**技术报告**

**题 目：**关于ardupilot工程的Makefile文件

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技术报告：关于ardupilot工程的Makefile文件

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主要内容：一、Makefile是什么

二、怎样翻译Makefile文件？

三、分析ardupilot工程的Makefile

一、Makefile文件是什么

make工具最主要也是最基本的功能就是通过makefile文件来描述源程序之间的相互关系并自动维护编译工作。而makefile 文件需要按照某种语法进行编写，文件中需要说明如何编译各个源文件并连接生成可执行文件，并要求定义源文件之间的依赖关系。

优点：“自动化编译”，一旦写好，只需要一个make 命令，整个工程完全自动编译，极大的提高了软件开发的效率。

二、怎样获取Makefile编译文件？

make 和 make -n 命令的区别：

make

该命令是执行Makefile文件，即完成自动编译的过程。

make -n

-n选项使make程序进入非执行模式，也就是说将原来应该执行的命令输出，而不是执行。

例：

make px4-v2 >/home/px4-v2.text

说明：该命令的作用是编译ardupilot工程文件，并将编译过程(仅仅是一些编译记录，不是详细的编译过程)重定向到 home文件夹下的px4-v2.text文件中。

make -n px4-v2 >/home/px4-v2-n.text

说明：该命令的作用是将编译ardupilot工程文件的过程(这个过程是很详细的过程)重定向到home文件夹下的px4-v2-n.text文件中，不编译该文件。

三、分析ardupilot工程的Makefile

(1) 固件中的子模块是怎么来的呢？

px4io.cpp.o

px4io\_uploader.cpp.o

drivers/px4io/module.pre.o px4io\_serial.cpp.o

(arm-none-eabi-ld工具) px4io\_i2c.cpp.o

px4io\_params.c.o

px4io\_params.c →px4io\_params.c.o (编译工具：arm-none-eabi-gcc)

px4io.cpp →px4io.cpp.o (编译工具：arm-none-eabi-g++)

px4io\_uploader.cpp →px4io\_uploader.cpp.o

px4io\_serial.cpp →px4io\_serial.cpp.o

px4io\_i2c.cpp →px4io\_i2c.cpp.o

编译时，先将这些 \*.c和 \*.cpp文件编译成对应的 \*.O文件，然后通过prelink工具将这些 \*.O文件预链接成对应的 \*.pre.o文件。最后再将这些 \*.pre.o 链接成Firmware.elf 固件

为什么编译的时候要使用Prelink工具呢？

Prelink是Red Hat 开发者 Jakub Jelinek 所设计的工具，正如其名字所示，Prelink利用事先链接代替运行时链接的方法来加速共享库的加载，它不仅可以加快起动速度，还可以减少部分内存开销，是各种Linux架构上用于减少程序加载时间、缩短系统启动时间和加快应用程序启动的很受欢迎的一个工具。

Prelink工具的原理主要基于这样一个事实：动态链接和加载的过程开销很大，并且在大多数的系统上, 函数库并不会常常被更动, 每次程序被执行时所进行的链接动作都是完全相同的，对于嵌入式系统来说尤其如此。因此，这一过程可以改在运行时之前就可以预先处理好，即花一些时间利用 Prelink工具对动态共享库和可执行文件进行处理，修改这些二进制文件并加入相应的重定位等信息，节约了本来在程序启动时的比较耗时的查询函数地址等工作，这样可以减少程序启动的时间，同时也减少了内存的耗用。

1. 固件由哪些子模块构成？

px4fmu-v2\_APM.build/builtin\_commands.c.o

mygit/ardupilot/module.pre.o

modules/PX4Firmware/src/drivers/

modules/PX4Firmware/src/lib/

Firmware.elf modules/PX4Firmware/src/systemcmds/

modules/PX4Firmware/src/platforms/

modules/PX4Firmware/src/modules/systemlib/

src/modules/uORB/module.pre.o

src/modules/uavcan/module.pre.o

还有一些库文件，如libm.a、libgcc.a

生成后的firmware.elf文件通过arm-none-eabi-objcopy工具转换为firmware.bin文件；然后通过Tools/px\_mkfw.py 工具将firmware.bin文件转换为firmware.px4文件；最后通过cp命令将firmware.px4文件复制给px4fmu-v2\_APM.px4，再将px4fmu-v2\_APM.px4文件复制给ArduCopter-v2.px4。

