DJM Transfer Manual

David McCaleb – 5 NOV 2021

Purpose

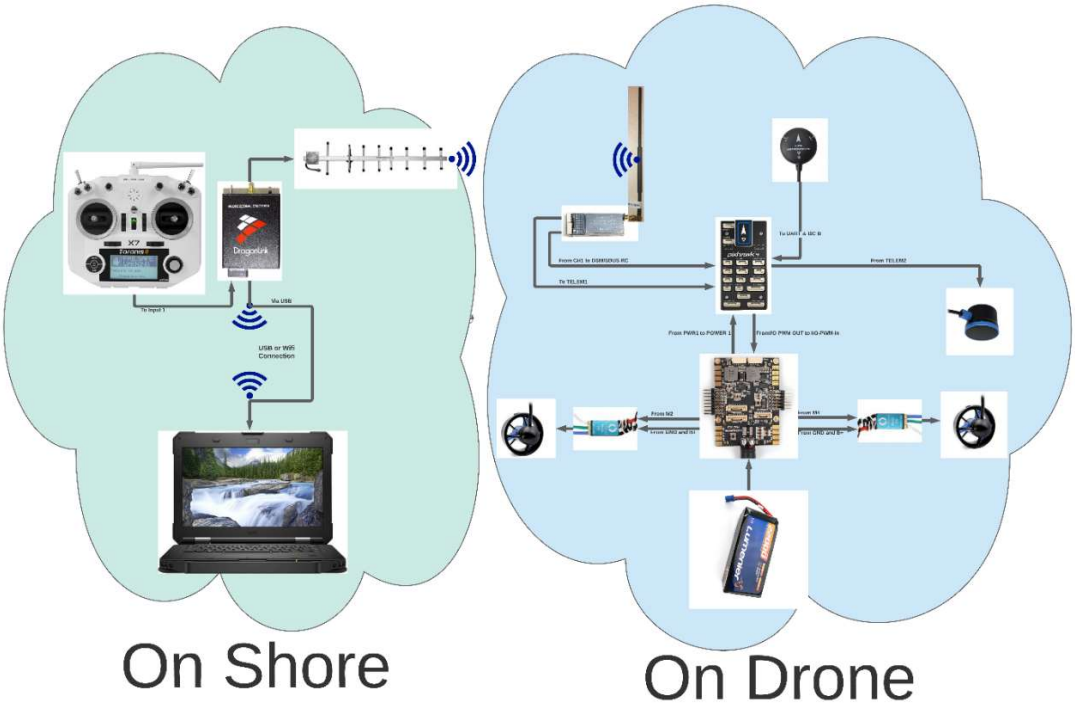
- Outline DJM's knowledge of the "Little Red Doggie" hydro drone.

