BCS Hardware Manual

Release 4.8

Embention

2023-08-02

CONTENTS

Veronte BCS is a miniaturized high reliability control station for avionics applications.

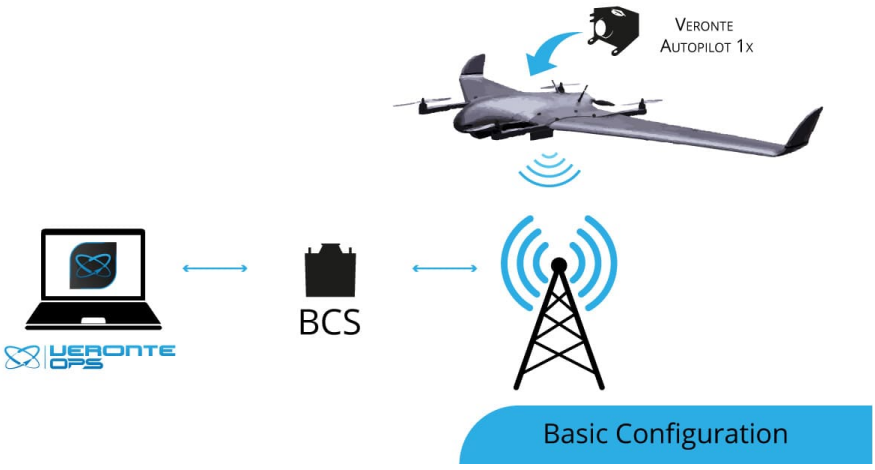
CHAPTER

ONE

INTRODUCTION

Fig. 1: **BCS**

Veronte BCS is a ground control station that establishes communications with **Veronte Autopilot 1x** (read its user manual to know more). **BCS** is part of flying control systems such as multirotors, helicopters, airplanes, VTOL… as well as ground vehicles, surface vehicles or many others.



CHAPTER

TWO

QUICK START

This user manual covers the *mechanical* and *electric* assembly.

The software user manual explains how to configure and use the **BCS**.

A Veronte-based FCS contains the following elements:

- A **Veronte Autopilot 1x** installed in a vehicle to control. This autopilot executes GNC algorithms in real time in order to accomplish the planned mission and handle the payload.
- **Veronte Ops** - Software dedicated to mission planning, configuration and operation. It allows the user to monitor connected UAS in real time, to interact with them and to replay previous missions for post-flight analysis.
- A **BCS** or **PCS** linked between **Veronte Ops** and **Veronte Autopilot 1x**. They support manual and arcade modes with conventional joysticks.

2.1 Warnings

- This user manual includes references to manuals for software applications. Select your software version to read them.
- Power out of range can cause irreversible damage to the system. Please read carefully the manual before powering the system.
- Each I/O pin withstands a maximum current of 1.65 mA. See *pinout* for more information.

2.2 Basic connection for operation

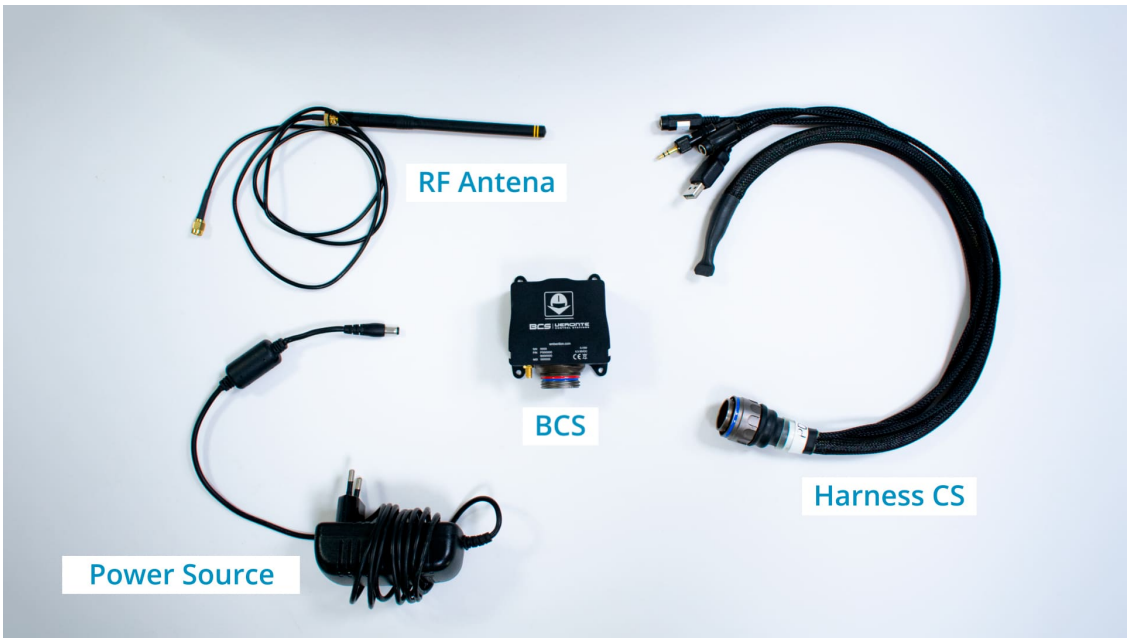


Fig. 1: **Basic operation elements**

The steps described below cover the basic connection of a **BCS** for operation:

1. Connect the RF antenna to the **LOS port**:

Fig. 2: **Basic connection - Step 1**

2. Connect the **harness** and **power it** using the power supply:

Fig. 3: **Basic connection - Step 2**

3. Connect the **harness USB** to the computer and Veronte Link will detect the **BCS**:

Fig. 4: **Basic connection - Step 3**

CHAPTER

THREE

TECHNICAL

3.1 Features

- **Communications**
  - 2 x isolated CAN buses
  - 1 x RS 232 bus
  - 1 x I2C bus
  - 1 x USB port
  - 1 x RS 485 full duplex bus
  - Over USB, RS 485 or RS 232 firmware update
- **Input / Output**
  - 16 x configurable input / output signals
  - 1 x EQEP bus
- **Power**
  - 6.5 - 36 V DC required for input power supply
  - 1 x output power with 3.3 V, up to 100 mA
  - 1 x output power with 5 V, up to 100 mA
- **Protection**
  - EMI shield
  - Against inrush current for connecting power supply

Note: The number of communication ports and signals can be increased with Veronte CEX or Veronte MEX.

3.2 Internal Radio

RF baudrate	250 kbps
LOS range	Up to 3200 m
Transmission power	19 dBm
Receiver sensitivity	-103 dBm
Frequency band	ISM 2.4 GHz

3.3 Mechanical and Electrical Specifications

Variable	Value
Weight	Standard version: 190 g.
Temperature range	-40 to 65 ºC.
Protection rating	IP67.
Maximum acceleration	32 g.
Power input	6.5 V to 36 V.
Temperature measurement range	-40 to 55 ºC. **Warning:** An external pressure sensor is required to measure below -20 ºC.

3.4 Interfaces

3.4.1 Connector Layout

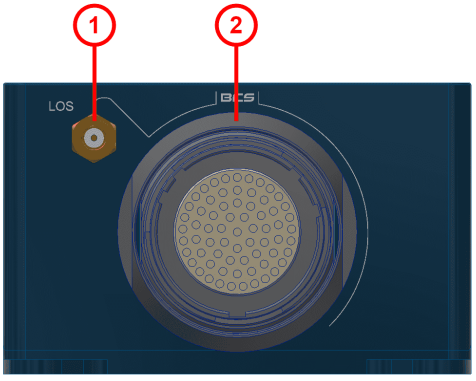


Fig. 1: **Connectors**

Index	Connector
1	LOS SSMA connector
2	68-pin connector

3.4.2 Mating Connectors

Index	Connector	Mating Connector
1	RF antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
2	Connector HEW.LM.368.XLNP	Mating connector: FGW.LM.368.XLCT. Mating harness with cable is available on demand with the Embention reference **P007043 B000358**

CHAPTER

FOUR

HARDWARE INSTALLATION

4.1 Mechanical assembly

BCS is manufactured using an anodized aluminium enclosure with enhanced EMI shielding and IP protection. A high reliability connector is also provided in this version. The total weight of standard version is 190g.

