

# **Apollo User Manual**

## **Version: 1.2**

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## Content

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## 1 Objective

Apollo User Manual (hereinafter referred to as the Manual) intends to introduce Apollo system to users and help users rapidly install and apply the system.

### 1.1 Audience

This manual is written in hope of application and testing of Apollo and development personnel who have known something about Linux and ROS. This manual is a basic tutorial for users who don't know a lot about computers.

### 1.2 Agreement

According to this manual, you are assumed to generally know about computers. This is an online user manual, which is more complete and prompt. With the iterative release of new versions, subsequent manuals might more or less deviate from this manual. In this case, you are supposed to operate according to the latest online user manual.

## 2 About Software

### 2.1. Functional Features

Apollo, as brain of unmanned aerial vehicles (UAVs), has powerful computing capability, many interfaces and 4G networking capability. With Linux operating system and integrated with TopXGun SDK, Apollo makes it more convenient to develop application scenarios of UAVs and brings more potential of UAVs into play.

#### ➤ **Powerful computing capability**

Using Freescale i.MX6 processor, Apollo is composed of 4 ARM Cortex-A9 processors and its dominant frequency is up to 1.2GHZ. With 2GBDDR3 memory and 16GB EMMC, it has powerful computing capability. In addition, Apollo uses a STM32F103 MCU as coprocessor for interacting with powerful real-time equipment, in order to ensure real-time performances of the whole system.

#### ➤ **Support of numerous interfaces**

With many interfaces, Apollo is used for managing and controlling airborne equipment (e.g.

task load, sensors and control modules).

➤ **High-speed networking capacity**

With built-in high-speed 4G modules, Apollo is applicable to China Mobile, China Telecom and China Unicom. By 4G, users can perform extremely remote control, cluster control and remote real-time monitoring of UAVs, in order that UAVs can really become online smart platforms.

➤ **Convenient development environment**

Apollo, equipped with Linux operating system and integrated with TopXGun SDK, is very convenient for developing airborne applications and software. Furthermore, Apollo is equipped with ROS and Qianxun Si SDK, making it convenient for developing applications and software for UAVs.

➤ **Low power consumption**

The power consumption of Apollo. In starting 4G communications, the maximum power consumption is 8W. Without 4G, the maximum power consumption is only 5W. With fan-free heat dissipation structure, Apollo is more reliable.

## 2.2. New Characteristics

Following functions are added in this launch:

Access to FCUs: it is applicable for accessing TopXGun M2 FCU to Apollo and controlling it.

External control: Integrating serial Interfaces, USB, OTG, CAN, ethernet, PWM and GPIO general control modules makes it convenient for rapid connection and functional extension between the system and the peripheral equipment.

Data transmission: applicable to transmission via bluetooth, networking cables, USB, 4G and radios for wireless data transmission.

Operation scheduling: applicable to mapping/surveying and power patrolling.

## 2.3. Technical Support

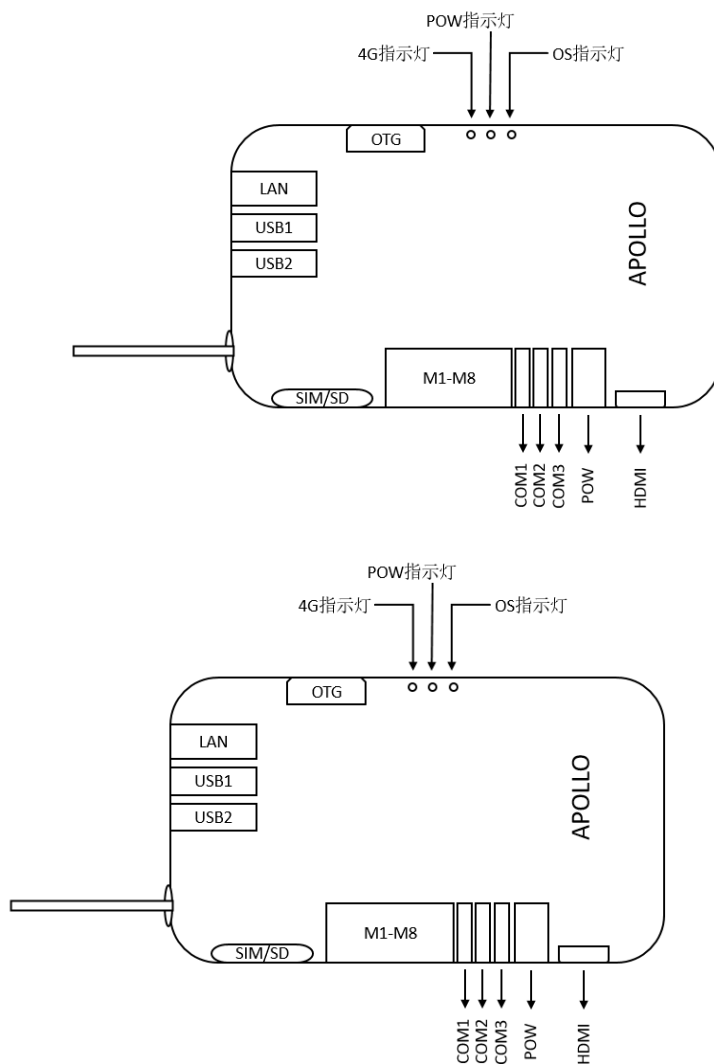
For details about technical support, refer to the official website of TopXGun: <http://www.topxgun.com/col-contact.html>

# 3. Hardware Environment

## 3.1. Preparation for Installation

For details about preparation for installation, please refer to the quick guide supplied together with Apollo as gift.