这个ardupilot工程文件里面的所有的\*.c/.cpp文件在经过编译之后，会生成一个\*.d文件，这个\*.d文件描述了该文件在编译时包含了哪些头文件。

以Arducopter.cpp文件为例，该文件经过编译之后会生成一个Arducopter.cpp.d文件。在这个.d文件中，我们就可以看到Arducopter.cpp在编译时引用了哪些头文件。

分析Makefile文件的**方法**：

先使用make -n命令工具获取Makefile文件执行编译命令时详细的编译过程，然后分析这个编译过程中编译了哪些\*.c/.cpp文件，然后阅读这些\*.c/.cpp文件编译时生成的\*.d文件(这个\*.d文件描述了该文件在编译时包含了哪些头文件和库文件)。

**附录：**

**F103芯片上运行的代码：**

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/drivers/boards/px4io-v2/px4iov2\_init.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/drivers/boards/px4io-v2/px4iov2\_pwm\_servo.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/drivers/stm32/drv\_hrt.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/adc.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/controls.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/dsm.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/px4io.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/registers.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/safety.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/sbus.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/up\_cxxinitialize.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/perf\_counter.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/mixer.cpp

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/mixer/mixer.cpp

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/mixer/mixer\_group.cpp

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/mixer/mixer\_multirotor.cpp

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/mixer/mixer\_simple.cpp

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../systemlib/pwm\_limit/pwm\_limit.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../../lib/rc/st24.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/../../lib/rc/sumd.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/px4iofirmware/serial.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/platforms/common/px4\_getopt.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/platforms/nuttx/px4\_layer/px4\_nuttx\_tasks.c

**F427芯片上运行的代码：**

/home/liuguanggui/mygit/ardupilot/ArduCopter/AP\_State.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/ArduCopter.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/Attitude.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/capabilities.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/commands.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/commands\_logic.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/compassmot.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/compat.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_acro.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_althold.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_auto.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_autotune.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_brake.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_circle.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_drift.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_flip.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_guided.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_land.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_loiter.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_poshold.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_rtl.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_sport.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/control\_stabilize.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/Copter.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/crash\_check.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/ekf\_check.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/esc\_calibration.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/events.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/failsafe.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/fence.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/flight\_mode.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/GCS\_Mavlink.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/heli\_control\_acro.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/heli\_control\_stabilize.cpp

/home/liuguanggui/mygit/ardupilot/ArduCopter/heli.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/inertia.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/land\_detector.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/landing\_gear.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/leds.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/Log.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/motors.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/motor\_test.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/navigation.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/Parameters.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/perf\_info.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/position\_vector.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/precision\_landing.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/radio.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/sensors.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/setup.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/switches.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/system.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/takeoff.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/test.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/tuning.cpp /home/liuguanggui/mygit/ardupilot/ArduCopter/UserCode.cpp

libraries/AP\_Common/AP\_Common.cpp

libraries/AP\_Common/c++.cpp

libraries/AP\_Menu/AP\_Menu.cpp

libraries/AP\_Param/AP\_Param.cpp libraries/StorageManager/StorageManager.cpp libraries/GCS\_MAVLink/GCS\_Common.cpp libraries/GCS\_MAVLink/GCS\_Logs.cpp libraries/GCS\_MAVLink/GCS\_MAVLink.cpp libraries/GCS\_MAVLink/GCS\_serial\_control.cpp libraries/GCS\_MAVLink/MAVLink\_routing.cpp libraries/AP\_SerialManager/AP\_SerialManager.cpp libraries/AP\_GPS/AP\_GPS.cpp

libraries/AP\_GPS/AP\_GPS\_GSOF.cpp libraries/AP\_GPS/AP\_GPS\_MTK19.cpp libraries/AP\_GPS/AP\_GPS\_MTK.cpp libraries/AP\_GPS/AP\_GPS\_NMEA.cpp

libraries/AP\_GPS/AP\_GPS\_PX4.cpp

libraries/AP\_GPS/AP\_GPS\_SBF.cpp

libraries/AP\_GPS/AP\_GPS\_SBP.cpp

libraries/AP\_GPS/AP\_GPS\_SIRF.cpp libraries/AP\_GPS/AP\_GPS\_UBLOX.cpp libraries/AP\_GPS/GPS\_Backend.cpp libraries/DataFlash/DataFlash\_Backend.cpp libraries/DataFlash/DataFlash\_Block.cpp libraries/DataFlash/DataFlash.cpp libraries/DataFlash/DataFlash\_Empty.cpp libraries/DataFlash/DataFlash\_File.cpp libraries/DataFlash/DataFlash\_SITL.cpp libraries/DataFlash/DFMessageWriter.cpp libraries/DataFlash/LogFile.cpp

