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RK3399PRO_Linux_SDK_V1.0.0_20190528

(Technical Department, Dept.Ⅲ)

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Revision History

Revision Date	Version No.	Revision Description	Author	Reviewer
2019-02-17	Beta_V0.01	Initial Beta version	Caesar Wang	Eddie Cai
2019-03-21	Beta_V0.02	1. Modify the method of using .mkfirmware.sh to generate image in chapter 5.1.3 2. Change the description of adding debian to rknn_demo in chapter 8. 3. Change the SDK firmware to v0.02 in chapter 8	Caesar Wang	Eddie Cai
2019-05-28	V1.0.0	1. Release version 2. Add NPU related instructions	Caesar Wang	ZYY, Eddie Cai

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Fuzhou Rockchip Electronics Co., Ltd
Address: No.18 Building, A District, No.89 Software Boulevard, FuZhou, FuJian, PRC
Website: www.rock-chips.com
Customer service Tel.：+86-591-83991906
Customer service Fax：+86-591-83951833
Customer service e-Mail: fae@rock-chips.com

Chapter 1 Overview

This SDK is based on Linux Buildroot and Debian 9 system with kernel 4.40. It is applicable to the development of RK3399Pro EVB and all other Linux products based on it.
This SDK supports NPU TensorFlow/Caffe model, VPU hardware decoding, GPU 3D, Wayland display, QT and other functions. For detailed functions debugging and interfaces instructions, please refer to related documents under the project’s docs/ directory.

Chapter 2 Main functions

Functions	Module Names
Data Communication	Wi-Fi, Ethernet Card, USB, SDCARD
Application	Gallery, settings, video, audio, video playback

Chapter 3 How to obtain SDK

SDK is released by Rockchip server. Please refer to chapter 6 SDK compiling instruction to build a development environment.

To get RK3399Pro Linux software package, customers need an account to access the source code repository provided by Rockchip. Customers apply SDK from Rockchip technical window, have to provide SSH public key synchronization server certificate authority to get synchronization code after authorized at the same time. About Rockchip server SSH public key authorization, please refer to chapter 10 SSH public key instruction.

RK3399Pro_Linux_SDK download command is as follows:

```
repo init --repo-url ssh://git@www.rockchip.com.cn/repo/rk/tools/repo -u
ssh://git@www.rockchip.com.cn/linux/rk/platform/manifests -b linux -
m rk3399pro_linux_release.xml
```

Repo is a script that google uses Python script to call git. It is mainly used to download and manage software repository of projects. The download address is as follows:

```
git clone ssh://git@www.rockchip.com.cn/repo/rk/tools/repo
```

For quick access SDK source code, Rockchip Technical Window usually provides corresponding version of SDK initial compression package. In this way, developers can obtain SDK source code from decompression the initial compression package, which is the same as the one downloaded by repo. Take rk3399pro_linux_sdk_beta_v0.01_20190217.tgz as an example. After copying initialization package, you can get source code by the following command:

```
mkdir rk3399pro
tar xvf rk3399pro_linux_sdk_beta_v0.01_20190217.tgz -C rk3399pro
cd rk3399pro
.repo/repo/repo sync -l
.repo/repo/repo sync
```

Developers can update via ".repo/repo/repo sync" command according to update instructions that are regularly released by FAE window.

Chapter 4 Software development guide

4.1 Development guide

RK3399Pro Linux SDK Kernel version is Linux4.4, Rootfs is Buidlroot (2018.02-rc3) and Debian9 respectively. To help engineers get familiar with SDK development and debugging work more quickly, "Rockchip Linux Software Development Guide" is released with the SDK. It can be obtained in the docs/ directory and will be continuously updated.

4.2 NPU development tool

This SDK NPU development tool includes the following items:

RKNN_DEMO(MobileNet SSD):

For RKNN Demo, please refer to the directory external/rknn_demo/. See the project directory docs/SoC platform related/RK3399PRO/Rockchip RKNN_DEMO Module Development Guide V0.2.pdf for details.

RKNN-TOOLKIT:

Development tools are in project directory external/rknn-toolkit. Please refer to the document in the docs/Develop reference documents/NPU/ for details.

-RK3399Pro_Linux&Android_RKNN_API_V0.9.4_20190311.pdf

-RKNN-Toolkit FAQ.pdf

-RKNN-Toolkit Quick Start Guide_V1.0.0.pdf

-RKNN-Toolkit User Guide_V1.0.0.pdf

- Deep neural network model design recommendations based on RKNN.pdf

RKNN-DRIVER:

RKNN DRIVER development materials are in the project directory external/rknpu

RKNPUTools:

RKNN API development materials are in the project directory external/NRKNPUTool

NPU software startup instructions:

RK3399PRO NPU software startup instructions, please refer to the project directory docs/SoC platform related/RK3399PRO/RK3399PRO_NPU power on and startup instructions.pdf

4.3 Software update history

Software release version upgrade can be viewed through project xml, the detailed method is as follows:

```
.repo/manifests$ ls -l -h rk3399pro_linux_release.xml
```

Software release version updates information can be viewed through the project text, as follows:

```
.repo/manifests$ cat rk3399pro_linux_v0.01/RK3399PRO_Release_Note.txt
```

Or refer to the project directory:
docs/SoC platform related/RK3399PRO/RK3399PRO_Release_Note.pdf

Chapter 5 Hardware development guide

Hardware development can refer to user guides in the project directory docs/SoC platform related/RK3399PRO/

-RK3399Pro EVB User Guide_V10_20190401.pdf

-RK3399Pro_EVB board introduction_20181212.pdf

-RK3399PRO_IO_LIST_V11_for EVB 20181203.pdf

-RK3399Pro Hardware Design Guide and Schematic PCB Review Notes_V10_20190111/*

Chapter 6 SDK compiling instruction

Ubuntu 16.04 system:

