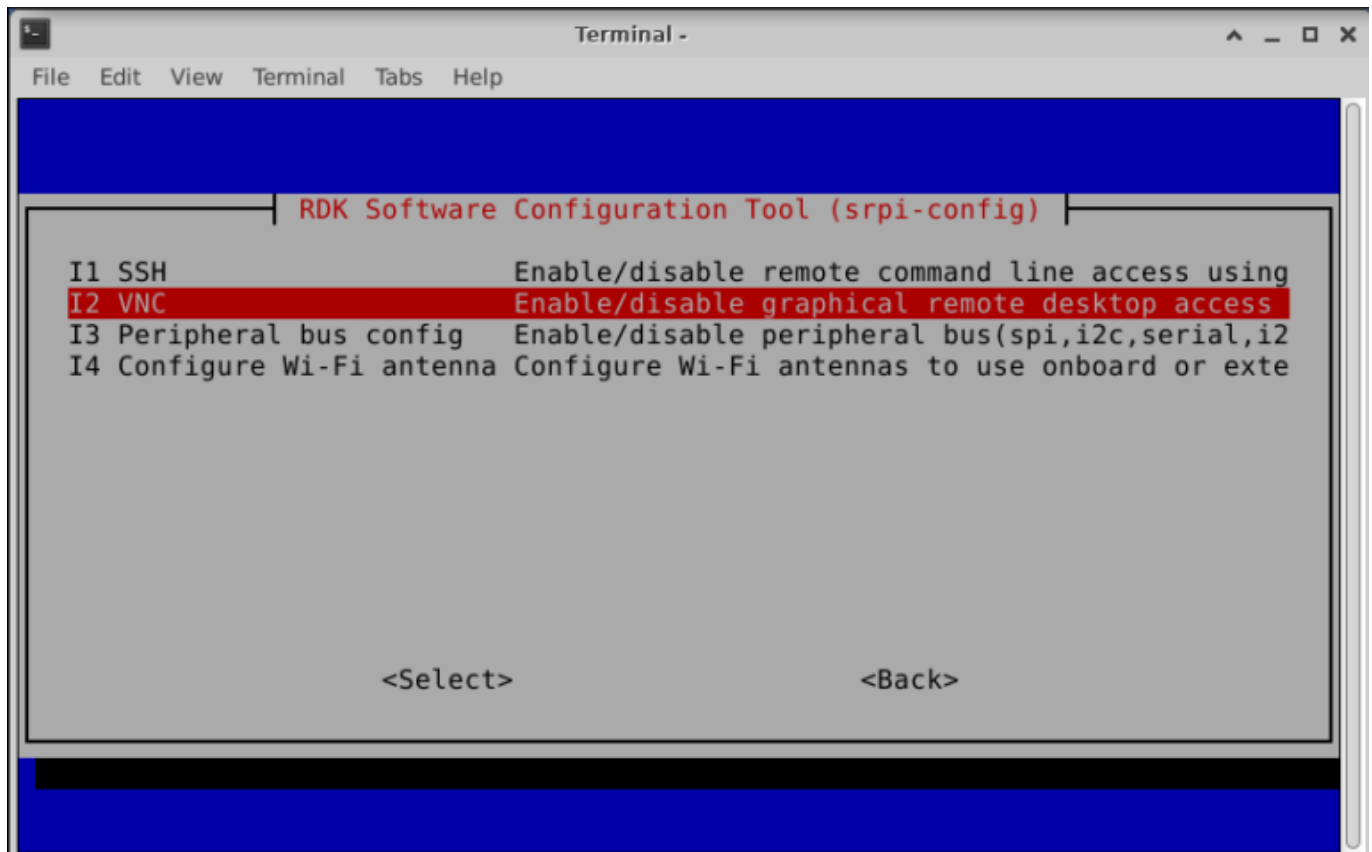
For the use of SSH, please refer to Remote Login - SSH Login.

Enabling VNC Service

Find the `RDK Configuration` item in the menu bar and click to open.

Select Interface Options -> VNC item, and choose to enable or disable the VNC service as prompted. When enabling VNC, you need to set a login password, which must be an 8-character string composed of characters.

For the use of VNC, please refer to Remote Login - VNC Login.

Setting Login Mode

The desktop graphical system supports four login modes:

1. Enable the graphical interface and log in automaticallyHere is the translation of the provided text into English, with the original format and content preserved:

---

2. Enable graphical interface, user logs in manually
3. Character terminal, automatic login
4. Character terminal, user logs in manually