## 3.2 Hardware Installation



场景：测绘

- 1、OTG连接PC电脑进行应用安装
- 2、M1-M8连接测绘相机
- 3、COM1连接数传电台与地面站通讯
- 4、COM2连接M2 FCU飞控，控制飞机
- 5、COM3连接电脑进行Apollo调试
- 6、POW连接电源给Apollo供电

场景：电力巡检

- 1、OTG连接PC电脑进行应用安装
- 2、COM2连接M2 FCU飞控，控制飞机
- 3、COM3连接电脑进行Apollo调试
- 4、POW连接电源给Apollo供电
- 5、SIM口安装4G SIM卡进行控制
- 6、USB1连接云台相机

## 4. Software Environment

### 4.1 Software List

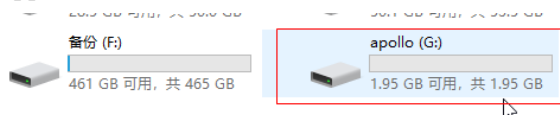
| SN | Type                   | Document Name                        | Specifications                                      |
|----|------------------------|--------------------------------------|-----------------------------------------------------|
| 1  | Apollo System Firmware | aos-0.1.1-nx001.apsw                 | Apollo Operating System                             |
| 2  |                        | apl-engine-1.2.3-r1.imx6qsabresd.rpm | Apollo engines provide waypoint-related tasks       |
| 3  |                        | apl-fcu-1.2.2-r1.imx6qsabresd.rpm    | Apollo interacts with FCU to obtain UID, configured |

|   |                      |                                                |                                                                                                |
|---|----------------------|------------------------------------------------|------------------------------------------------------------------------------------------------|
|   | Apollo Application   |                                                | parameters and telemetry data for the units                                                    |
| 4 |                      | apl-iocu-1.2.0-r1.imx6qsabresd.rpm             | Apollo is used for setting GPIO and PWM outputs as modes of operation for M1 and M8            |
| 5 |                      | apl-mapping-1.2.0-r1.imx6qsabresd.rpm          | Apollo is used for mapping, surveying and shooting                                             |
| 6 | Apollo IOCU firmware | APOLLO_IOCUC_0000_FA_2018040801_U_1.1.firmware | Apollo controls firmware that interacts with peripheral equipment in terms of input and output |

## 4.2 Software Installation

**Notes: For following operations, installations can be installed in computers with Windows system.**

1. Connect data cables of OTG to their interfaces via Apollo, and the other end to the USB interface of PC;
2. Electrify Apollo and wait for some time (about 20s), so that drive letters of Apollo appear on PC;

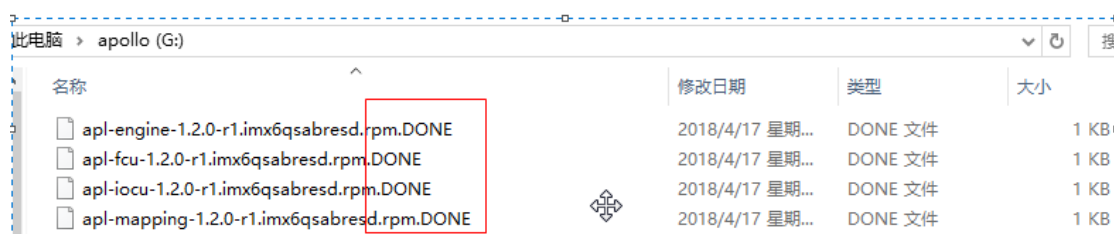


3. Copy files to be installed or updated to drive letters of Apollo. When several documents are copied together, Apollo will install and update them in succession;

|                                      |                  |       |          |
|--------------------------------------|------------------|-------|----------|
| apl-engine-1.2.0-r1.imx6qsabresd.rpm | 2018/5/2 星期三 ... | 360压缩 | 5,289 KB |
| apl-fcu-1.2.0-r1.imx6qsabresd.rpm    | 2018/5/2 星期三 ... | 360压缩 | 4,582 KB |

4. Reboot Apollo. Then, the system will be installed automatically.
5. After installation, a file suffixed “DONE” can be seen in the drive letter of Apollo. This means the installation has been completed. If the installation fails, a file suffixed failed will appear.