The installation commands for compiling the package on which Buildroot environment built are as follows:

```
sudo apt-get install repo git-core gitk git-gui gcc-arm-linux-gnueabihf u-boot-to
ols device-tree-compiler gcc-aarch64-linux-gnu mtools parted libudev-dev libus
b-1.0-0-dev python-linaro-image-tools linaro-image-tools autoconf autotools-de
v libsigsegv2 m4 intltool libdrm-dev curl sed make binutils build-essential gcc g
++ bash patch gzip bzip2 perl tar cpio python unzip rsync file bc wget libncurse
s5 libqt4-dev libglib2.0-dev libgtk2.0-dev libglade2-dev cvs git mercurial rsync
openssh-client subversion asciidoc w3m dblatex graphviz python-matplotlib libc
6:i386 libssl-dev texinfo liblz4-tool genext2fs
```

The installation commands for compiling the packages on which Debian environment built are as follows:

```
sudo apt-get install repo git-core gitk git-gui gcc-arm-linux-gnueabihf u-boot-to
ols device-tree-compiler gcc-aarch64-linux-gnu mtools parted libudev-dev libus
b-1.0-0-dev python-linaro-image-tools linaro-image-tools gcc-4.8-multilib-arm-
linux-gnueabihf gcc-arm-linux-gnueabihf libssl-dev gcc-aarch64-linux-gnu  g+c
onf autotools-dev libsigsegv2 m4 intltool libdrm-dev curl sed make binutils buil
d-essential gcc g++ bash patch gzip bzip2 perl tar cpio python unzip rsync file
bc wget libncurses5 libqt4-dev libglib2.0-dev libgtk2.0-dev libglade2-dev cvs git
 mercurial rsync openssh-client subversion asciidoc w3m dblatex graphviz pyth
on-matplotlib libc6:i386 libssl-dev texinfo liblz4-tool genext2fs
```

Ubuntu 17.04 or later version system:

In addition to the above, the following dependencies is needed:

```
sudo apt-get install lib32gcc-7-dev  g++-7  libstdc++-7-dev
```

(Don't need to install gcc-4.8-multilib-arm-linux-gnueabihf)

Note: RK3399Pro will load NPU firmware when power on. The default NPU firmware is pre-programmed into /usr/share/npu_fw directory of rootfs. For NPU firmware programming and startup methods, please refer to the document under docs/Soc Platform related/RK3399PRO /RK3399PRO_NPU power on and start.pdf

It will describe firmware compiling methods of NPU and RK3399pro respectively as follows：

6.1 NPU compiling instruction

6.1.1 Uboot compiling

Enter project npu/u-boot directory and run make.sh to get rknpu_lion_loader_v1.02.103.bin trust.img uboot.img:
rk3399pro-npu：

```
./make.sh rknpu-lion
```

The compiled files are in u-boot directory:

```
u-boot/
├── rknpu_lion_loader_v1.02.103.bin
├── trust.img
└── uboot.img
```

6.1.2 Kernel compiling Steps

Enter project root directory and run the following command to automatically compile and package kernel:
rk3399pro evb board：

```
cd kernel
make ARCH=arm64 rk3399pro_npu_defconfig
make ARCH=arm64 rk3399pro-npu-evb-v10.img -j12
```

6.1.3 Boot.img and npu firmware generate steps

Enter project npu directory and run the following command to automatically compile and package boot.img:

```
cd npu
./build.sh ramboot
./mkfirmware.sh  rockchip_rk3399pro-npu
```

After compiling, boot.img, uboot.img, trust.img, MiniLoaderAll.bin are generated in rockdev directory.
Note that npu firmware generated under rockdev needs to be placed in the rootfs specified location /usr/share/npu_fw, or manually placed in rootfs.

6.2 RK3399pro compiling instruction

6.2.1 Uboot compiling

Enter project u-boot directory and execute make.sh to get rk3399pro_loader_v1.22.115.bin trust.img uboot.img:

rk3399pro evb：

```
./make.sh rk3399pro
```

The compiled file is in u-boot directory:

```
u-boot/
├── rk3399pro_loader_v1.22.115.bin
├── trust.img
```

6.2.2 Kernel compiling steps

Enter project root directory and run the following command to automatically compile and package kernel:

rk3399pro evb v10 board：

```
cd kernel
make ARCH=arm64 rockchip_linux_defconfig
make ARCH=arm64 rk3399pro-evb-v10-linux.img -j12
```

rk3399pro evb v11

```
cd kernel
make ARCH=arm64 rockchip_linux_defconfig
make ARCH=arm64 rk3399pro-evb-v11-linux.img -j12
```

After compiling, boot.img which contains image and DTB of kernel is generated in kernel directory.

6.2.3 Recovery compiling steps

Enter project root directory and run the following command to automatically complete compiling and packaging of Recovery.

rk3399pro evb board：

```
 ./build.sh recovery
```

Recovery.img is generated in Buildroot directory /output/rockchip_rk1808_recovery/images after compiling.

6.2.4 Buildroot rootfs and app compiling

Enter project root directory and run the following commands to automatically complete compiling and packaging of Rootfs.
rk3399pro evb board：

```
./build.sh rootfs
```

After compiling, rootfs.ext4 is generated in Buildroot directory output/rockchip_rk3399pro/images.

Note：
If you need to compile a single module or a third-party application, you need to configure cross-compiling environment.
Cross-compiling tool is located in buildroot/output/rockchip_rk3399pro/host/usr directory. You need to set bin/ directory of tools and aarch64-buildroot-linux-gnu/bin/ directory to environment variables, and execute auto-configuration environment variable script in the top-level directory (only valid for current console):

```
source envsetup.sh
```

Enter the command to view:

```
aarch64-linux-gcc --version
```

When the following log is printed, configuration is successful:

```
aarch64-linux-gcc.br_real (Buildroot 2018.02-rc3-00218-gddd64f1) 6.4.0
```

6.2.5 Debian rootfs compile

Enter rootfs/directory firstly:

```
 cd rootfs/
```

Then compile and generate Debian firmware, you can refer to readme.md in the current directory

6.2.5.1 Building base debian system by ubuntu-build-service from linaro

```
sudo apt-get install binfmt-support qemu-user-static live-build
sudo dpkg -i ubuntu-build-service/packages/*
sudo apt-get install -f
```

Compile 32-bit debian:

```
RELEASE=stretch TARGET=desktop ARCH=armhf  ./mk-base-debian.sh
```