libraries/AP\_ADC/AP\_ADC\_ADS1115.cpp libraries/AP\_ADC/AP\_ADC\_ADS7844.cpp

libraries/AP\_ADC/AP\_ADC.cpp libraries/AP\_ADC\_AnalogSource/AP\_ADC\_AnalogSource.cpp libraries/AP\_Baro/AP\_Baro\_Backend.cpp libraries/AP\_Baro/AP\_Baro\_BMP085.cpp

libraries/AP\_Baro/AP\_Baro.cpp

libraries/AP\_Baro/AP\_Baro\_HIL.cpp libraries/AP\_Baro/AP\_Baro\_MS5611.cpp libraries/AP\_Baro/AP\_Baro\_PX4.cpp libraries/AP\_Compass/AP\_Compass\_AK8963.cpp libraries/AP\_Compass/AP\_Compass\_Backend.cpp libraries/AP\_Compass/AP\_Compass\_Calibration.cpp libraries/AP\_Compass/AP\_Compass\_HIL.cpp libraries/AP\_Compass/AP\_Compass\_HMC5843.cpp libraries/AP\_Compass/AP\_Compass\_LSM303D.cpp libraries/AP\_Compass/AP\_Compass\_PX4.cpp libraries/AP\_Compass/CompassCalibrator.cpp libraries/AP\_Compass/Compass.cpp libraries/AP\_Compass/Compass\_learn.cpp libraries/AP\_Math/AP\_Math.cpp

libraries/AP\_Math/edc.cpp

libraries/AP\_Math/location.cpp

libraries/AP\_Math/matrix3.cpp

libraries/AP\_Math/matrix\_alg.cpp

libraries/AP\_Math/polygon.cpp

libraries/AP\_Math/quaternion.cpp

libraries/AP\_Math/vector2.cpp

libraries/AP\_Math/vector3.cpp

libraries/AP\_Curve/AP\_Curve.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_Backend.cpp libraries/AP\_InertialSensor/AP\_InertialSensor.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_Flymaple.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_HIL.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_L3G4200D.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_LSM9DS0.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_MPU6000.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_MPU9150.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_MPU9250.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_PX4.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_SITL.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_UserInteract\_MAVLink.cpp libraries/AP\_InertialSensor/AP\_InertialSensor\_UserInteract\_Stream.cpp libraries/AP\_InertialSensor/AuxiliaryBus.cpp libraries/AP\_AHRS/AP\_AHRS.cpp libraries/AP\_AHRS/AP\_AHRS\_DCM.cpp libraries/AP\_AHRS/AP\_AHRS\_NavEKF.cpp libraries/AP\_NavEKF/AP\_NavEKF\_core.cpp libraries/AP\_NavEKF/AP\_NavEKF.cpp libraries/AP\_NavEKF/AP\_SmallEKF.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_AirDataFusion.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_Control.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_core.cpp libraries/AP\_NavEKF2/AP\_NavEKF2.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_MagFusion.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_Measurements.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_OptFlowFusion.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_Outputs.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_PosVelFusion.cpp libraries/AP\_NavEKF2/AP\_NavEKF2\_VehicleStatus.cpp libraries/AP\_NavEKF2/AP\_NavEKF\_GyroBias.cpp libraries/AP\_Mission/AP\_Mission.cpp