4.1.1 Dimensions

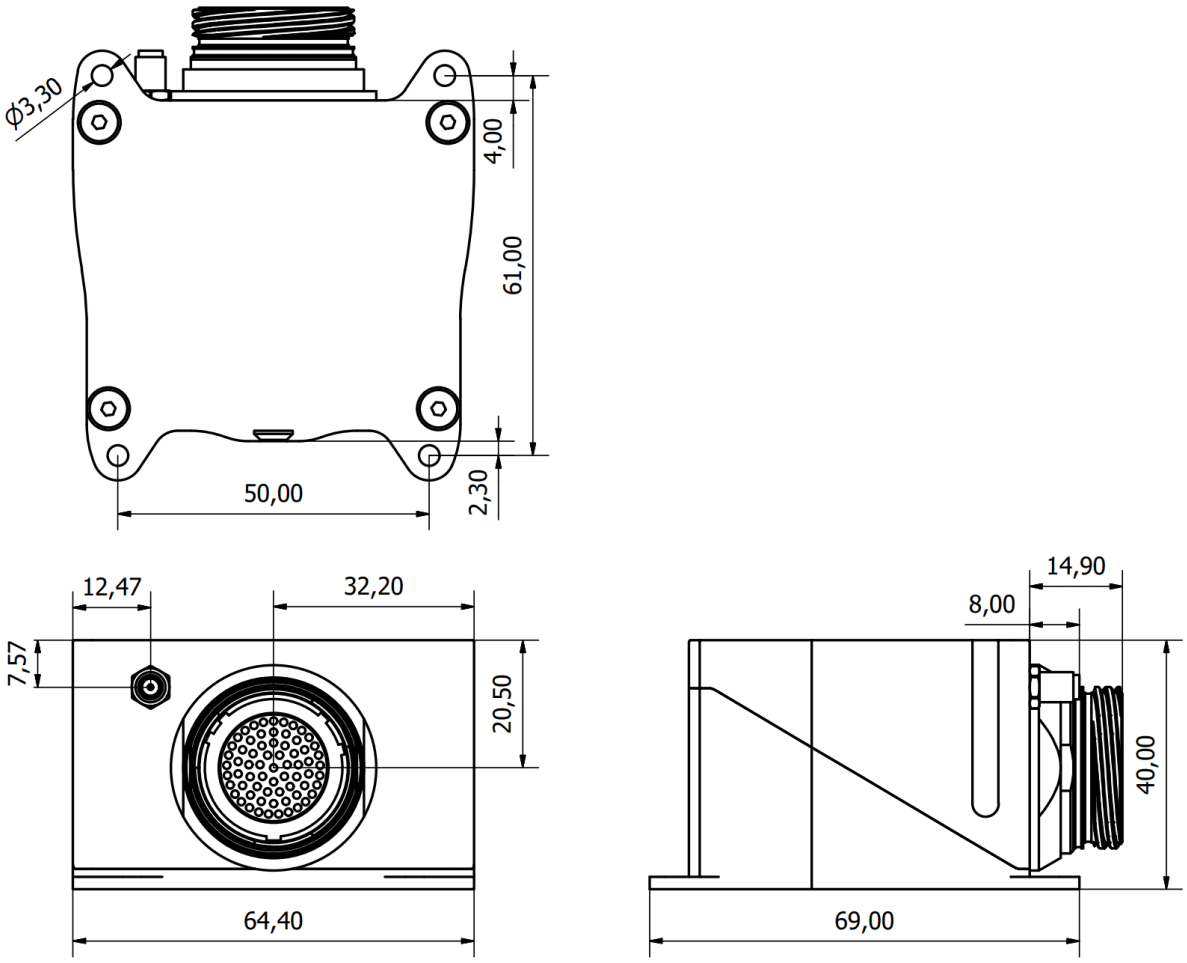


Fig. 1: **Veronte BCS dimensions (mm)**

M3 screws are recommended for mounting. In saline environments such as coastal and oceanic, the screw material must be stainless steel.

4.2 Antenna Integration

The system uses different kinds of antennas to operate that must be installed on the airframe. Here you can find some advice for obtaining the best performance and for avoiding antenna interferences.

- **Antenna Installation**
  - Maximize separation between antennas as much as possible.
  - Keep them far away from alternators or other interference generators.
  - Always isolate antenna ground panel.
  - Make sure the antenna is securely mounted.

- Always use high-quality RF wires minimising the wire length.
- Always follow the antenna manufacturer manual.
- SSMA connections shall be tightened applying 1 Nm of torque
- For all-weather aircraft, insert SSMA lightning protectors.

4.3 Electrical

4.3.1 Power

BCS can use unregulated DC (**6.5V to 36V**).

LiPo batteries between 2S and 8S can be used without regulation needs. Remaining battery level can be controlled by the internal voltage sensor and by configuring the voltage warnings by software.

For higher voltage installations, voltage regulators must be used. For dimensioning voltage regulators take into account that a blocked servo can activate regulator thermal protection.

Warning: Power out of range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

4.3.2 Pinout

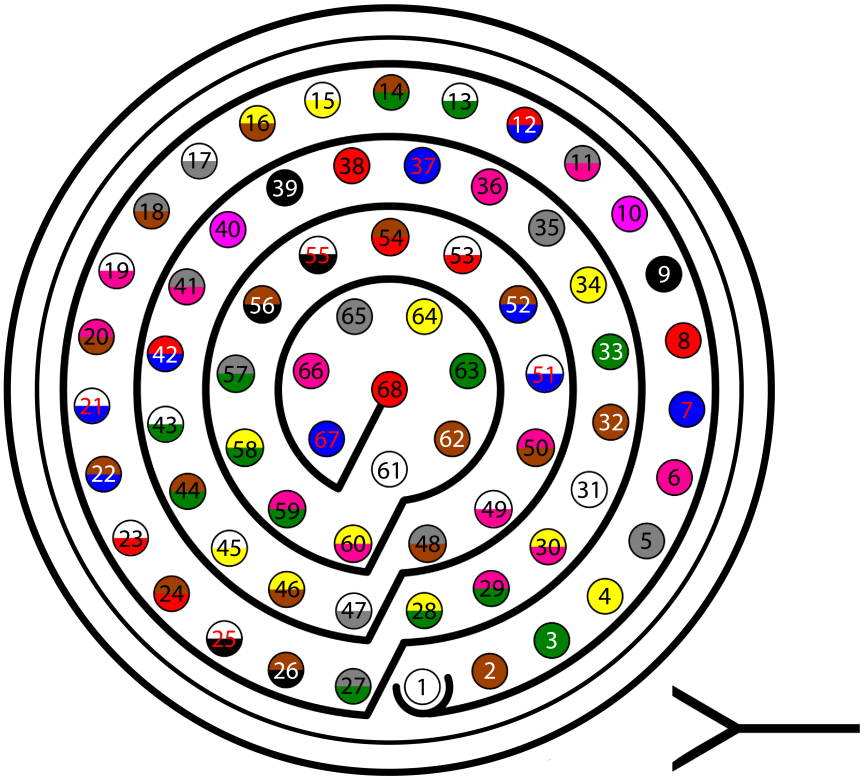


Fig. 2: **68 pin connector for BCS (frontal view)**

Pin	Signal	Type	Comments
1	I/O1	I/O	Pins for PWM or digital I/O signals (0-3.3V). Protected against ESD and short circuit. **Warning:** Each pin withstands a maximum current of 1.65 mA.
2	I/O2		
3	I/O3		
4	I/O4		
5	I/O5		
6	I/O6		
7	I/O7		
8	I/O8		
9	GND	GROUND	Ground signal for actuators 1-8
10	I/O9	I/O	Pins for PWM or digital I/O signals (0-3.3V). Protected against ESD and short circuit. **Warning:** Each pin withstands a maximum current of 1.65 mA.
11	I/O10		
12	I/O11		
13	I/O12		