Or compile 64-bit debian

```
RELEASE=stretch TARGET=desktop ARCH=arm64  ./mk-base-debian.sh
```

After compiling, linaro-stretch-alip-xxxxx-1.tar.gz (xxxxx is timestamp generated) will be generated in rootfs/:

FAQ:

If you encounter the following problem during above compiling:

```
noexec or nodev issue /usr/share/debootstrap/functions: line
1450: ..../rootfs/ubuntu-build-service/stretch-desktop-armhf/chroot/test-dev-
null: Permission denied E: Cannot install into target
'/home/foxluo/work3/rockchip/rk_linux/rk3399_linux/rootfs/ubuntu-build-
service/stretch-desktop-armhf/chroot' mounted with noexec or nodev
```

Solution：

```
mount -o remount,exec,dev xxx (xxx is the mount place), then rebuild it.
```

In addition, if there are other compiling issues, firstly to exclude ext2/ext4 system types are used.

6.2.5.2 Building rk-debian rootfs

Compile 32-bit debian:

```
VERSION=debug ARCH=armhf ./mk-rootfs-stretch.sh
```

(With a “debug” behind is recommended in the development process)

Compile 64-bit debian:

```
VERSION=debug ARCH=arm64 ./mk-rootfs-stretch-arm64.sh
```

(With a “debug” behind is recommended in the development process)

6.2.5.3 Creating the ext4 image(linaro-rootfs.img)

```
./mk-image.sh
```

Will generate linaro-rootfs.img.

6.2.6 Fully automatic compiling

After compile various parts of Kernel/Uboot/Recovery/Rootfs above, enter root directory of project directory and execute the following commands to automatically complete all compiling:

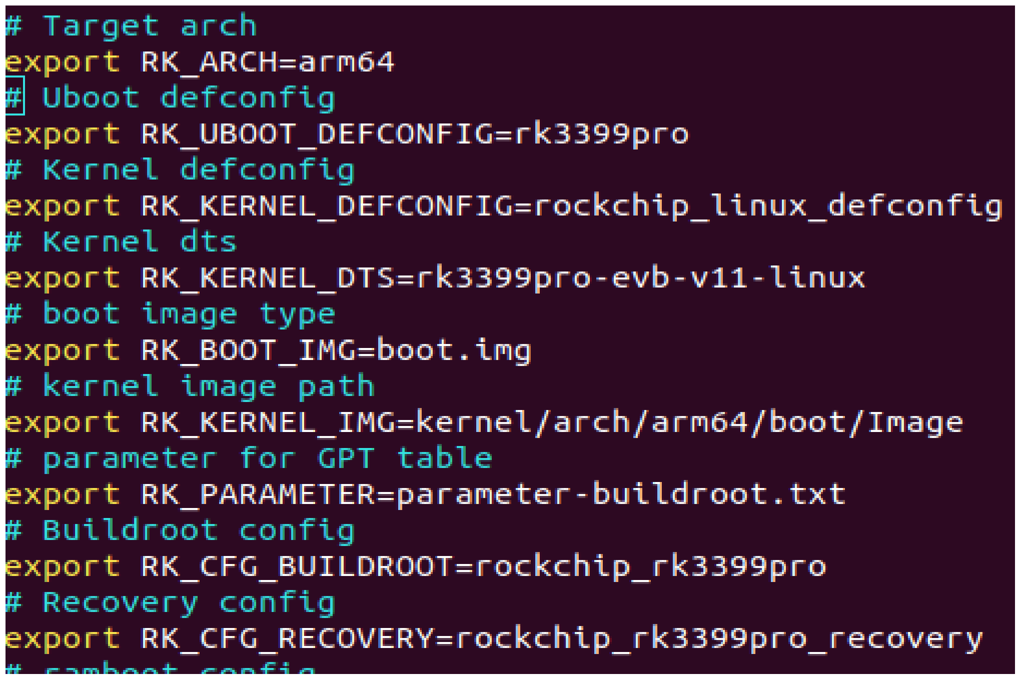
./build.sh

Detailed parameter usage, you can use help to search, for example

```
rk3399pro$ ./build.sh --help
Can't found build config, please check again

====USAGE: build.sh modules====
uboot              -build uboot
kernel              -build kernel
rootfs              -build default rootfs, currently build buildroot as default
buildroot         -build buildroot rootfs
yocto              -build yocto rootfs, currently build ros as default
ros                  -build ros rootfs
debian             -build debian rootfs
pcba                -build pcba
recovery          -build recovery
all                   -build uboot, kernel, rootfs, recovery image
....
```

Board level configurations of each board need to be configured in /device/rockchip/rk3399pro/Boardconfig.mk.

Main configurations of rk3399pro evb are as follows:



```
# Target arch
export RK_ARCH=arm64
# Uboot defconfig
export RK_UBOOT_DEFCONFIG=rk3399pro
# Kernel defconfig
export RK_KERNEL_DEFCONFIG=rockchip_linux_defconfig
# Kernel dts
export RK_KERNEL_DTS=rk3399pro-evb-v11-linux
# boot image type
export RK_BOOT_IMG=boot.img
# kernel image path
export RK_KERNEL_IMG=kernel/arch/arm64/boot/Image
# parameter for GPT table
export RK_PARAMETER=parameter-buildroot.txt
# Buildroot config
export RK_CFG_BUILDROOT=rockchip_rk3399pro
# Recovery config
export RK_CFG_RECOVERY=rockchip_rk3399pro_recovery
# camboot config
```

6.2.7 Firmware package steps

After compiling various parts of Kernel/Uboot/Recovery/Rootfs above, enter root directory of project directory and run the following command to automatically complete all firmware packaging into rockdev directory:

Generate Buildroot firmware:

```
./mkfirmware.sh
```

Generate Debian firmware：

```
./build.sh BoardConfig_debian.mk
```

./mkfirmware can generate debian firmware.

Chapter 7 Upgrade instruction

There are v10 and v11 two versions of current rk3399pro evb, the green board is v10 version, and the black board is v11 version. Board functions position are the same. The following is the introduction of rk3399pro evb v10 board, as shown in the following figure.