libraries/AP\_Rally/AP\_Rally.cpp

libraries/AC\_PID/AC\_HELI\_PID.cpp

libraries/AC\_PID/AC\_P.cpp

libraries/AC\_PID/AC\_PI\_2D.cpp

libraries/AC\_PID/AC\_PID.cpp libraries/AC\_AttitudeControl/AC\_AttitudeControl.cpp libraries/AC\_AttitudeControl/AC\_AttitudeControl\_Heli.cpp libraries/AC\_AttitudeControl/AC\_AttitudeControl\_Multi.cpp libraries/AC\_AttitudeControl/AC\_PosControl.cpp libraries/RC\_Channel/RC\_Channel\_aux.cpp libraries/RC\_Channel/RC\_Channel.cpp libraries/AP\_Motors/AP\_Motors\_Class.cpp libraries/AP\_Motors/AP\_MotorsCoax.cpp libraries/AP\_Motors/AP\_MotorsHeli.cpp libraries/AP\_Motors/AP\_MotorsHeli\_RSC.cpp libraries/AP\_Motors/AP\_MotorsHeli\_Single.cpp libraries/AP\_Motors/AP\_MotorsHexa.cpp libraries/AP\_Motors/AP\_MotorsMatrix.cpp libraries/AP\_Motors/AP\_MotorsMulticopter.cpp libraries/AP\_Motors/AP\_MotorsOcta.cpp libraries/AP\_Motors/AP\_MotorsOctaQuad.cpp libraries/AP\_Motors/AP\_MotorsQuad.cpp libraries/AP\_Motors/AP\_MotorsSingle.cpp libraries/AP\_Motors/AP\_MotorsTri.cpp libraries/AP\_Motors/AP\_MotorsY6.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_analog.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_BBB\_PRU.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_LightWareI2C.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_LightWareSerial.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_MaxsonarI2CXL.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_PulsedLightLRF.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_PX4.cpp libraries/AP\_RangeFinder/AP\_RangeFinder\_PX4\_PWM.cpp libraries/AP\_RangeFinder/RangeFinder\_Backend.cpp libraries/AP\_RangeFinder/RangeFinder.cpp libraries/AP\_OpticalFlow/AP\_OpticalFlow\_HIL.cpp libraries/AP\_OpticalFlow/AP\_OpticalFlow\_Linux.cpp libraries/AP\_OpticalFlow/AP\_OpticalFlow\_PX4.cpp libraries/AP\_OpticalFlow/OpticalFlow\_backend.cpp libraries/AP\_OpticalFlow/OpticalFlow.cpp libraries/AP\_RSSI/AP\_RSSI.cpp libraries/Filter/DerivativeFilter.cpp libraries/Filter/LowPassFilter2p.cpp libraries/Filter/LowPassFilter.cpp libraries/AP\_Relay/AP\_Relay.cpp libraries/AP\_ServoRelayEvents/AP\_ServoRelayEvents.cpp libraries/AP\_Camera/AP\_Camera.cpp libraries/AP\_Mount/AP\_Gimbal.cpp libraries/AP\_Mount/AP\_Mount\_Alexmos.cpp libraries/AP\_Mount/AP\_Mount\_Backend.cpp libraries/AP\_Mount/AP\_Mount.cpp libraries/AP\_Mount/AP\_Mount\_MAVLink.cpp libraries/AP\_Mount/AP\_Mount\_Servo.cpp libraries/AP\_Mount/AP\_Mount\_SToRM32.cpp libraries/AP\_Mount/AP\_Mount\_SToRM32\_serial.cpp libraries/AP\_Airspeed/Airspeed\_Calibration.cpp libraries/AP\_Airspeed/AP\_Airspeed\_analog.cpp libraries/AP\_Airspeed/AP\_Airspeed.cpp libraries/AP\_Airspeed/AP\_Airspeed\_I2C.cpp libraries/AP\_Airspeed/AP\_Airspeed\_PX4.cpp libraries/AP\_InertialNav/AP\_InertialNav\_NavEKF.cpp libraries/AC\_WPNav/AC\_Circle.cpp libraries/AC\_WPNav/AC\_WPNav.cpp libraries/AP\_Declination/AP\_Declination.cpp libraries/AC\_Fence/AC\_Fence.cpp libraries/AP\_Scheduler/AP\_Scheduler.cpp libraries/AP\_RCMapper/AP\_RCMapper.cpp libraries/AP\_Notify/AP\_BoardLED.cpp libraries/AP\_Notify/AP\_Notify.cpp libraries/AP\_Notify/Buzzer.cpp libraries/AP\_Notify/ExternalLED.cpp libraries/AP\_Notify/NavioLED.cpp libraries/AP\_Notify/NavioLED\_I2C.cpp libraries/AP\_Notify/OreoLED\_PX4.cpp libraries/AP\_Notify/RGBLed.cpp libraries/AP\_Notify/ToneAlarm\_Linux.cpp libraries/AP\_Notify/ToneAlarm\_PX4.cpp libraries/AP\_Notify/ToshibaLED.cpp libraries/AP\_Notify/ToshibaLED\_I2C.cpp libraries/AP\_Notify/ToshibaLED\_PX4.cpp libraries/AP\_Notify/VRBoard\_LED.cpp libraries/AP\_BattMonitor/AP\_BattMonitor\_Analog.cpp libraries/AP\_BattMonitor/AP\_BattMonitor\_Backend.cpp libraries/AP\_BattMonitor/AP\_BattMonitor\_Bebop.cpp libraries/AP\_BattMonitor/AP\_BattMonitor.cpp libraries/AP\_BattMonitor/AP\_BattMonitor\_SMBus\_I2C.cpp libraries/AP\_BattMonitor/AP\_BattMonitor\_SMBus\_PX4.cpp libraries/AP\_BoardConfig/AP\_BoardConfig.cpp libraries/AP\_Frsky\_Telem/AP\_Frsky\_Telem.cpp libraries/AC\_Sprayer/AC\_Sprayer.cpp