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
14	I/O13		
15	I/O14		
16	I/O15		
17	I/O16		
18	GND	GROUND	Ground signal for actuators 9-16
19	RS 232 TX	Output	RS 232 Output (-13.2V to 13.2V Max, -5.4V to 5.4V Typical). Protected against ESD and short circuit
20	RS 232 RX	Input	RS 232 Input (-25V to 25V Max, -0.6V Low and 2.4V High Threshold). Protected against ESD and short circuit
21	GND	GROUND	Ground signal for buses
22	NO CONNECT		
23			
24	GND	GROUND	Ground signal for buses
25	CanA P	I/O	CANbus interface, up to 1Mbps (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
26	CanA N	I/O	Twisted pair with a 120 ohms Zo recommended (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
27	4XV_WD	I/O	Reserved. Do not connect.
28	CANB_P	I/O	CANbus interface. It supports data rates up to 1 Mbps. Protected against ESD
29	CANB_N	I/O	Twisted pair with a 120 ohms Zo recommended. Protected against ESD
30	GND	GROUND	Ground signal for buses
31	I2C_CLK	Output	Clk line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
32	I2C_DATA	I/O	Data line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
33	GND	GROUND	Ground for 3.3V power supply

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
34	3.3V	POWER	3.3V - 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
35	GND	GROUND	Ground for 5V power supply
36	5V	POWER	5V - 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
37	GND	GROUND	Ground for analog signals
38	NO CONNECT		
39			
40			
41	4XV_A	I/O	Reserved. Do not connect.
42	NO CONNECT		
43			
44	4XV_B	I/O	Reserved. Do not connect.
45	UARTA_TX	Output	Microcontroller UART
46	UARTA_RX	Input	Microcontroller UART
47	GND	GROUND	Ground signal comicro power supply
48	NO CONNECT		
49	FTS3_OUT_MPU	Output	MPU alive voting signal, to use with 4xVeronte. It is a Square Wave at [100,125] Hz. Protected against ESD and short circuit
50	OUT_RS485_P	Output	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
51	OUT_RS485_N	Output	Inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
52	IN_RS845_N	Input	Inverted input from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
53	IN_RS845_P	Input	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
54	RS-485_GND	GND	Ground for RS-485 bus
55	EQEP_A	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input A (0-3.3V). Protected against ESD and short circuit
56	EQEP_B	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input B (0-3.3V). Protected against ESD and short circuit WARNING!: Only use it as digital I/O with Veronte units of Hardware version 4.5 or lower
57	EQEP_S	I/O	DIGITAL output / DIGITAL input / Encoder strobe input (0-3.3V). Protected against ESD and short circuit
58	EQEP_I	I/O	DIGITAL output / DIGITAL input / Encoder index input A (0-3.3V). Protected against ESD and short circuit
59	GND	GROUND	Ground for encoders
60	V_USB_DP	I/O	Veronte USB data line. Protected against ESD
61	V_USB_DN	I/O	Veronte USB data line. Protected against ESD
62	USB_SHIELD	GND	USB cable shielding
63	FTS_OUT_MPU	Output	Abort mission voting signal from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
64	FTS2_OUT_MPU	Output	Abort mission voting signal 2 from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit
65	GND	GROUND	Veronte ground input
66	GND	GROUND	Veronte ground input
67	VCC	POWER	Veronte power supply (6.5V to 36V). Protected against ESD and reverse polarity. **Warning:** Both pins are common. They MUST be connected to the same power supply.
68	VCC	POWER	

Warning: Remember!! All GND pins are common.

4.3.3 Connector colour code:

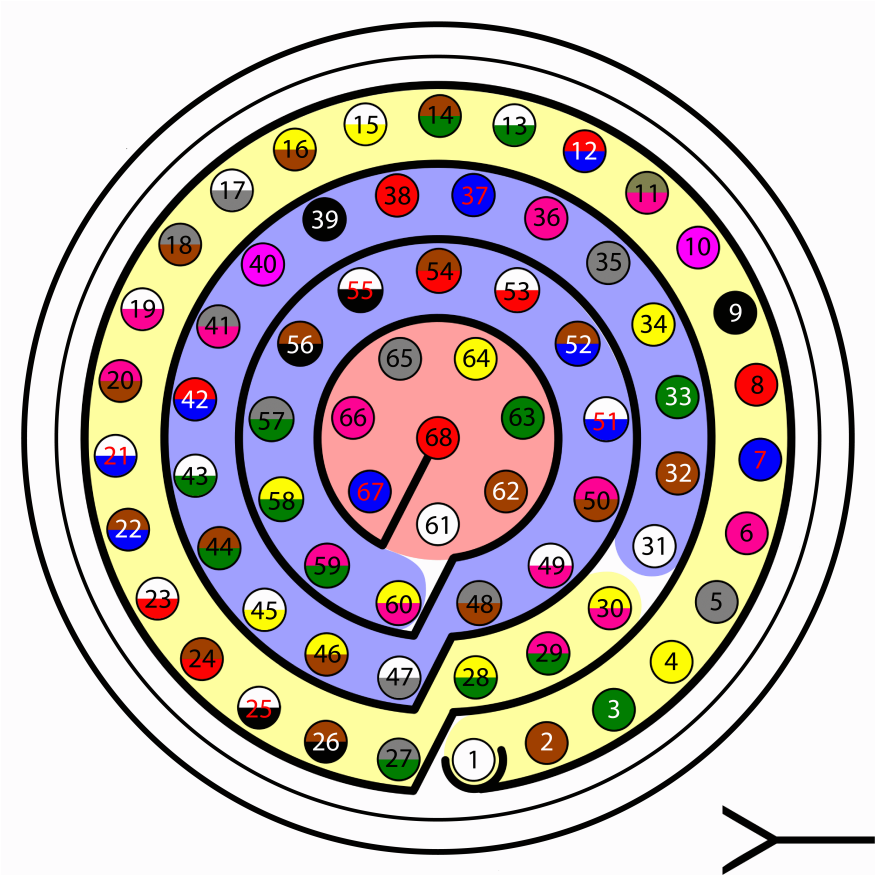

Fig. 3: **Connector HEW.LM.368.XLNP**

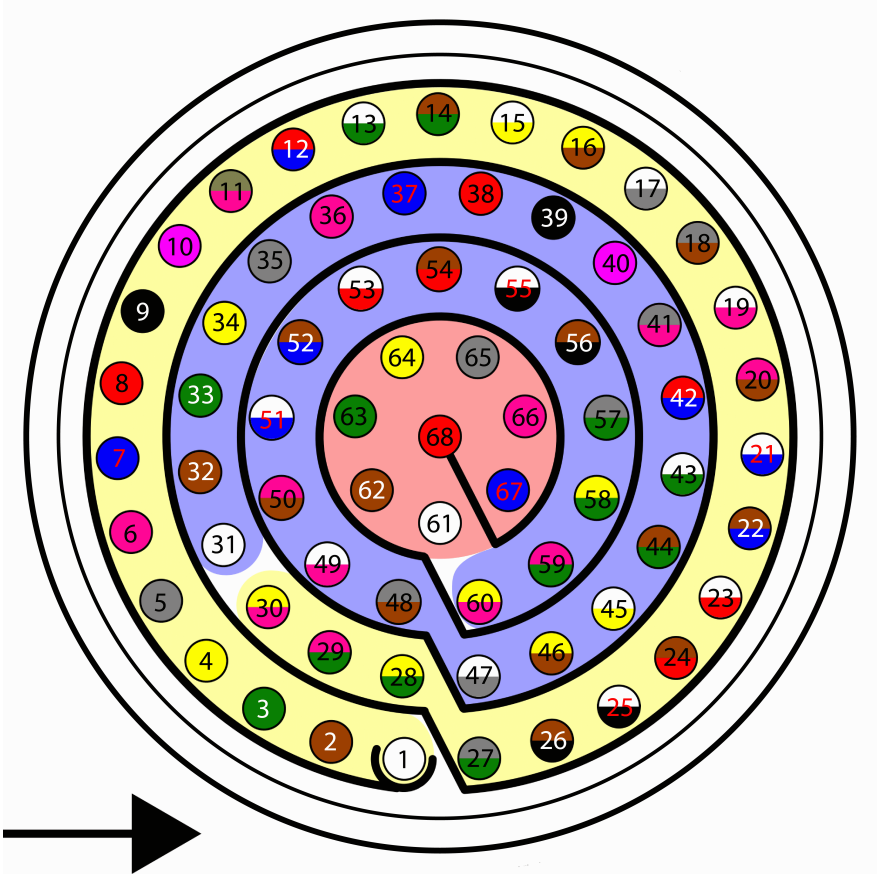

Fig. 4: **Harness plug**

Warning: Check the pin number before connecting. The colour code is repeated 3 times due to the amount of pins. First section (yellow) corresponds to pins 1-30, the second section (blue) to pins 31-60 and the third one (red) to pins 61-68. Pin number increases following the black line of the pictures above: counterclockwise for the connector and clockwise for the plug.