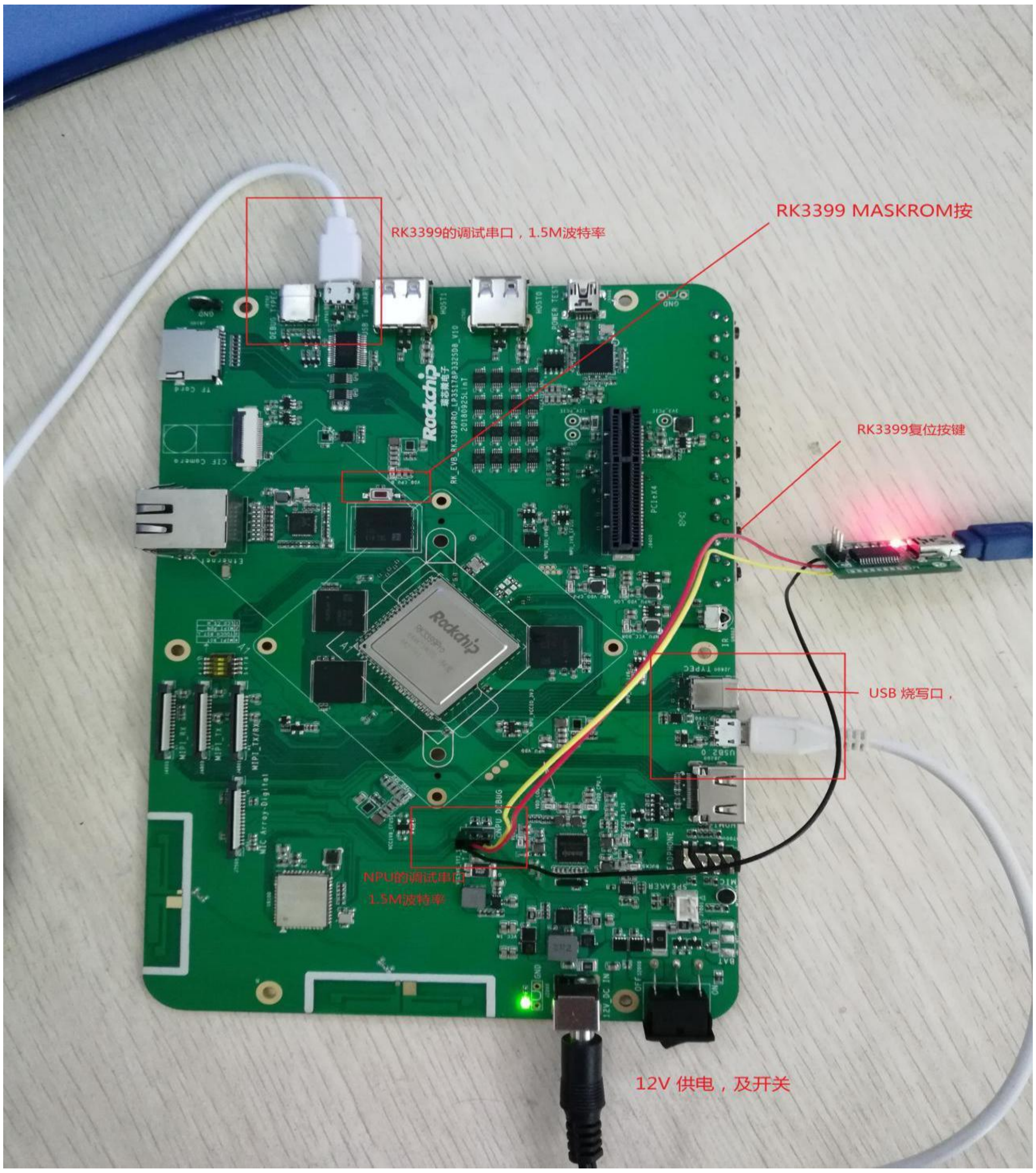


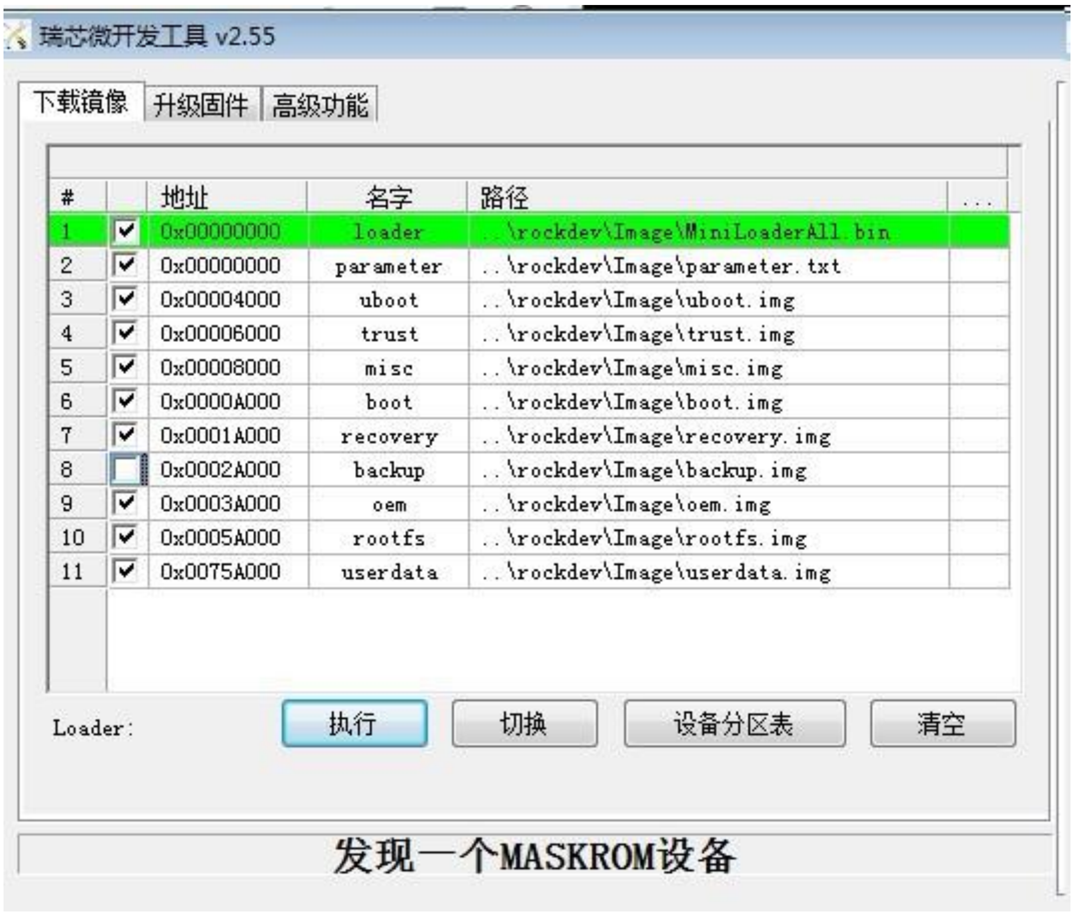
Figure 1 RK3399PRO EVB

7.1 Windows upgrade instruction

SDK provides windows upgrade tool (this tool should be V2.55 or later version) which is located in project root directory:

```
tools/
├── windows/AndroidTool
```

As shown below, after compiling the corresponding firmware, device needs to enter MASKROM (aka BootROM) mode for update. After connecting usb cable, long press the button " MASKROM " and press reset button "RST" at the same time and then release, device will enter MASKROM Mode. Then you should load the paths of the corresponding images and click "Run" to start update. You can also press the "recovery" button and press reset button "RST" then release to enter loader mode to update. Partition offset and update files of MASKROM Mode are shown as follows (Note: Window PC needs to run the tool as an administrator):



瑞芯微开发工具 v2.55

#		地址	名字	路径	...
1	✓	0x00000000	loader	..\rockdev\Image\MiniLoaderAll.bin	
2	✓	0x00000000	parameter	..\rockdev\Image\parameter.txt	
3	✓	0x00004000	uboot	..\rockdev\Image\uboot.img	
4	✓	0x00006000	trust	..\rockdev\Image\trust.img	
5	✓	0x00008000	misc	..\rockdev\Image\misc.img	
6	✓	0x0000A000	boot	..\rockdev\Image\boot.img	
7	✓	0x0001A000	recovery	..\rockdev\Image\recovery.img	
8		0x0002A000	backup	..\rockdev\Image\backup.img	
9	✓	0x0003A000	oem	..\rockdev\Image\oem.img	
10	✓	0x0005A000	rootfs	..\rockdev\Image\rootfs.img	
11	✓	0x0075A000	userdata	..\rockdev\Image\userdata.img	

发现一个MASKROM设备

Figure 2 Upgrade tool **AndroidTool.exe**

Note : Before upgrade, need to install the latest USB driver, which is in the below directory:

```
tools/windows/DriverAssitant_v4.7.zip
```

7.2 Linux upgrade instruction

The Linux upgrade tool (Linux_Upgrade_Tool should be v1.33 or later versions) is located in tools/linux directory. Please make sure your board is connected to MASKROM/loader rockusb, if the compiled firmware is in rockdev directory, upgrade commands are as below:

```
udo ./upgrade_tool ul          rockdev/MiniLoaderAll.bin
sudo ./upgrade_tool di  -p        rockdev/parameter.txt
sudo ./upgrade_tool di  -u        rockdev/uboot.img
sudo ./upgrade_tool di  -t        rockdev/trust.img
sudo ./upgrade_tool di  -misc   rockdev/misc.img
sudo ./upgrade_tool di  -b        rockdev/boot.img
sudo ./upgrade_tool di -recovery  rockdev/recovery.img