Important vocab

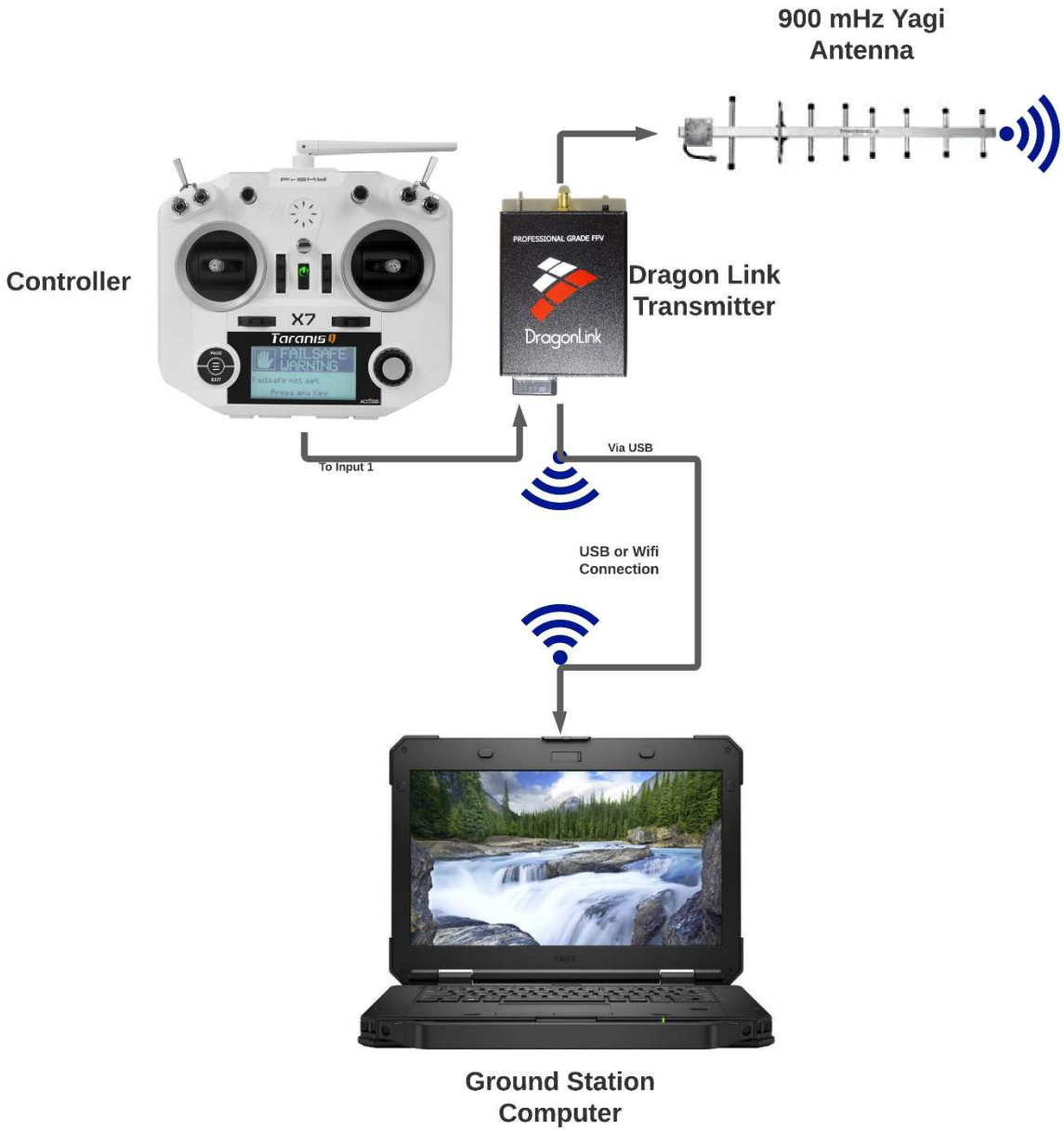
- TX – transmitter
- RX – Receiver
- GS – Ground Station
- JST – Japanese Solderless Terminal
- Telemetry – Two-way communication