PIN	Color code	PIN	Color code
1	White	35	Gray
2	Brown	36	Pink
3	Green	37	Blue
4	Yellow	38	Red
5	Gray	39	Black
6	Pink	40	Violet
7	Blue	41	Gray – Pink
8	Red	42	Red – Blue
9	Black	43	White – Green
10	Violet	44	Brown – Green
11	Gray – Pink	45	White – Yellow
12	Red – Blue	46	Yellow – Brown
13	White – Green	47	White – Gray

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Table 2 – continued from previous page

PIN	Color code	PIN	Color code
14	Brown – Green	48	Gray – Brown
15	White – Yellow	49	White – Pink
16	Yellow – Brown	50	Pink – Brown
17	White – Gray	51	White – Blue
18	Gray – Brown	52	Brown – Blue
19	White – Pink	53	White – Red
20	Pink – Brown	54	Brown – Red
21	White – Blue	55	White – Black
22	Brown – Blue	56	Brown – Black
23	White – Red	57	Gray – Green
24	Brown – Red	58	Yellow – Green
25	White – Black	59	Pink – Green
26	Brown – Black	60	Yellow – Pink
27	Grey – Green	61	White
28	Yellow – Green	62	Brown
29	Pink – Green	63	Green
30	Yellow – Pink	64	Yellow
31	White	65	Grey
32	Brown	66	Pink
33	Green	67	Blue
34	Yellow	68	Red

4.3.4 Electrical diagram of CAN bus

BCS includes an internal resistor of 120 Ω. A second resistor is required at the end of the line (again 120 Ω) to allow the connection of multiple CAN Bus devices to the same line. This resistor may be placed on cable or PCB.

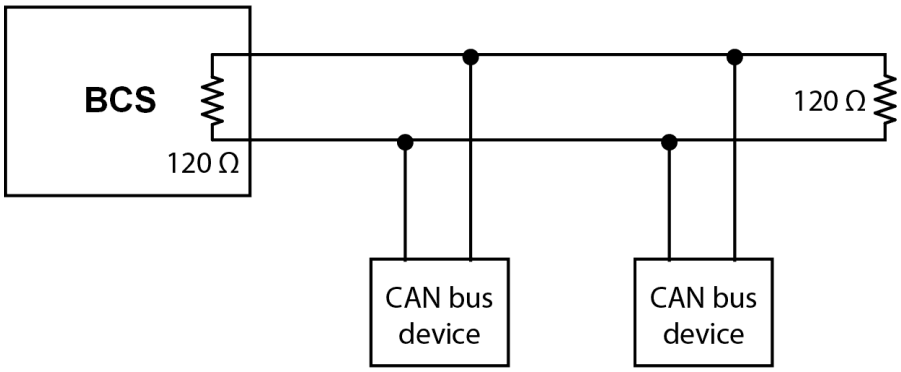


Fig. 5: **CAN assembly example diagram**

CHAPTER

FIVE

SOFTWARE INSTALLATION

In order to configure and use **Veronte BCS**, there are two ways to connect it to a computer: USB or serial.

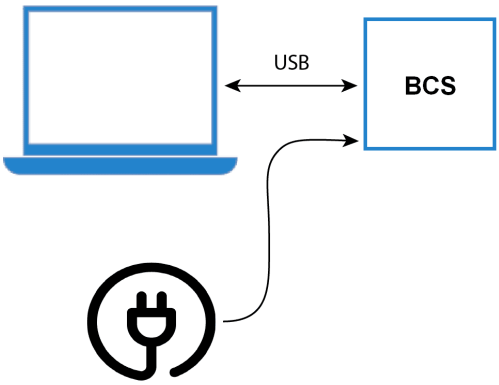


Fig. 1: **USB connection**

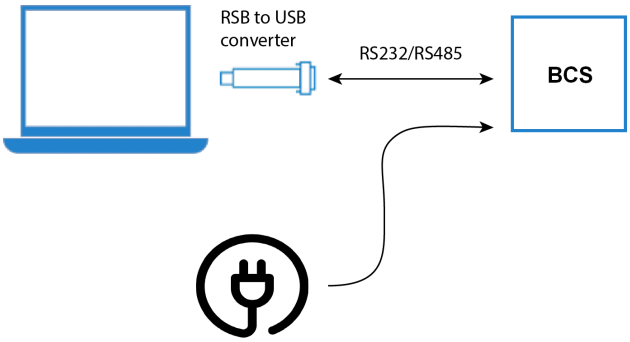


Fig. 2: **Serial connection**

To install the required software and configure **Veronte BCS**, read the BCS Software Manual.

CHAPTER

SIX

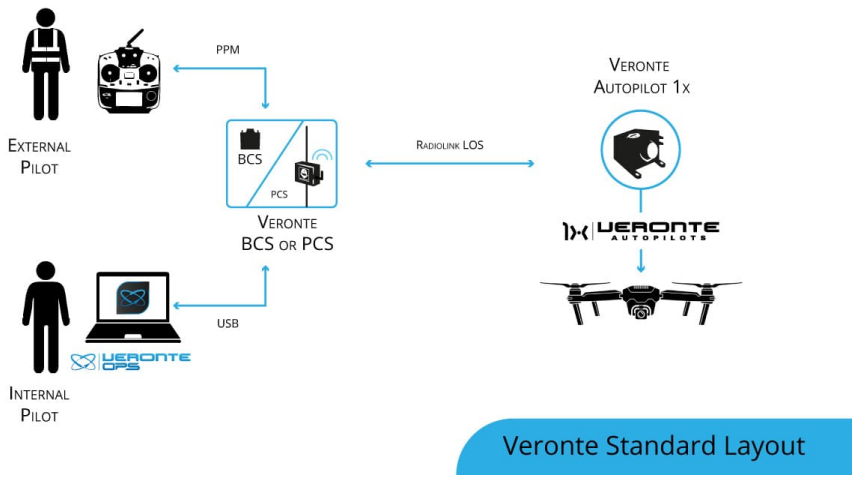
OPERATION

6.1 Flight Control Setups

Veronte Autopilot 1x allows for a wide variety of communication and control solutions to adapt to each mission and platform specifications. This section summarizes a list of recommended options to operate an **Autopilot 1x** in different situations.

Tip: Most of the following diagrams can be used independently or combinated, to create redundant systems or backup solutions.

The following image shows the standard Veronte System Layout for operation.



In the standard layout, an Operator (Internal Pilot) controls the UAV from the Ground Station using **Veronte Ops**.

Additionally, a Safety Pilot (External Pilot) is connected to the Ground Station using a radio controller. The stick commands are read by the Ground Unit and re-routed to the Air Unit. The Safety Pilot is able to take control of the flight at any point using an automation.