sudo ./upgrade_tool di -oem     rockdev/oem.img
sudo ./upgrade_tool di  -rootfs rocdev/rootfs.img
sudo ./upgrade_tool di  -userdata rockdev/userdata.img
sudo ./upgrade_tool  rd
```

Or in root directory, machine run the following command to upgrade in MASKROM state:

```
./rkflash.sh
```

7.3 System partition instruction

Default partition (below is RK3399PRO EVB reference partition):

Number	Start (sector)	End (sector)	Size	Code	Name
1	16384	24575	4096K	0700	uboot
2	24576	32767	4096K	0700	trust
3	32768	40959	4096K	0700	misc
4	40960	106495	32.0M	0700	boot
5	106496	303104	96.0M	0700	recovery
6	303104	368639	32.0M	0700	backup
7	368640	499711	64.0M	0700	oem
8	499712	25696863	1024M	0700	rootfs
9	2596864	30535646	13.3G	0700	userdata

uboot partition: update uboot.img compiled by uboot.

trust partition: update trust.img compiled by uboot.

misc partition: update misc.img for recovery.

boot partition: update boot.img compiled by kernel.

recovery partition: update recovery.img.

backup partition: reserved, temporarily useless. Used for backup of recovery like android in future.

oem partition: used by manufacturer to store manufacturer's app or data. Read only. Replace the data partition of original speakers. Mounted in /oem directory

rootfs partition: store rootfs.img compiled by buildroot or debian, read only.

userdata partition: store files temporarily generated by app or for users. Read and write, mounted in /userdata directory.

Chapter 8 RK3399Pro_Linux project directory introduction

There are buildroot, recovery, app, kernel, u-boot, device, docs, external and other directories in the project directory. Each directory or its sub-directories will correspond to a git project, and the commit should be done in the respective directory.

1) app: store upper layer application apps like Camer/Video/Music and other applications;

2) buildroot: customize root file system;

3) device/rockchip: store some scripts and prepared files for compiling and packaging firmware.

4) docs: store project help files.

5) external: related libraries, including audio, video, network and so on;

6) kernel: kernel source code.

7) prebuilts: store cross-compilation toolchain.

8) recovery: store recovery project files

9) rkbin: store firmwares and tools.

10) rockdev: store compiled output firmware

11) debian：Debian root file system

12) tools: store some commonly used tools.