Navigate to the `RDK Configuration` item through the menu bar and click to open. Select System Options -> Boot / Auto Login to access the following configuration items. Choose the corresponding item based on your needs.
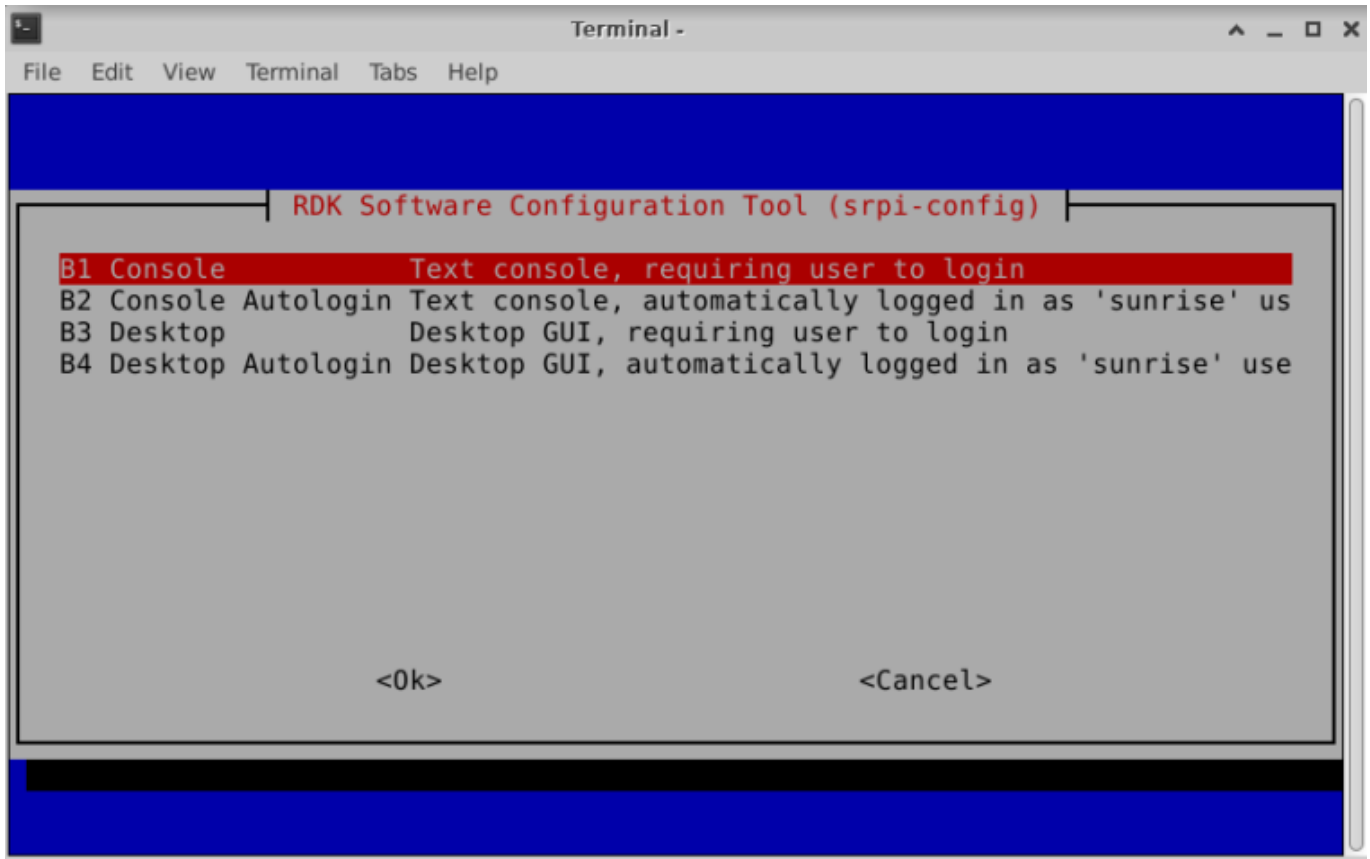
Changes take effect after reboot.

Character terminal supports two login modes:

1. Character terminal, automatic login
2. Character terminal, user logs in manually

Execute the `sudo srpi-config` command to enter the configuration menu. Select System Options -> Boot / Auto Login to access the following configuration items. Choose the corresponding item based on your needs.

Changes take effect after reboot.

Set up Chinese environment

Navigate to the `RDK Configuration` item through the menu bar and click to open. Select Localisation Options -> Locale to access the following configuration.

Step 1: Select the language environments you need (multiple selections), generally selecting `en_US.UTF-8 UTF-8` and `zh_CN.UTF-8 UTF-8` will suffice. Press Enter to confirm and proceed to the next step.
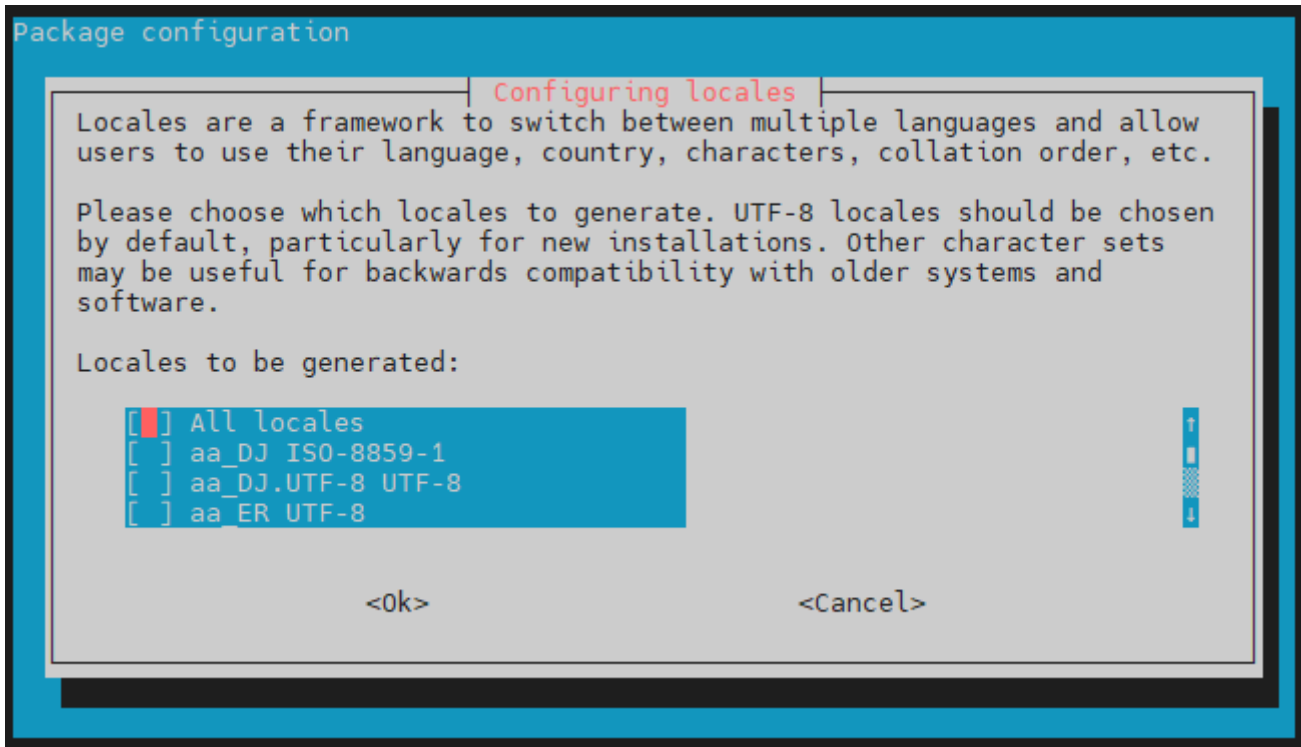
Step 2: Choose the default language environment, for Chinese select `zh_CN.UTF-8 UTF-8`. Press Enter to confirm and wait for a while to complete the configuration.