While this is the most common setup, there is a wide variety of options, including:

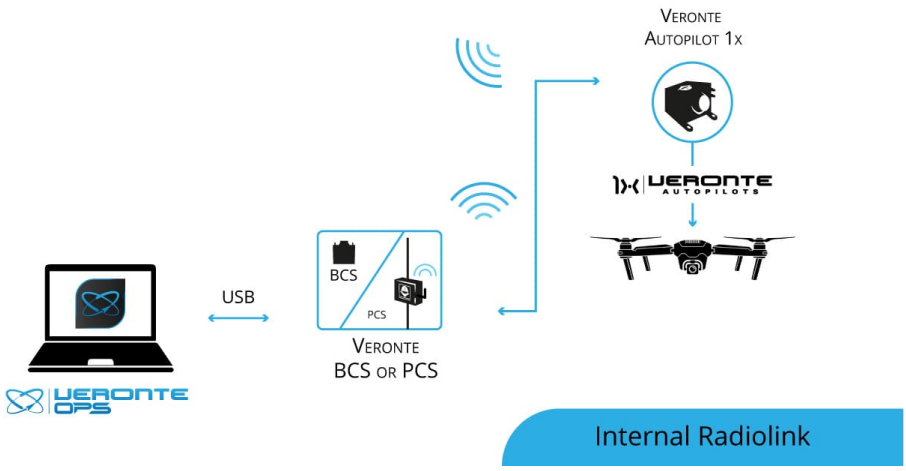
- BLOS communications
- Onboard RC receivers
- Point to Multipoint configurations

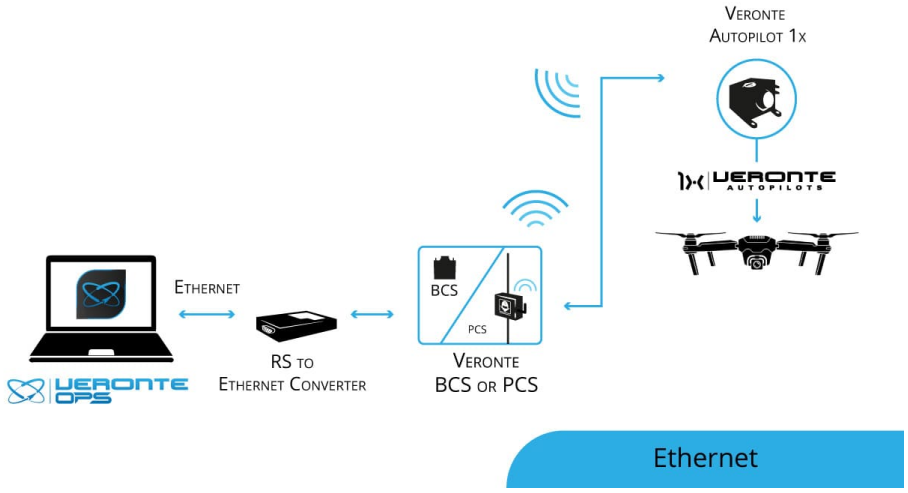
6.2 Air Communications

Communication solutions between air and ground devices.