13) u-boot: uboot code

14) npu: store npu code

Chapter 9 RK3399Pro SDK firmware and simple demo test

9.1 RK3399Pro SDK firmware

RK3399PRO_LINUX_SDK_V1.0.0_20190528 firmware download link are as follows:
(include Debian and Buildroot firmware)

V10 (green) development board:
Buildroot：https://eyun.baidu.com/s/3qZ3Wn72
Debian：https://eyun.baidu.com/s/3c3mJHWc

V11 (black) development board:
Buildroot： https://eyun.baidu.com/s/3c4iWmFe
Debian：https://eyun.baidu.com/s/3bqyXe8J

9.2 RKNN_DEMO test

Firstly, insert usb camera, run **rknn_demo** in buildroot system and run **test_rknn_demo.sh** in Debian system.
Refer to project document docs/Soc Platform Releated/RK3399PRO/Rockchip RKNN_DEMO module developer guide.pdf for details, the results of running in Buildroot are as follows：

```
[root@rk3399pro:/]# rknn_demo
librga:RGA_GET_VERSION:3.02,3.020000
ctx=0x2e834c20,ctx->rgaFd=3
Rga built version:version:+2017-09-28 10:12:42
success build                                                    |
size = 12582988, g_bo.size = 13271040
size = 12582988, cur_bo->size = 13271040
size = 12582988, cur_bo->size = 13271040
...
get device /dev/video10
read model:/usr/share/rknn_demo/mobilenet_ssd.rknn, len:32002449
spec = local:transfer_proxy
```

```
D RKNNAPI:
==============================================
D RKNNAPI: RKNN VERSION:
D RKNNAPI:   API: 0.9.5 (a949908 build: 2019-05-07 22:20:43)
D RKNNAPI:   DRV: 0.9.6 (c12de8a build: 2019-05-06 20:10:17)
D RKNNAPI:
==============================================
Using UVC media node
...
```

The effect on screen is as follows：

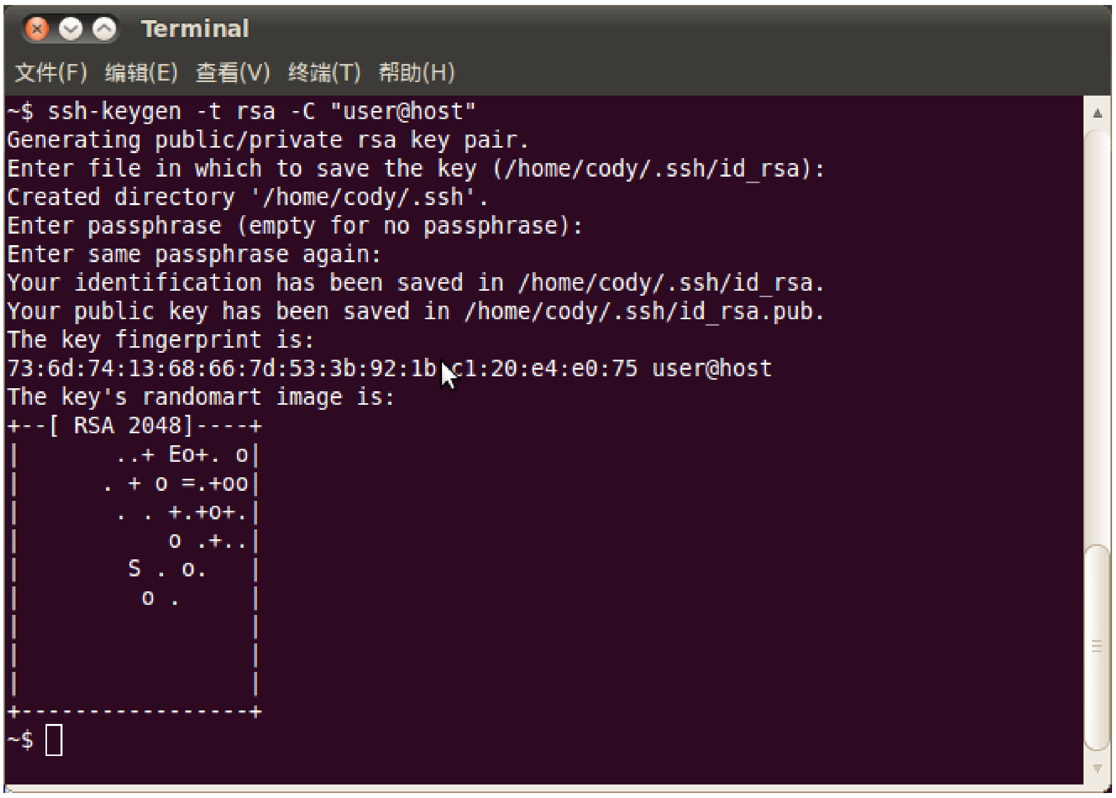
Chapter 10 SSH public key operation instruction

10.1 SSH public key generation

Use the following command to generate:：

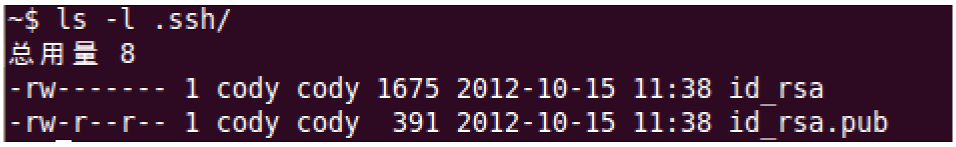
```
ssh-keygen -t rsa -C "user@host"
```

Please replace user@host with your email address



```
~$ ssh-keygen -t rsa -C "user@host"
Generating public/private rsa key pair.
Enter file in which to save the key (/home/cody/.ssh/id_rsa):
Created directory '/home/cody/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/cody/.ssh/id_rsa.
Your public key has been saved in /home/cody/.ssh/id_rsa.pub.
The key fingerprint is:
73:6d:74:13:68:66:7d:53:3b:92:1b:c1:20:e4:e0:75 user@host
The key's randomart image is:
+--[ RSA 2048]----+
|        ..+ Eo+. o|
|       . + o =.+oo|
|        . . +.+o+.|
|            o .+..|
|         S . o.   |
|          o .     |
|                  |
|                  |
|                  |
+-----------------+
~$ 
```

After running the command will generate a public key file in your directory.



```
~$ ls -l .ssh/
总用量 8
-rw------- 1 cody cody 1675 2012-10-15 11:38 id_rsa
-rw-r--r-- 1 cody cody  391 2012-10-15 11:38 id_rsa.pub
```

Please keep the private key file id_rsa and password generated, and email the public key id_rsa.pub to SDK server administrator.