Step 3: Reboot the development board to apply the latest configuration. `sudo reboot`

At startup, you will be prompted: Do you want to update the names of several common folders under the home directory? It is recommended to select `Don't ask me again` `Keep Old Name`, so that the names of directories such as `Desktop Documents Downloads` under the user's working directory do not change with the language environment.

Execute the `sudo srpi-config` command to enter the configuration menu. Select Localisation Options -> Locale to access the following configuration.

Step 1: Select the language environments you need (multiple selections), generally selecting `en_US.UTF-8 UTF-8` and `zh_CN.UTF-8 UTF-8` will suffice. Press Enter to confirm and proceed to the next step.
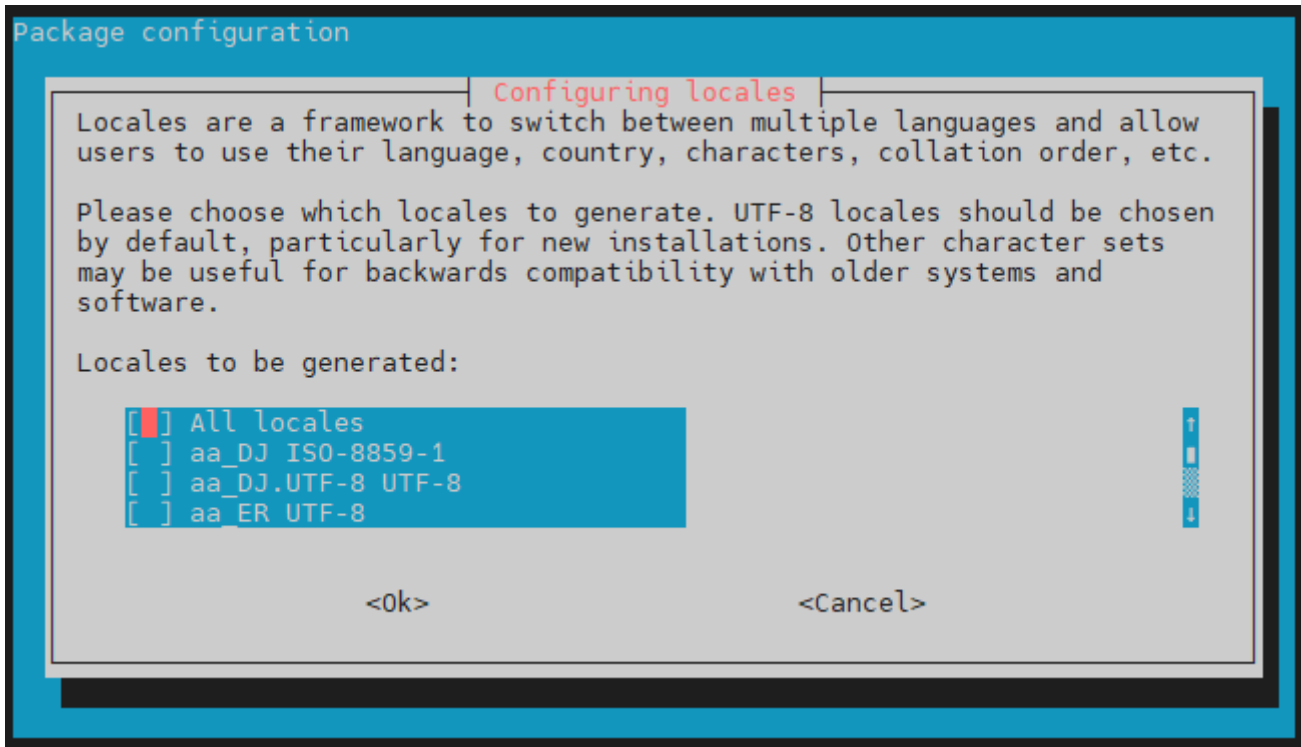
Step 2: Choose the default language environment, for Chinese select `zh_CN.UTF-8 UTF-8`. Press Enter to confirm and wait for a while to complete the configuration.