6.2.1 Line of Sight

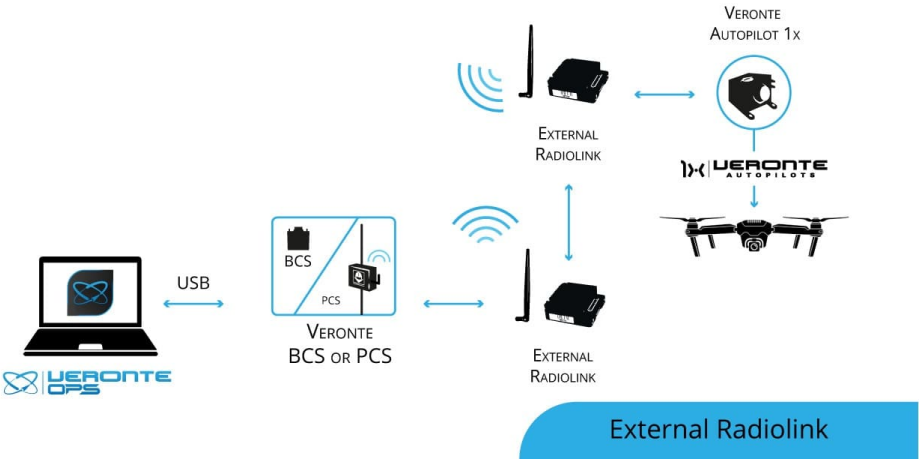
6.2.1.1 Standard setup



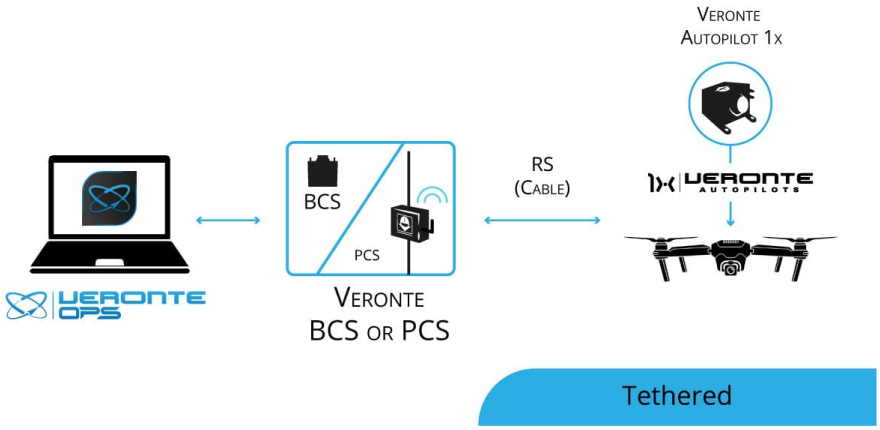


6.2.1.2 External radiolink

For increased range, bandwidth or channels are needed

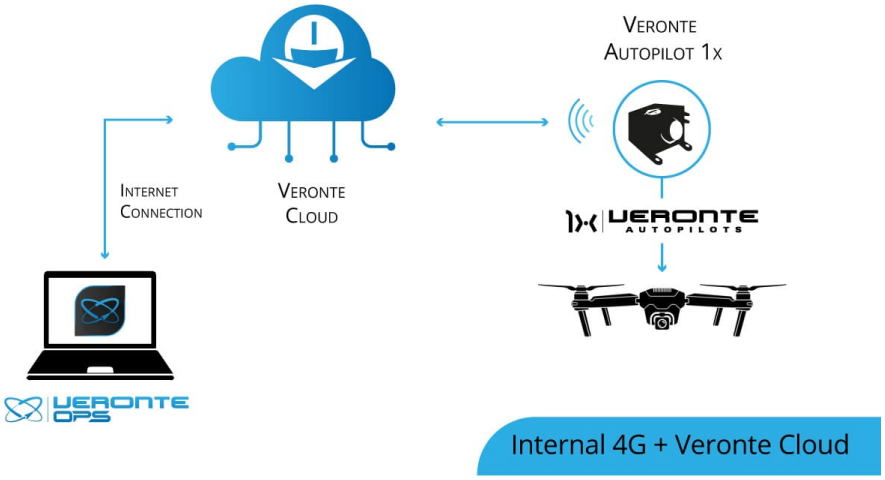


6.2.1.3 Tethered



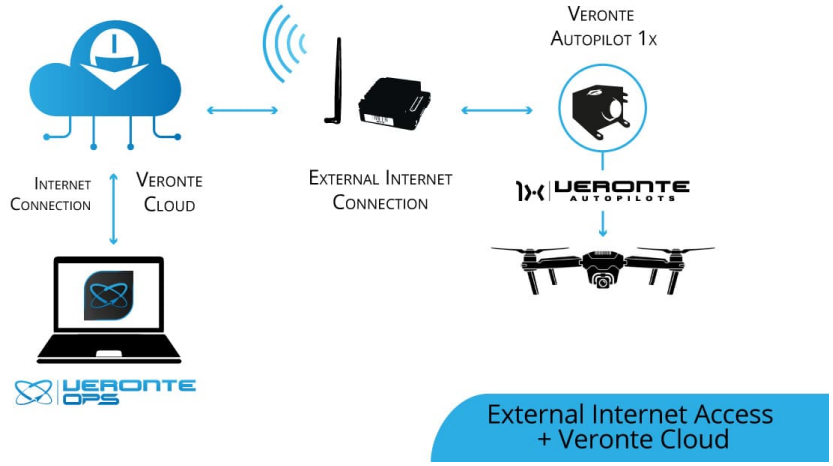
6.2.2 Beyond Line of Sight

6.2.2.1 Internal 4G + Veronte Cloud



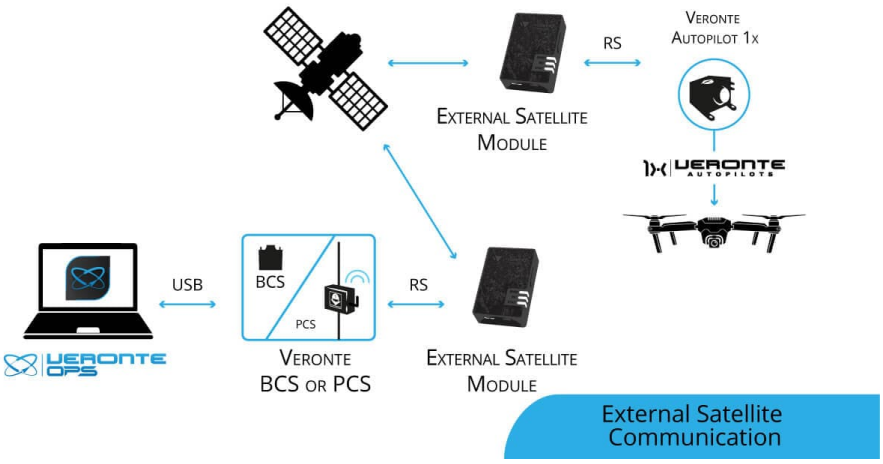
6.2.2.2 External Internet access + Veronte Cloud

For alternative internet access



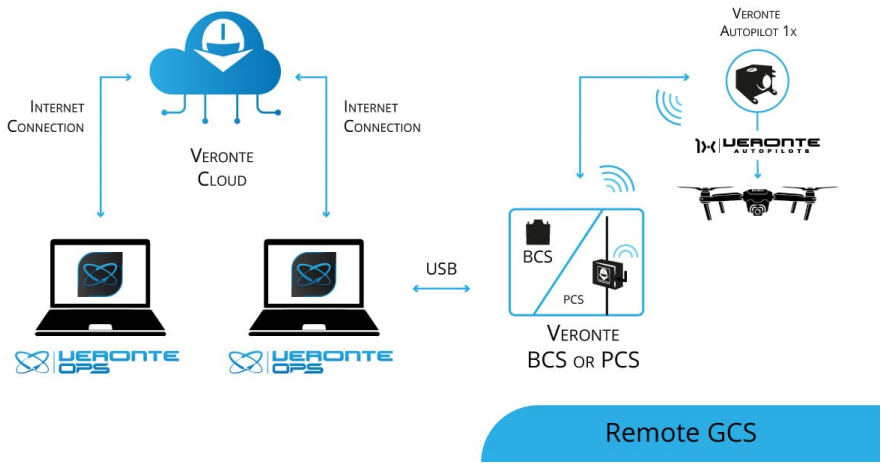
6.2.2.3 External Satellite communication

For maximum reliability



6.2.2.4 Remote GCS

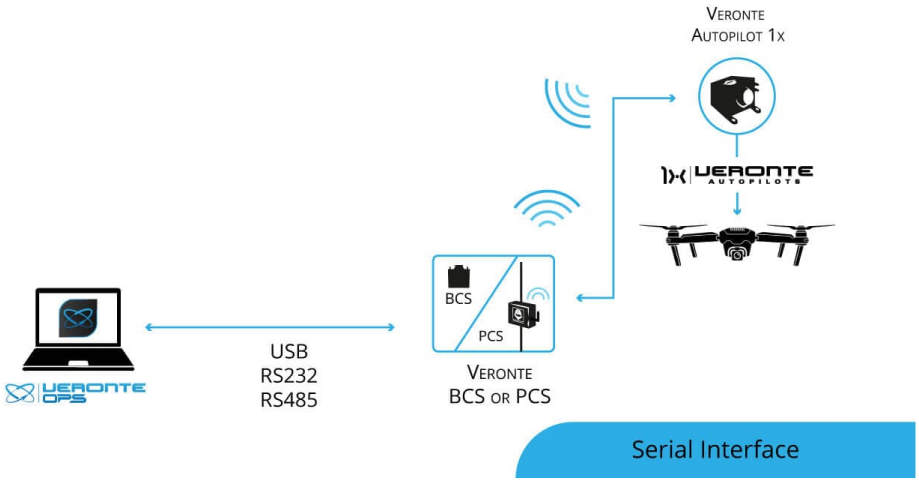
For remote solutions with LOS backup operator



6.3 Ground Communications

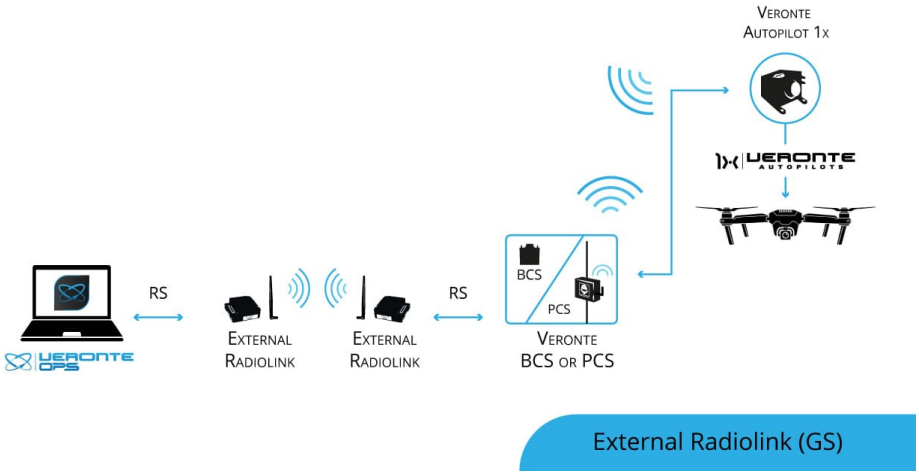
Comunication solutions between the different GS devices

6.3.1 Serial interface



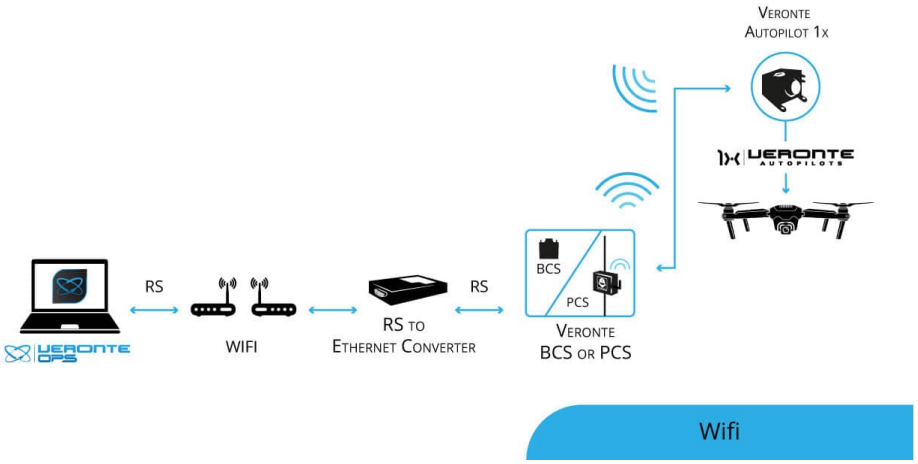
6.3.2 External Radiolink

For modular ground stations.



6.3.3 Wifi

For operation with laptops or tablets.