10.2 Use key-chain to manage keys

It is recommended to use a simple tool keychain to manage keys.

The detail usage is as follows:

1. Install keychain package:

```
$sudo aptitude install keychain
```

2. Configure the key:

```
$vim ~/.bashrc
```

Add the following line:

```
eval `keychain --eval ~/.ssh/id_rsa`
```

id_rsa is private key file name among them.

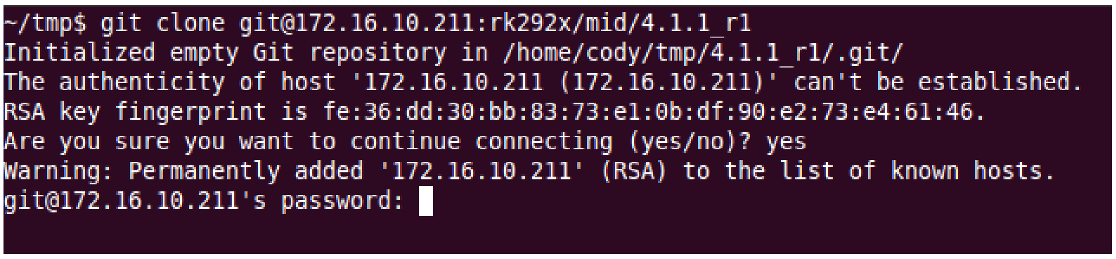
After the above configuration, log in to console again and it will prompt to enter password. Just enter password used to generate the key. If there is no password, you can not enter it.

In addition, try not to use sudo or root users unless you know how to handle, it will lead to permission and key management confusion.

10.3 Multiple machines use the same SSH public key

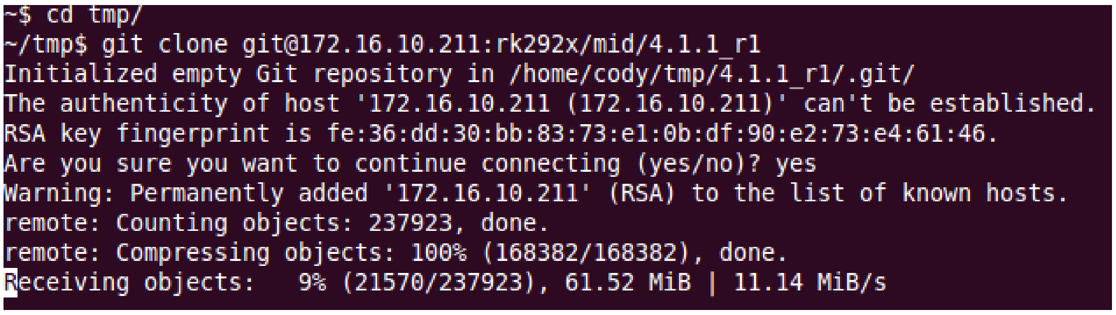
Use on different machines, you can copy ssh private key file id_rsa to "~/.ssh/id_rsa" of machines you want to use.

The following prompt will appear when using a wrong private key, please be careful to replace it with the correct private key.



```
~/tmp$ git clone git@172.16.10.211:rk292x/mid/4.1.1_r1
Initialized empty Git repository in /home/cody/tmp/4.1.1_r1/.git/
The authenticity of host '172.16.10.211 (172.16.10.211)' can't be established.
RSA key fingerprint is fe:36:dd:30:bb:83:73:e1:0b:df:90:e2:73:e4:61:46.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.16.10.211' (RSA) to the list of known hosts.
git@172.16.10.211's password:
```

After adding the correct private key, you can use git to clone code, as shown below.



```
~$ cd tmp/
~/tmp$ git clone git@172.16.10.211:rk292x/mid/4.1.1_r1
Initialized empty Git repository in /home/cody/tmp/4.1.1_r1/.git/
The authenticity of host '172.16.10.211 (172.16.10.211)' can't be established.
RSA key fingerprint is fe:36:dd:30:bb:83:73:e1:0b:df:90:e2:73:e4:61:46.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.16.10.211' (RSA) to the list of known hosts.
remote: Counting objects: 237923, done.
remote: Compressing objects: 100% (168382/168382), done.
Receiving objects:   9% (21570/237923), 61.52 MiB | 11.14 MiB/s
```

Adding ssh private key may result in the following error.

```
Agent admitted failture to sign using the key
```

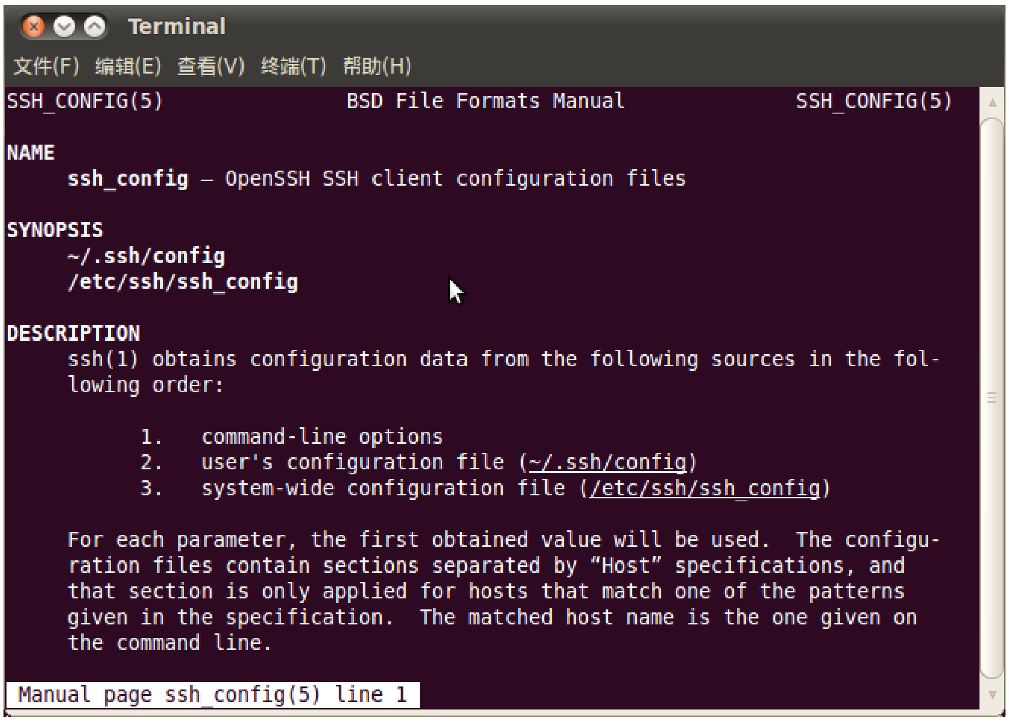
Enter the following command in console to solve

```
ssh-add ~/.ssh/id_rsa
```