Step 3: Reboot the development board to apply the latest configuration. `sudo reboot`

Set up Chinese input method

Step 1: On the desktop, find the EN input method icon and right-click on Preferences

Step 2: Click on Input Method --> Add on the right side --> Select Chinese

Step 3: Choose Smart Pinyin, and finally, you can right-click on EN in the top right corner to select Smart Pinyin

Set up RDK Studio

RDK Studio provides RDK users with a wealth of features and conveniences, including device management, quick start with demos, and quick access to community forums. Next, we will introduce how to uniformly manage and use your own RDX.

Step 1: Download RDK Studio link: Download link is the translation of the provided content with Chinese parts translated into English, while retaining the original format and content:

(Here is an example using a local area network IP for connection), for wired connection methods, please refer to Bilibili ([Video Link](#)), and for flash connection methods, please see the Tip section later in this chapter.

(2) `Example Applications`: Here you can directly install some simple Demos to your development board.

(3) `Community`: This section provides direct access to the Digua Robot Community, so there is no need to open a web page for reference.

(4) `NodeHub`: This section provides direct access to NodeHub, offering a rich collection of encapsulated example nodes.

(5) `Flashing`: Please refer to Section 1.2 for system flashing.
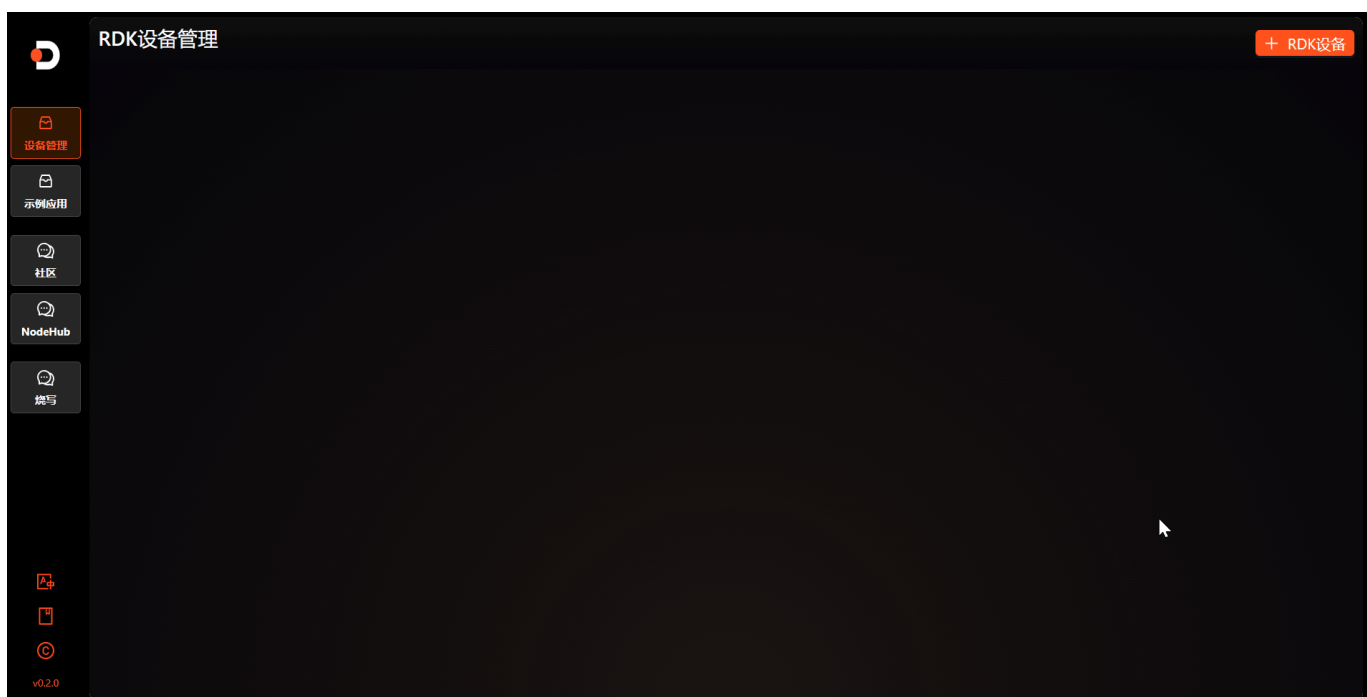
Step 3: Usage of Studio Integrated Tools

(1) `Terminal Usage`: Click the terminal button, and the Windows terminal will automatically pop up, enter the password to connect automatically.

(2) `Vscode Usage`: Click the Vscode icon to automatically call the local Vscode Remote plugin for connection (PS: You must have Vscode and the plugin installed locally).