General overview of drone

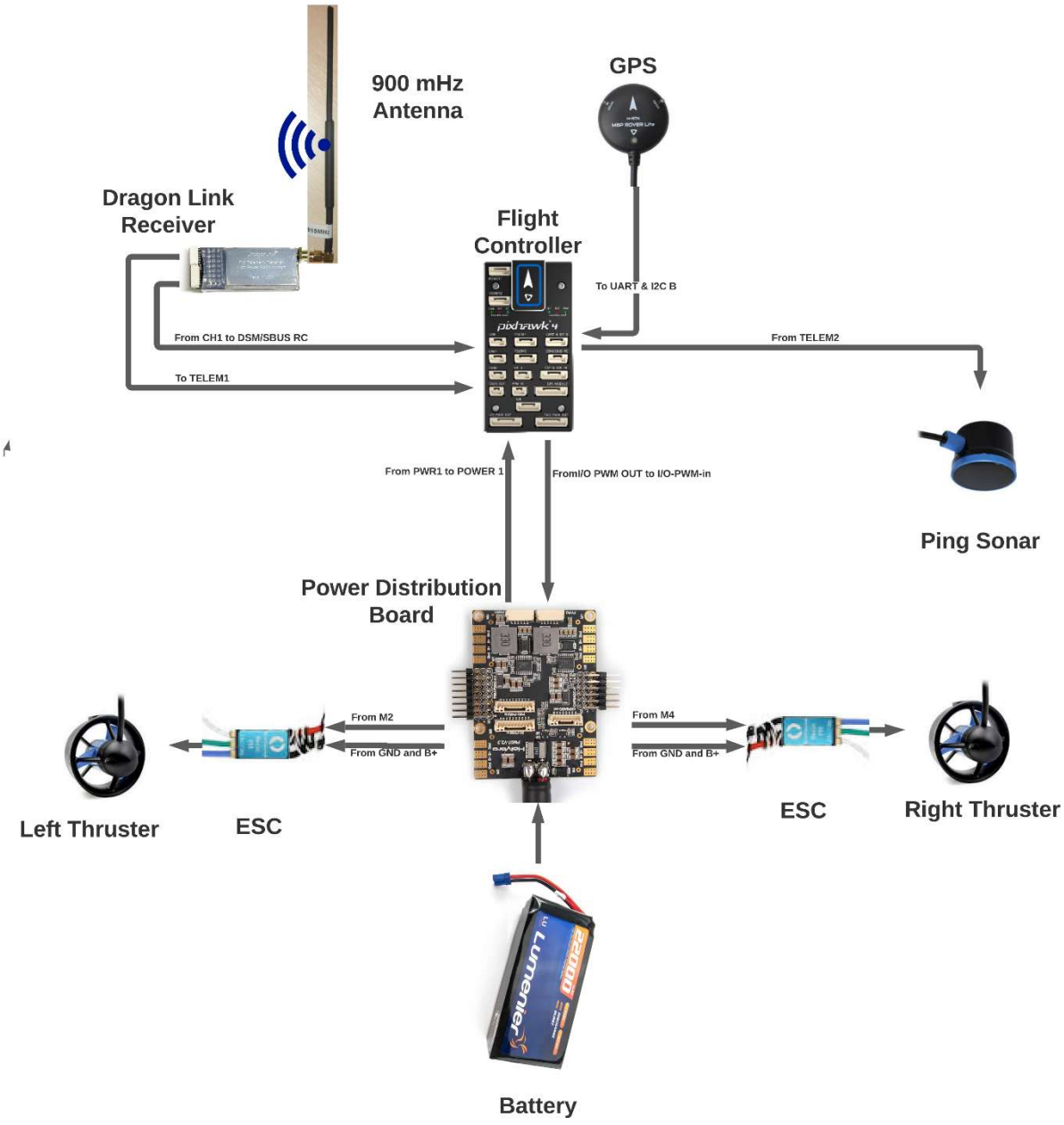
- **Entire System Diagram**



- **Shore Side System Diagram**



- **Drone Side**


900 mHz
Antenna
GPS
Dragon Link
Receiver
Flight
Controller
To UART & I2C B
From CH1 to DSM/SBUS RC
To TELEM1
From TELEM2
From PWR1 to POWER 1
FromI/O PWM OUT to I/O-PWM-in
Ping Sonar
Power Distribution
Board
From M2
From GND and B+
From M4
From GND and B+
Left Thruster
ESC
ESC
Right Thruster
Battery

Components

900 mHz Yagi Antenna

- This is a high gain (very directional) antenna.
- The original antenna that came with the Dragon link had a dBi of 3 and broke prematurely.