➤ **The successful installation is shown as follows:**



➤ **The failed installation is shown as follows:**

|                                                |                  |             |       |
|------------------------------------------------|------------------|-------------|-------|
| APOLLO_IOCUC_0000_FA_2018040801_U_1.1.firmware | 2018/5/3 星期四 ... | FIRMWARE 文件 | 15 KB |
| APOLLO_IOCUC_0000_FA_2018040801_U_1.1.firmware | 2018/4/17 星期...  | FAILED 文件   | 0 KB  |

6. By entering `cat /etc/aos-version` into the XShell terminal, current version of AOS can be viewed as shown in the following figure:

```
flier@imx6qsabresd:~$ cat /etc/aos-version
aos-0.1.1
```

### 4.3 Software Operation

Apollo systems and software can be powered on and run automatically once Apollo is electrified.

### 4.4 Software Development

For secondary software development based on Apollo operating system, please refer to the manual on Apollo development for details.

## 5 Common Problems

### 5.1 Connect the serial interfaces of Apollo with USB, but a question mark is displayed at the COM interface

- 1) Whether drivers have been installed correctly

Solution:

- a) Whether corresponding software has been correctly installed to drive the operating system
- b) Connect a computer to the FCU to check if the ports are numbered inside the equipment manager
- c) Switch off the power and resume operation

2. Check whether USB data cables are damaged

Solution:

- a) Replace data cables to resume operations

3. Problems with operating systems of computers

Solution:

- a) In view that some streamlined third-party operating systems lack files, we recommend genuine or pure operating systems

### 5.2 HDMI of Apollo can't be used

HDMI is disabled on a default basis for Apollo products. If necessary, please contact official after-sales service specialists of TopXGun

### 5.3 Meanings of indicator lamps of Apollo's OS

These indicator lamps are reserved to be used by customers and not uniformly defined.

### 5.4 Can 4G SIM cards be inserted into and pulled out of 4G card slots of Apollo without powering off?

4G SIM cards of Apollo can't be inserted into and pulled out of the slots without powering off for the time being. To insert and pull out 4G SIM cards, please power the Apollo off first.

### 5.5 4G of Apollo is automatically started without electrification. Then, how to make automatic connection of 4G possible just by powering on?

1. Log in to the No.3 serial interface of Apollo with terminal management tools (e.g. XShell) and confirm that 0.1.1 is the version of Apollo system. Enter following command line:

```
cat /etc/aos-version
```

2. Add following command line to #!bin/bash of /etc/rc5.d/S50app-run.sh, and restart Apollo after saving:

```
rm /home/flier/.4g-log
```

```
source /etc/4g-connect.sh > /home/flier/.4g-log &
```

### 5.6 How to configure for automatic startup of CAN without electrification?

1. Log in to the No.3 serial interface of Apollo with terminal management tools (e.g. XShell) and confirm that 0.1.1 is the version of Apollo system. Enter following command line:

```
cat /etc/aos-version
```

2. Add following command line to #!bin/bash of /etc/rc5.d/S50app-run.sh, and restart Apollo after saving:

```
ip link set can0 up type can bitrate 1000000 triple-sampling on
```

### 5.7 Packet loss is caused when gigabit network is accessed to Apollo

In this case, set the Apollo network interface cards under the 100M mode. Steps shall be taken as follows:

1. Log in to the No.3 serial interface of Apollo with terminal management tools (e.g. XShell) and confirm that 0.1.1 is the version of Apollo system. Enter following command line:

```
cat /etc/aos-version
```

2. Input following commands and power on to boot scripts

```
sudo vi /etc/rc5.d/S50app-run.sh
```

3. Add following command line to the second row and restart Apollo after saving the command line

---

```
ethtool -s eth0 speed 100 duplex full autoneg off
```

## 5.8 Changes to IP upon Each Startup of Apollo

In this case, static IP of Apollo shall be configured. Steps shall be taken as follows:

1. Log in to the No.3 serial interface of Apollo with terminal management tools (e.g. XShell) and confirm that 0.1.1 is the version of Apollo system. Enter following command line:

```
cat /etc/aos-version
```

2. Input following commands and open the control scripts

```
sudo vi /etc/network/interfaces
```

3. Add following content to scripts and save them.

```
auto eth0:0
iface eth0:0 inet static
address 10.10.10.10
netmask 255.0.0.0
```

4. Apollo will recognize the static IP of 10.10.10.10 on a default basis through above configurations

## 5.9 Regular manual cleaning will be necessary when the space and files for saving log files are too large.

1. Log in to the No.3 serial interface of Apollo with terminal management tools (e.g. XShell) and confirm that 0.1.1 is the version of Apollo system. Enter following command line:

```
cat /etc/aos-version
```

2. Input following command line to delete logs

```
rm -rf ~/.ros/log/*
```

## 5.10 How to upgrade AOS in case of failed upgrade?

To upgrade AOS, it is necessary to update Apollo loader at first. In this case, steps shall be taken as follows:

1. Copy “aloader-0.1.3-nx001.alsw” to Apollo through USB drives or networks;
2. Mount loader drives:  

```
sudo mount /dev/mmcblk3p2 /media/mmcblk3p2/
```
3. Delete the old loader:  

```
sudo rm /media/mmcblk3p2/* -rf
```
4. Load the new loader:  

```
sudo tar xvf aloader-0.1.3-nx001.alsw -C /media/mmcblk3p2/
```
5. Renovate magnetic disks:  

```
sync
```