(3) `Other Features`: Other features such as Jupyter that require installation can be installed as needed by the team.
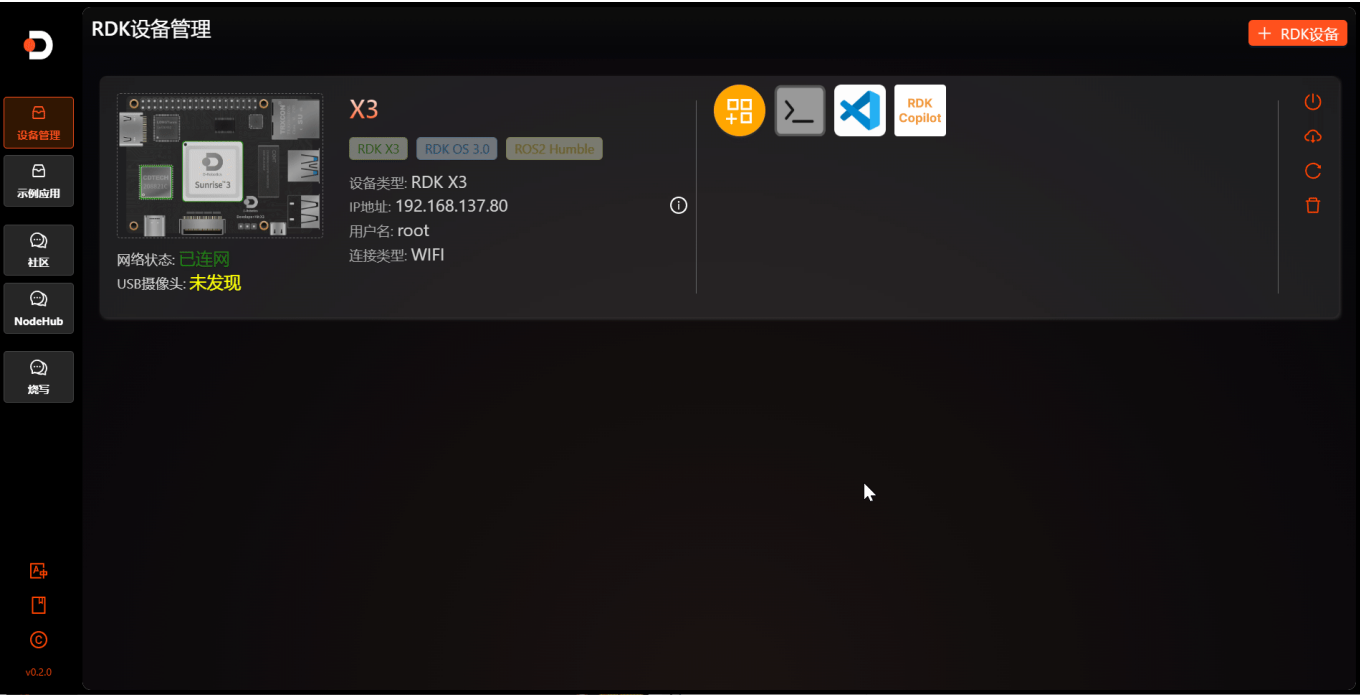
:::tip

The above operations are universal for various systems. For flash connection operations, note that only the Type C interface of RDX X5 can be used.

The specific usage method is as follows:

:::

Step 1: Confirmation of Development Board Network

Take the 3.0 version image of X5 as an example (do not use Beta version images), the IP network segment corresponding to the Type C network card is `192.168.128.10`. (PS: For other versions, you can choose the connection method mentioned earlier and use `ifconfig` to check)

Step 2: Personal PC Network Settings

Open the Control Panel of your Windows computer, find Network and Internet——>Network and Sharing Center——>Change adapter settings on the left

Find the Ethernet of the board card (PS: Plug and unplug the connection line between the board card and the computer multiple times to know which one is the development board's Ethernet)——>Right-click and select Properties, fill in according to the following figure.

Step 3: Flash Connection Operation

Open the RDK Studio device management section, add RDK device in the upper right corner——>Select the flash connection option——>Select the network (PS: Choose the board card network from the previous step)——>Select the user——>Connect to the WIFI you want to configure for the card——>Finally, add note information

Note: Since connecting to WIFI takes time, it may show no WIFI found when the device is added, just wait a moment and refresh the card.
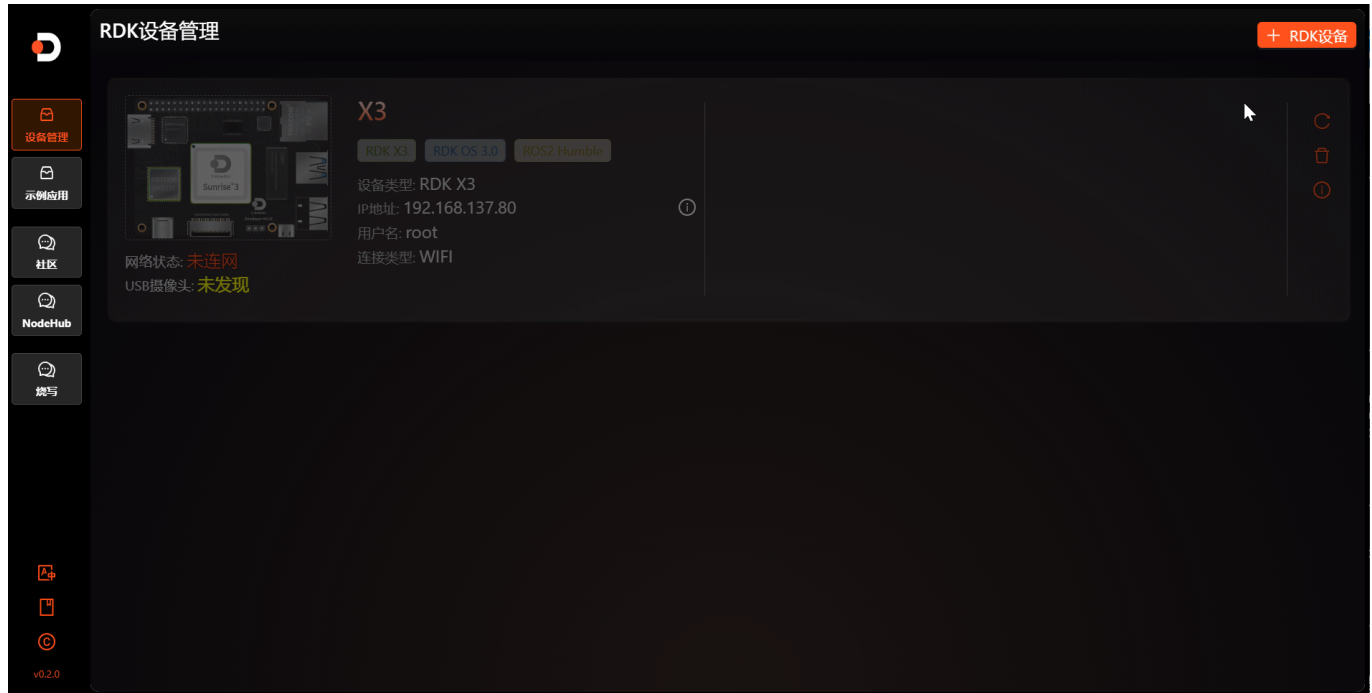
:::tip