10.4 One machine switches different SSH public keys

You can configure SSH by referring to ssh_config documentation.

```
~$ man ssh_config
```

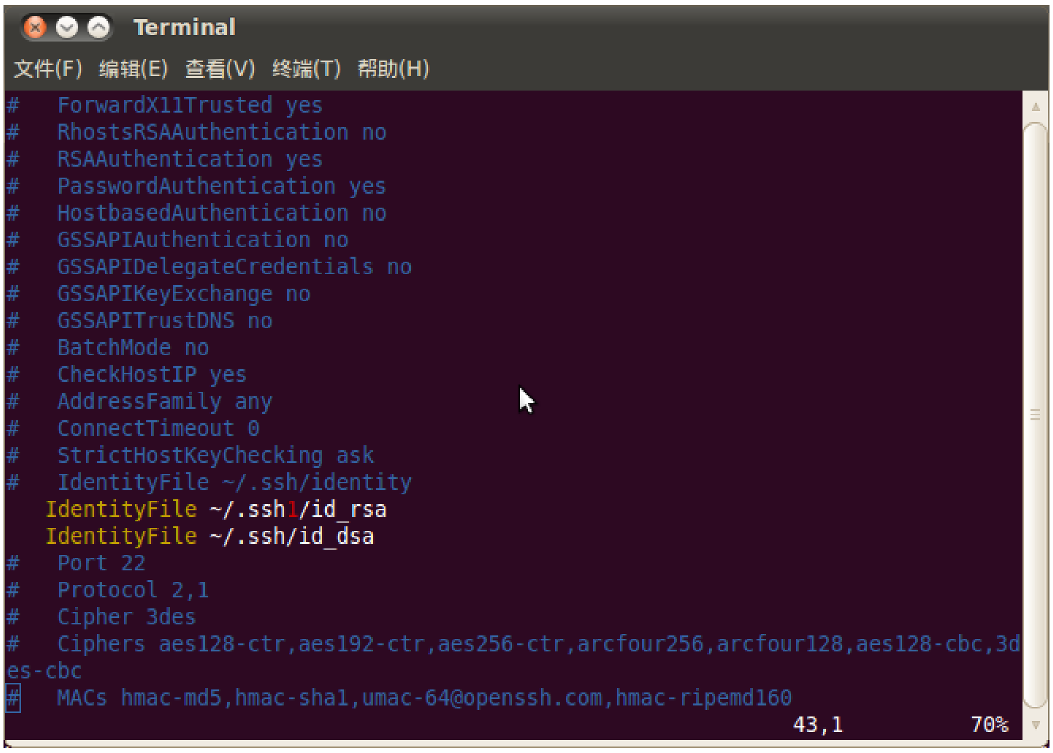


```
SSH_CONFIG(5)             BSD File Formats Manual            SSH_CONFIG(5)

NAME
     ssh_config — OpenSSH SSH client configuration files

SYNOPSIS
     ~/.ssh/config
     /etc/ssh/ssh_config

DESCRIPTION
     ssh(1) obtains configuration data from the following sources in the fol-
     lowing order:

           1.   command-line options
           2.   user's configuration file (~/.ssh/config)
           3.   system-wide configuration file (/etc/ssh/ssh_config)

     For each parameter, the first obtained value will be used.  The configu-
     ration files contain sections separated by “Host” specifications, and
     that section is only applied for hosts that match one of the patterns
     given in the specification.  The matched host name is the one given on
     the command line.

 Manual page ssh_config(5) line 1
```

Run the following command to configure SSH configuration of current user.

```
~$ cp /etc/ssh/ssh_config ~/.ssh/config
~$ vi .ssh/config
```

As shown in the figure, ssh uses the file "~/.ssh1/id_rsa" of another directory as an authentication private key. In this way, different keys can be switched.



```
#   ForwardX11Trusted yes
#   RhostsRSAAuthentication no
#   RSAAuthentication yes
#   PasswordAuthentication yes
#   HostbasedAuthentication no
#   GSSAPIAuthentication no
#   GSSAPIDelegateCredentials no
#   GSSAPIKeyExchange no
#   GSSAPITrustDNS no
#   BatchMode no
#   CheckHostIP yes
#   AddressFamily any
#   ConnectTimeout 0
#   StrictHostKeyChecking ask
#   IdentityFile ~/.ssh/identity
   IdentityFile ~/.ssh1/id_rsa
   IdentityFile ~/.ssh/id_dsa
#   Port 22
#   Protocol 2,1
#   Cipher 3des
#   Ciphers aes128-ctr,aes192-ctr,aes256-ctr,arcfour256,arcfour128,aes128-cbc,3d
es-cbc
#   MACs hmac-md5,hmac-sha1,umac-64@openssh.com,hmac-ripemd160
                                                              43,1          70%
```

10.5 Key authority management

Server can monitor download times and IP information of a key in real time. If an abnormality is found, download permission of the corresponding key will be disabled.
Keep the private key file properly. Do not grant second authorization to third parties.

10.6 Git access application instruction

Please email the public key file created according to the above chapter to fae@rock-chips.com, to apply for SDK code download permission.