Technical characteristics of the antenna:

Polarization	linear
Resonant frequency, MHz	915
Gain, dBi	13,3
VSWR, not more	1,2
Impedance, Ohm	50
Input power, W	10
Jack	SMA male(can change by your request)
Cable Length, cm	40
Weight, g	350
Operating temperature, deg. Celsius	-40 Ã· +50

- Here is a link discussing antenna gain: https://www.telewave.com/2018/02/understanding-antenna-gain/
- Here is the link where you can purchase this antenna: https://www.ebay.com/itm/224358205079
- Here is the email of the manufacturer: baliv@ua.fm
- Note: There are different kinds of antenna jacks (plugs). There are two kinds of SMA connectors you need to be aware of. RP SMA will not fit in a regular SMA. https://www.arcantenna.com/blogs/news/sma-vs-rpsma-coax-connectors-what-is-the-difference

Dragon link Transmitter

- This is a UHF (Ultra High Frequency) transmitter used for long range communication.
- It transmits up to 1 watt at 900 mHz. Power can be adjusted in the GUI.
- Radio Frequency band explained: https://en.wikipedia.org/wiki/Radio_spectrum
- Transmitter power output explained: https://en.wikipedia.org/wiki/Transmitter_power_output
- Legally, you need an amature radio license to operate a 900mhz radio. Most Dragon Link owners do not however because it uses a frequency hopping band. This reduces the impact to other 900mHz “listeners”.
- Frequency hopping explained: https://en.wikipedia.org/wiki/Frequency-hopping_spread_spectrum
- It receives power and a PPM signal (not PWM) from the controller.

- If it is not receiving enough power (at least 6.5v), it will beep and the LED on the top will tun red.
- This is powered by the Controller or USB. USB will only supply 5v however.
- A blue led means it is connected to the RX.
- A green led means it is receiving a valid PPM signal from the controller but is not connected to the RX.
- Here are the steps to bind the TX and the RX (you should only need to do this once unless you make certain edits):
  - Power off the TX and RX
  - Hold down the “menu” button on the TX
  - Power on the TX and wait until the LED turns blue
  - Release the “menu” button
  - Power on the RX
  - Both the TX and RX should have a blue led
  - Power both systems off
  - Power both systems on
- It also acts as a receiver from the drone as well.
- It can connect to the ground station computer via USB or WIFI. This is set up in the GUI under “Extenal Connections”
  - We preferred using USB because it was more reliable.
  - QGC could not connect via WIFI.
  - For WIfi connection, go to the GUI and change the Wifi/Bluetooth option to Radio Modem and USB function to GUI
  - To connect to the drone using Mission planner over wifi:
    - Connect the GS computer to Dragon Link Wifi
    - Open Mission Planner
    - Select TCP in the top left drop down instead of COM_
    - Baud should be the same as is specified in “External Connections” in the Dragon Link GUI
    - Type IP address of 192.168.1.1 and port of 14550
  - Here is some info: http://www.dragonlinkrc.com/instructions/v3equipment/wifisetup/ (note, the firmware has already been updated)
- IMPORTANT: Do not power on the transmitter without an antenna screwed on. The antenna acts as a resistor and the circuitry will fry without it.
- Here is the link to purchase it: http://www.fpvpro.com/dragon-link-advanced-900-mhz-wifi-complete-system

Controller

- This is a FrSky TARANIS Q X7
- This has all the buttons and switches used to manually control the drone.
- It contains a 2.4 mHz transmitter but the dragon link transmitter is being used instead to boost range.
- The top left switch is used to arm and disarm the drone (away=disarm, close=arm)

- 
- The left most switch is used to switch the mode of the drone (away=manual, middle=auto, close=loiter)
- 
- The two gimbals are used to control the drone
- All other buttons and switches are not currently used
- To power on the drone, press and HOLD the power button
- The battery is stored in the back of the controller and can be swapped out for one with more capacity if necisary.
- The Dragon link is plugged into the pins in the module bay as seen

- 

- These pins are specific to this style of controller.
- The controller will beep when not in use
- IMPORTANT: configuring the qx7 https://www.youtube.com/watch?v=NIR85KOqIAo https://www.youtube.com/watch?v=YD3ojhwVmrI