The RDK Studio for Windows has been officially released. For those using Linux and Mac, please wait a bit longer as the developers are typing away at full speed.

:::

:::tip

The RDK Studio for Windows has been officially released. For those using Linux and Mac, please wait a bit longer as the developers are typing away at full speed.

:::

1.4 Remote Login

This section is designed to introduce users who need to remotely access the development board via a personal computer (PC) how to remotely log in through serial port, network (VNC, SSH) methods.

Before logging in remotely via network methods, the development board needs to be connected to the network via wired Ethernet or wireless WiFi, and the development board's IP address should be configured properly. For IP address information under both connection methods, please refer to the following description:

- Wired Ethernet: The development board defaults to a static IP mode, with IP address `192.168.127.10`, subnet mask `255.255.255.0`, and gateway `192.168.127.1`
- Wireless WiFi: The development board's IP address is generally assigned by the router and can be viewed in the device command line through the `ifconfig` command for the IP address of the wlan0 network

Serial Port Login{#login_uart}

Video: https://www.bilibili.com/video/BV1rm4y1E73q/?p=2

Before using serial port login, it is necessary to confirm that the development board's serial port cable is correctly connected to the computer. The connection method can refer to the debugging serial port section of the corresponding development board:

- rdk_ultra Debugging Serial Port Section
- rdk_x3 Debugging Serial Port Section
- rdk_x5 Debugging Serial Port Section

Serial port login requires the assistance of a PC terminal tool. Commonly used tools include `Putty`, `MobaXterm`, etc. Users can choose according to their own usage habits. The port configuration process for different tools is basically similar. Below is an example using `MobaXterm` to introduce the process of creating a new serial port connection:

- When the serial port USB adapter is first inserted into the computer, a serial port driver needs to be installed. The driver can be obtained from the Tools Sub-column of the resource center. After the driver is installed, the device manager can normally recognize the serial port board port, as shown in the figure below:

- Open the `MobaXterm` tool, click on `Session`, and then select `Serial`

- Configure the port number, for example, `COM3`, the actual serial port number used should be based on the serial port number recognized by the PC

- Set the serial port configuration parameters as follows:

Configuration Item	Parameter Value
Baud rate	RDK X3 (921600), RDK X5 (115200)
Data bits	8
Parity	None
Stop bits	1
Flow Control	None

- Click `OK`, enter username: `root`, password: `root` to log in to the device

At this point, you can use the `ifconfig` command to query the development board's IP address, where eth0 and wlan0 represent wired and wireless networks, respectively:

```
root@ubuntu:~# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.127.10  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 fe80::211:22ff:feaa:7637  prefixlen 64  scopeid 0x20<link>
        ether 00:11:22:aa:76:37  txqueuelen 1000  (Ethernet)
        RX packets 767  bytes 54006 (54.0 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 5766  bytes 246466 (246.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt Here is the translation of the provided text into
```

> English, with the Chinese parts translated and the original format and
> content preserved:

- Confirm the IP address configuration of the development board and computer; the first three segments should generally be the same, for example, development board: `192.168.127.10` computer: `192.168.127.100`
- Confirm whether the subnet mask and gateway configuration of the development board and computer are consistent
- Confirm whether the computer's network firewall is turned off

The development board's wired Ethernet defaults to static IP mode, with the IP address being `192.168.127.10`. For the situation where the development board and computer are directly connected via the network, it is only necessary to configure the computer with a static IP, ensuring it is on the same network segment as the development board. Taking the WIN10 system as an example, the method to modify the computer's static IP is as follows:

- Find the corresponding Ethernet device in the network connection and double-click to open
- Find the Internet Protocol Version 4 option and double-click to open
- Enter the corresponding network parameters in the red-boxed area in the figure below and click OK