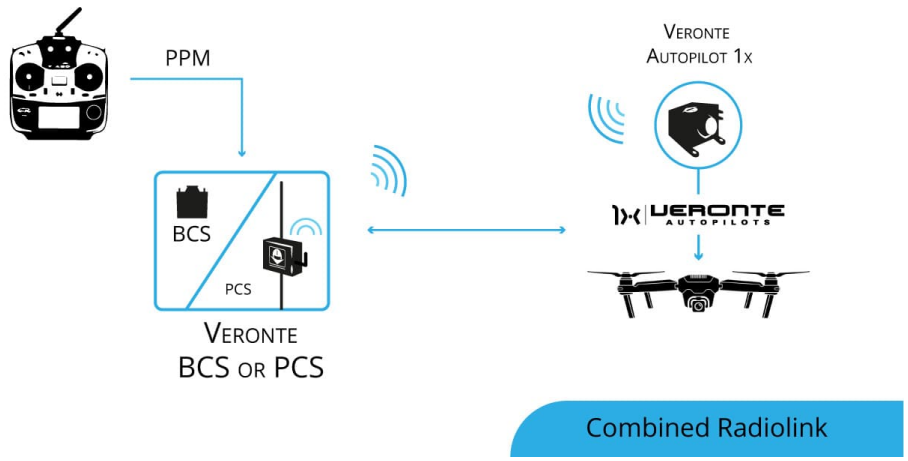


6.4 Manual Control Layouts

Veronte allows for a wide variety of pilot interface solutions in order to interact with manual flight modes, assisted flight modes (arcade) or payloads.

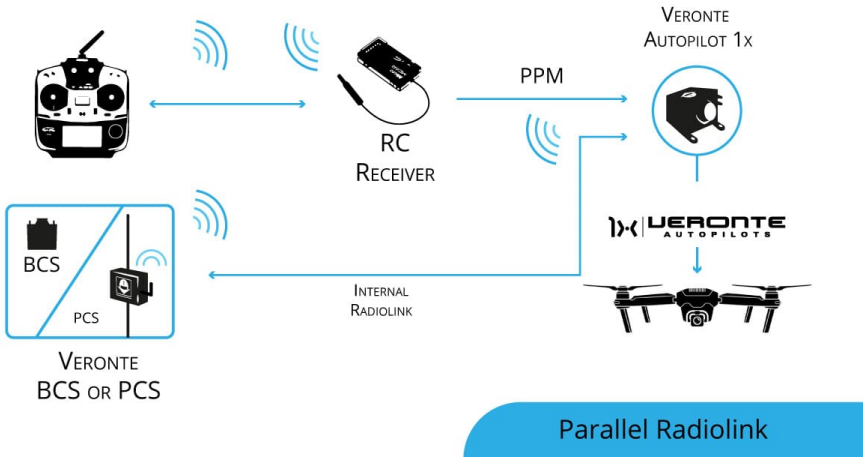
6.4.1 PPM to Ground Unit

Standard setup. Allows the usage of a single radio channel both for stick, control commands and telemetry, minimizing any potential interferences.



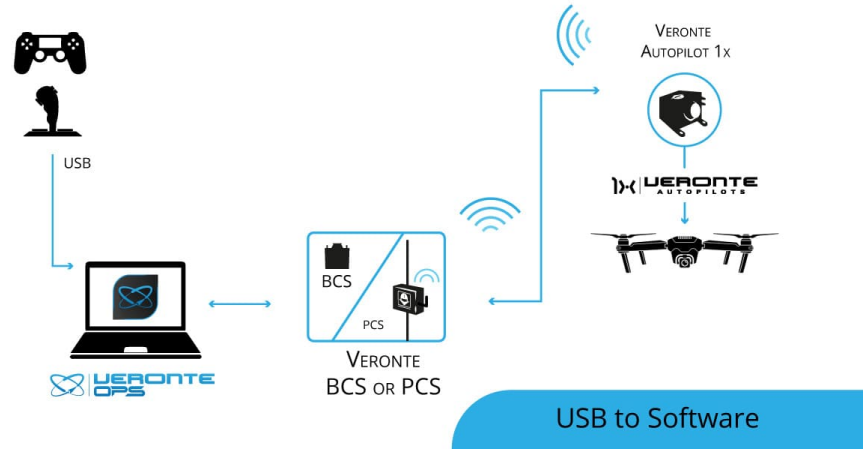
6.4.2 PPM to Air Unit

Allows for a backup manual channel when there is a main channel loss and an emergency manual landing is needed. Recommended for initial developement stages where automatic landing phases are not defined yet.



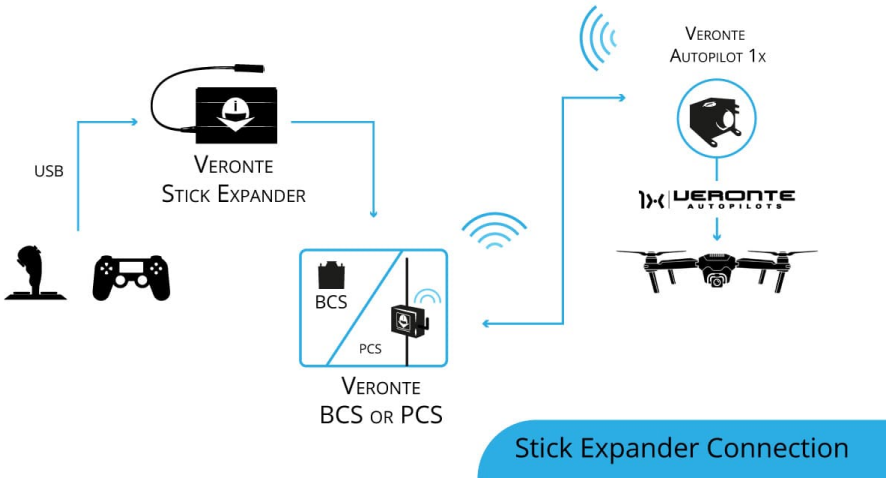
6.4.3 USB to Software

Allows the use of any device that is detected as a remote controller by the operative system



6.4.4 Stick Expander

The **Veronte Stick Expander** allows for the integration of commercial flight station devices and remote controllers. In addition, **Stick Expander** enables the use of USB sticks within the Veronte ecosystem.



6.4.5 Virtual Stick

The Virtual stick feature allows to integrate as a stick controller any device that can interface with **BCS** or Air unit (RS232, RS485, ADC, CAN…) and can provide control reference values.

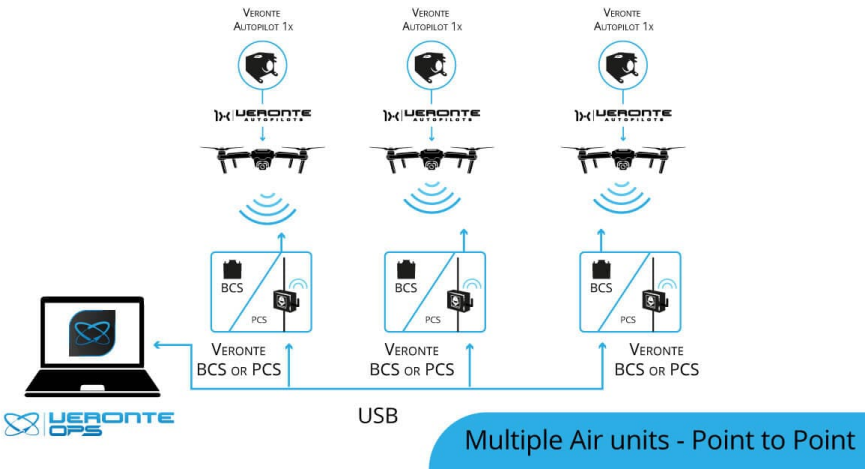
While the configuration is slightly more complex, this feauture allows using a wide variety of devices as flight control interfaces.

6.5 Point to Multipoint Layouts

Due to Veronte's modular configuration, it is possible to integrate several air and ground units within the same network.

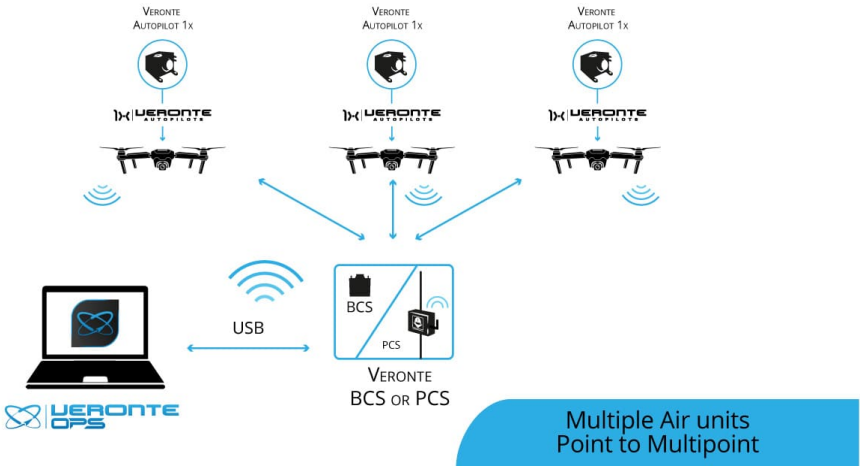
6.5.1 Point to Point

Standard multiplatorm setup.