libraries/AP\_EPM/AP\_EPM.cpp libraries/AP\_Parachute/AP\_Parachute.cpp libraries/AP\_LandingGear/AP\_LandingGear.cpp libraries/AP\_Terrain/AP\_Terrain.cpp

libraries/AP\_Terrain/TerrainGCS.cpp

libraries/AP\_Terrain/TerrainIO.cpp libraries/AP\_Terrain/TerrainMission.cpp libraries/AP\_Terrain/TerrainUtil.cpp

libraries/AP\_RPM/AP\_RPM.cpp

libraries/AP\_RPM/RPM\_Backend.cpp libraries/AP\_RPM/RPM\_PX4\_PWM.cpp libraries/AC\_PrecLand/AC\_PrecLand\_Companion.cpp libraries/AC\_PrecLand/AC\_PrecLand.cpp libraries/AC\_PrecLand/AC\_PrecLand\_IRLock.cpp libraries/AP\_IRLock/AP\_IRLock\_PX4.cpp

libraries/AP\_IRLock/IRLock.cpp libraries/AC\_InputManager/AC\_InputManager.cpp libraries/AC\_InputManager/AC\_InputManager\_Heli.cpp libraries/AP\_HAL/HAL.cpp

libraries/AP\_HAL/UARTDriver.cpp

libraries/AP\_HAL/Util.cpp

libraries/AP\_HAL\_Empty/AnalogIn.cpp libraries/AP\_HAL\_Empty/GPIO.cpp libraries/AP\_HAL\_Empty/HAL\_Empty\_Class.cpp libraries/AP\_HAL\_Empty/I2CDriver.cpp libraries/AP\_HAL\_Empty/PrivateMember.cpp libraries/AP\_HAL\_Empty/RCInput.cpp libraries/AP\_HAL\_Empty/RCOutput.cpp libraries/AP\_HAL\_Empty/Scheduler.cpp libraries/AP\_HAL\_Empty/Semaphores.cpp libraries/AP\_HAL\_Empty/SPIDriver.cpp libraries/AP\_HAL\_Empty/Storage.cpp libraries/AP\_HAL\_Empty/UARTDriver.cpp libraries/AP\_HAL\_PX4/AnalogIn.cpp

libraries/AP\_HAL\_PX4/GPIO.cpp libraries/AP\_HAL\_PX4/HAL\_PX4\_Class.cpp libraries/AP\_HAL\_PX4/I2CDriver.cpp libraries/AP\_HAL\_PX4/NSHShellStream.cpp libraries/AP\_HAL\_PX4/px4\_param.cpp libraries/AP\_HAL\_PX4/RCInput.cpp

libraries/AP\_HAL\_PX4/RCOutput.cpp libraries/AP\_HAL\_PX4/Scheduler.cpp

libraries/AP\_HAL\_PX4/Storage.cpp libraries/AP\_HAL\_PX4/UARTDriver.cpp

libraries/AP\_HAL\_PX4/Util.cpp

libraries/AP\_HAL/utility/ftoa\_engine.cpp libraries/AP\_HAL/utility/getopt\_cpp.cpp libraries/AP\_HAL/utility/Print.cpp libraries/AP\_HAL/utility/print\_vprintf.cpp libraries/AP\_HAL/utility/Socket.cpp libraries/AP\_HAL/utility/utoa\_invert.cpp"

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/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/drivers/boards/px4fmu-v2/px4fmu\_can.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/drivers/boards/px4fmu-v2/px4fmu2\_init.c

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/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/modules/systemlib/perf\_counter.c

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/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/transport/uc\_transfer\_buffer.cpp

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/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/transport/uc\_transfer\_listener.cpp

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/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/uc\_dynamic\_memory.cpp

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/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/driver/uc\_can.cpp

/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/uc\_data\_type.cpp

/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/protocol/uc\_node\_status\_monitor.cpp

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/home/liuguanggui/mygit/ardupilot/modules/uavcan//libuavcan/src/protocol/uc\_global\_time\_sync\_master.cpp

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/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/platforms/common/px4\_getopt.c

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/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/systemcmds/bl\_update/bl\_update.c

/home/liuguanggui/mygit/ardupilot/modules/PX4Firmware/src/systemcmds/mixer/mixer.cpp

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