Ground Station Computer

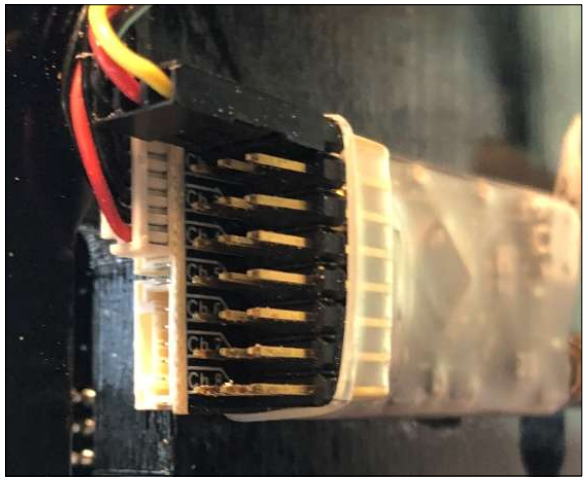
- This computer is what you plan missions and view the telemetry data from the drone with.
- You control the drone using QGroundControl or Mission Planner software. These are outlined in the software_videos folder.

900 mHz Antenna

- This is a high-quality antenna for the Dragon Link receiver.
- You can purchase it at this link: https://www.ebay.com/itm/222751331415
- Here is the email of the manufacturer: baliv@ua.fm
- Carbon fiber, metal, and other materials will interfere if they are near the antenna.

Dragon Link Receiver

- This receives information from the transmitter and relays it to the Flight Controller
- This is a 1W receiver that operates at 900mhz
- You can purchase it at this link: http://www.fpvpro.com/dragon-link-advanced-900-mhz-micro-receiver
- Ensure you purchase the 1000mW not the 25mW
- If the blue light is on, it is bound to the transmitter.
- There are two cables connecting it to the Flight Controller. The RX's 6pin JST connector connects to TELEM 1 of the Flight Controller. The servo connector plugged into Ch 1 on the RX connects to DSM/SBUS RC on the Flight Controller. This is shown in the system diagram.

- 
- The second (SBUS) cable is not necessary if the system is configured properly (as it has been in the past). The Flight controller was receiving telemetry information but not manual control information so, in the interest of time, we configured (in the dragon ling GUI) Ch 1 as a SUBS out and connected it to the Flight controller's SBUS in. This works well and we have had no problems with it.
- IMPORTANT: Do not power on the RX without an antenna. This will fry it.
- JST explained: https://core-electronics.com.au/tutorials/what-is-a-jst-connector.html

GPS

- This supplies location and orientation information to the flight controller
- This is a F9P module created by UBLOX and placed in a case and sold by Holybro. This module is configured into a base station or rover gps. The rover lite has all the capabilities of the rover but does not have the safety switch.
- Here is the link to the manual for the F9P: https://www.u-blox.com/sites/default/files/ZED-F9P_IntegrationManual_UBX-18010802.pdf
- Here is the link to purchase it: http://shop.holybro.com/h-rtk-f9p-gnss-series_p1226.html
- Here is a link with info about GPS: https://www.nj.gov/dep/gis/faqgps.html#:~:text=back%20to%20top-,What%20is%20a%20base%20station%3F,most%20often%20a%20personal%20computer.

Flight Controller

- This is the "brain" of the drone. It is a computer that receives information from the GPS and internal sensors and decides how much power to provide each thruster
- This uses open-source software
- It is created by Holybro
- It can be configured to control a wide range of drones, including fixed wing and multirotor
- It was originally flashed with PX4 but we flashed it with ArduPilot

- Here is a video describing how to flash ArduPilot on a Pixhawk 4: https://www.youtube.com/watch?v=mEECLCmXEXg
- ArduPilot and Drone Code worked together to make the Pixhawk 4, but relations fell apart after its release. Drone Code stole the "Pixhawk" name and subsequent models of ArduPilot's flight controllers were called "Pixhawk Cubes" or just "Cubes". There is far more support for ArduPilot systems than Pixhawk 4 systems. Because of this we will use a Cube in our next build.
- Here is the most important link. It gives clear explanations on how to configure almost anything about the flight controller: https://ardupilot.org/rover/
- The flight controller is configured in Mission Planner or QGroundControl. This is outlined the videos under software_videos.