If you need to configure the development board's wired network to dynamically obtain DHCP mode, you can refer to the Wired Network section for configuration.
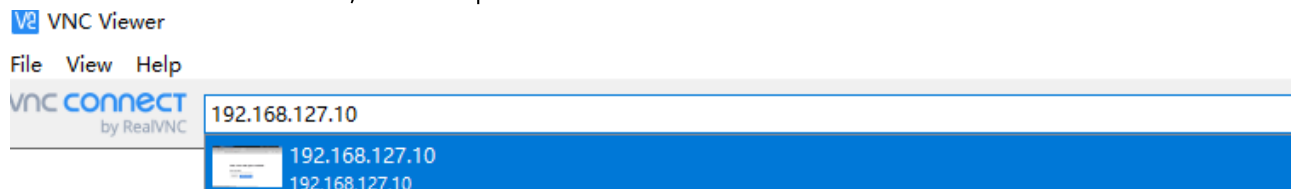
VNC Login

Video: https://www.bilibili.com/video/BV1rm4y1E73q/?p=4

This section is for users of the Ubuntu Desktop system version, introducing how to achieve remote desktop login functionality through `VNC Viewer`. `VNC Viewer` is a graphical desktop sharing software that can realize remote login and control of the desktop on a computer. This software can preview the development board system desktop on the computer monitor and use the computer's mouse and keyboard for remote operations. Users can achieve the same effect as local operations on the development board through VNC Viewer operations, download link VNC Viewer.

Connecting to the Development Board VNC currently supports direct and cloud-based connection methods, and users can choose according to their own situation. This article recommends using the direct connection method, and the connection steps are as follows:
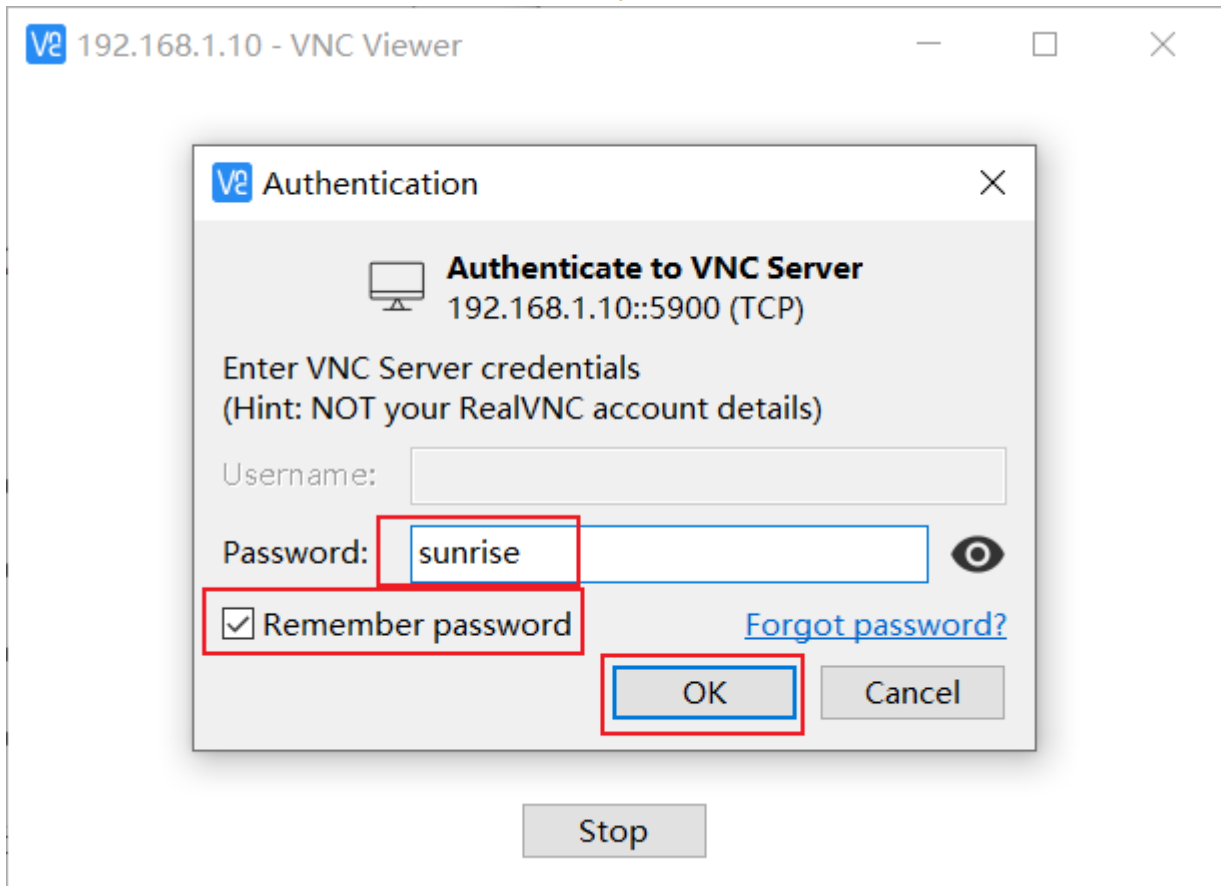
- Enter the device IP address, for example: 192.168.127.10