Ping Sonar

- This uses sound to determine the depth of water
- This is plugged into the TELEM 2 port of the Flight Controller
- Ping sonar Pixhawk setup: https://ardupilot.org/rover/docs/common-bluerobotics-ping.html
- Link about sonar https://www.furuno.com/en/technology/sonar/basic/
- Link to purchase it https://bluerobotics.com/product/ping-sonar-r2-rp/

Power Distribution Board

- Also known as a PDB, this one comes with the Pixhawk 4. It supplies power to all the systems on the drone.
- The flight controller can be plugged into the PWR1 or PWR2 port.
- The I/O-PWM-in port is connected to the flight controller's I/O PWM out port.
- The signal to control the thrusters comes from the flight controller and is routed through the PDB before going to the ESCs

ESC

- The thrusters require large amounts of amperage. Because you would fry the flight controller if you pumped this power through it, you need Electronic Speed Controllers. These receive a PWM signal from the flight controller and power from the PDB (this power is directly from the battery. The PDB is just like a wire) and output a regulated voltage through the three wires connected to the thruster.
- Link about PWM signals https://www.sciencedirect.com/topics/engineering/pulse-width-modulation#:~:text=Pulse%20width%20modulation%20(PWM)%20is,for%20a%20low%2Damplitude%20signal
- Here is a video on how ESCs and brushless motors work https://www.youtube.com/watch?v=uOQk8SJso6Q

Left/Right Thruster

- These are Blue Robotics T200 Thrusters with the penetrator cable.
- The link to purchase them is here https://bluerobotics.com/product/t200-thruster-r1-rp-dd/

- We have attempted many ways to connect these to the ESCs. Currently we are using automotive connectors but because these tend to melt slightly, we are switching to xt60s.

Battery

- How to charge
  - Ensure the display reads as follows before selecting enter and going to the next page
  - Use the four buttons to navigate
  - 

  - 

- If the charger states voltage to low, charge the battery as a NiMH battery at 2a for a few minutes then try charging it with Lipo balance again.

Data Extraction Process

1. Remove the SD card from the Pixhawk
2. Insert the SD card into computer via an adapter
3. Copy the log file stored under APM>LOGS (you can verify it is the correct log by the date edited)
4. Paste the log into a new folder named yyyy.mm.dd_description
5. Name the log file the same as the folder
6. Paste mat_to_csv.m and data_labels.txt into the folder
7. Open Mission Planner

8. Select “DataFlash Logs” in the bottom left of the screen

9. Select “Create KML + gpx”

10. Find and select the log file

11. Select “Convert .Bin to .Log”

12. Find and select the log file

13. Select “Create Matlab File”

14. Find and select the log file

15. It may take a few minutes to process

16. Run mat_to_csv.m (via Matlab)

17. Rename the exported file the same as the folder

Pixhawk setup links

- These links will help you setup the setup the drone
- ArduRover First time Setup: https://ardupilot.org/rover/docs/apmrover-setup.html (this website will answer 90% of the questions you have; just look for the topic in the table on the left)
- ArduRover Full Parameter list: https://ardupilot.org/rover/docs/parameters.html
- Dragon Link Setup: http://www.dragonlinkrc.com/instructions/v3equipment/radiomodem/
- Dragon Link Support Forum: https://www.rcgroups.com/forums/showthread.php?1518533-NEW-DRAGON-LINK-ADVANCED-Full-Telemetry-Bluetooth-Droid-Planner-Data-Modem
- Ping Sonar Setup: https://ardupilot.org/rover/docs/common-bluerobotics-ping.html
- This is the ArduRover support forum: https://discuss.ardupilot.org/c/ardurover/8
- You may compare parameters with “2021.11.05_little_red_doggie_parameters” using the “compare” under “full parameter list” in mission planner. This will show you what parameters are different between your parameter list and the current working parameter list.