- After entering the IP address, press Enter, and a prompt for an unencrypted link will appear, click `Continue`
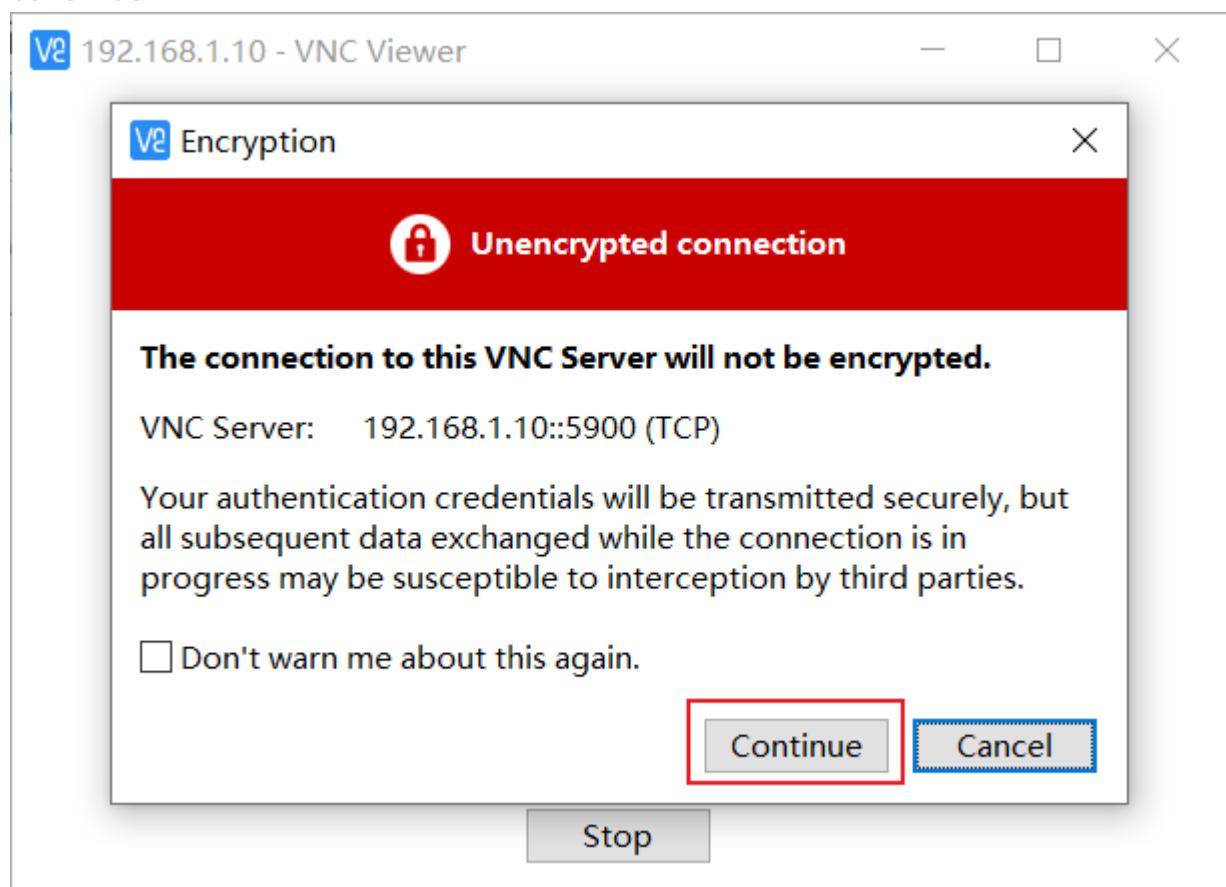
- Enter the password `sunrise`, check `Remember password`, and click `OK` to connect

SSH Login{#ssh}

In addition to VNC login for remote desktop, you can also log in to the development board via SSH. The following introduces the creation steps for terminal software and terminal command line in two methods.

Terminal Software

Commonly used terminal tools include `Putty`, `MobaXterm`, etc., and users can choose according to their own usage habits. The port configuration process for different tools is basically similar. Below is an example using `MobaXterm` to introduce the process of creating a new SSH connection:

1. Open the `MobaXterm` tool, click `Session`, and then select `SSH`
2. Enter the development board IP address, for example, `192.168.127.10`
3. Select `specify username`, and enter `sunrise`
4. Click OK, and enter the username (sunrise) and password (sunrise) to complete the login

Computer Command Line

Users can also log in via SSH using the command line, and the steps are as follows:

1. Open the terminal window, enter the SSH login command, for example, `ssh sunrise@192.168.127.10`
2. A connection confirmation prompt will appear, enter YES
3. Enter the password (sunrise) to complete the login

![image-Cmdline-Linux](../../../static/img/01_Quick_start/image/remote_login

FCC statement
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For RDK X5，FCC ID: 2BGUG-RDKX5K,   Ⓡ211-241225，5GHz Band（W52）：Indoor use only

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C&E has been investigated. It is applicable to the modular.

2.3 Specific operational use conditions
This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures
Not applicable

2.5 Trace antenna designs
Not applicable

2.6 RF exposure considerations
To maintain compliance with FCC's RF Exposure guidelines, this equipment should be installed and operated with minimum distance of 20cm from your body.

2.7 Antennas
This radio transmitter FCC ID: 2BGUG-RDKX5K has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

maximum Gain / Antenna type	2.4G	5.2G	5.8G
Chip antenna	0.43dBi	2.86dBi	3.0dBi

2.8 Label and compliance information
The final end product must be labeled in a visible area with the following " Contains FCC ID: 2BGUG-RDKX5K"

2.9 Information on test modes and additional testing requirements
Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer
Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.