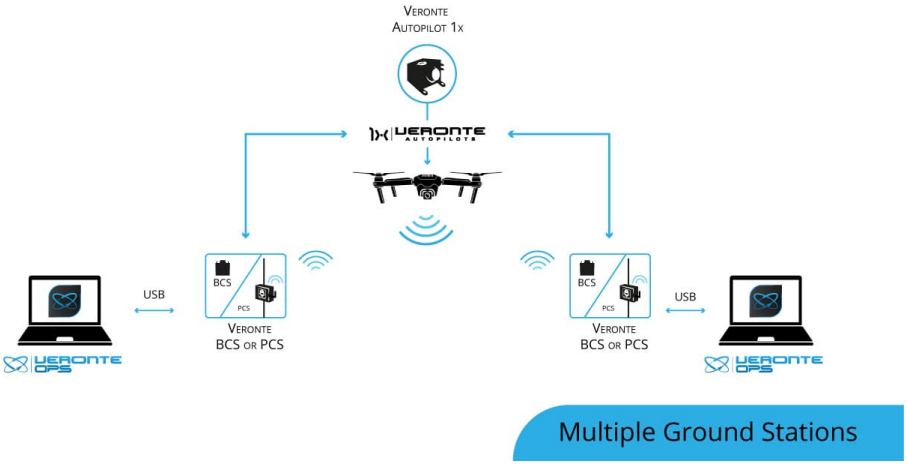
6.5.2 Point to Multipoint with Single Ground Station

Managing several platforms with a single radiolink.



6.5.3 Multipoint to Point with Multiple Ground Stations

For long range operations with several LOS stations.



CHAPTER

SEVEN

MAINTENANCE

7.1 Preventive maintenance

Apart from cleaning, no extra maintenance is required to guarantee the correct operation of the **Veronte BCS**.

In order to clean **BCS** properly follow the next recommendations.

- Turn off the device before cleaning.
- Use a clean, soft, damp cloth to clean the unit.
- Do not immerse the unit in water to clean it.

7.2 Software update

To update the software, an additional app is required: Veronte Updater.

Note: The file with the new software version will be shared with the customer in the **Joint Collaboration Framework** when it is requested. For more information about the **Joint Collaboration Framework**, read its user manual.

Warning: Select your version before reading any user manual for software.

CHAPTER

EIGHT

COMPATIBLE DEVICES

8.1 Power management units

Company	Comments
EMBENTION	**Veronte product:** BEC
VISION AIR TRONICS	

8.2 Cameras

Company	Comments
EMBENTION	**Products:** Gimbal 10z Gimbal 30z
OCTOPUS ISR SYSTEMS	
merio UAV PAYLOAD SYSTEMS	
AVT ASCENT VISION TECHNOLOGIES	
NextVision STABILIZED SYSTEMS LTD	
DAEDALEAN APPLIED INTELLIGENCE	Autopilot 1x reads identified objects by their cameras

8.3 LOS communications

Company	Comments
	**Antenna:** Tracker T28 **Radio module:** Data Link
	**I/O:** RS232 communication tunnel
	**I/O:** RS232 communication tunnel **DTC radio**: SOL8SDR-C, read the DTC integration example of the **1x Hardware Manual**, to know how to use it with Veronte Autopilot 1x
	**I/O:** RS232 communication tunnel **Streamcaster radio:** 4200E, read the Silvus integration example of the **1x Hardware Manual**, to know how to use it with Veronte Autopilot 1x
	**Radio:** To know how to configure Digi radios, read its user guide or the Digi integration example of the **1x Hardware Manual** to communicate a BCS with an Autopilot 1x.

8.4 BLOS communications

Company	Comments
SKYTRAC	**Broadband UAV satcom:** IMS-350 **Midband UAV Datalink and GPS System:** DLS-100
Ground Control	**Satellite communications:** RockBLOCK
satlink	
ATMOSPHERE	Requires Veronte COM

8.5 Transmitters

Company	Comments
Futaba	**Products:** 8J/10J/12K/14SG with 8 channels 12K/14SG with 12 channels T18SZ with 8 channels
EMBENTION	Stick Expander

8.6 Expansion modules

Company	Comments
EMBENTION	**Products:** Smart CAN isolator CEX MEX

CHAPTER

NINE

INTEGRATION EXAMPLES

9.1 Connection Examples

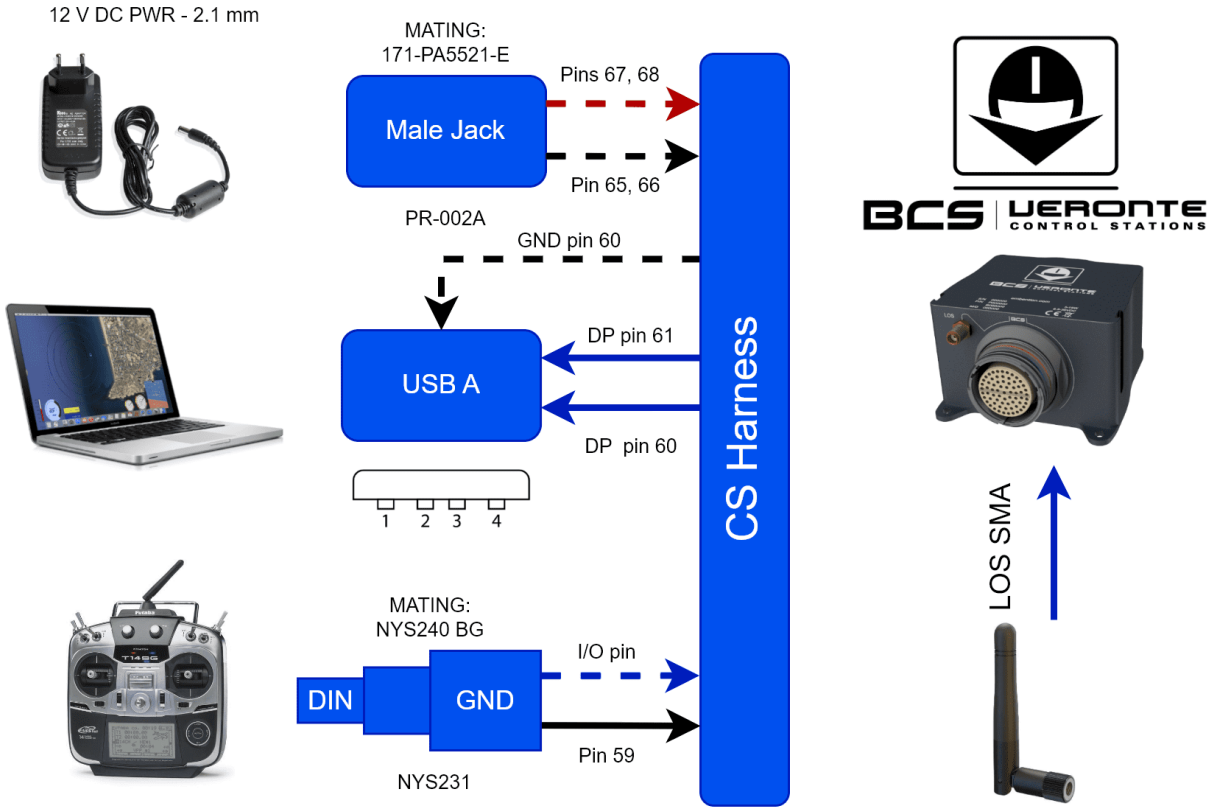


Fig. 1: **Basic ground station setup**

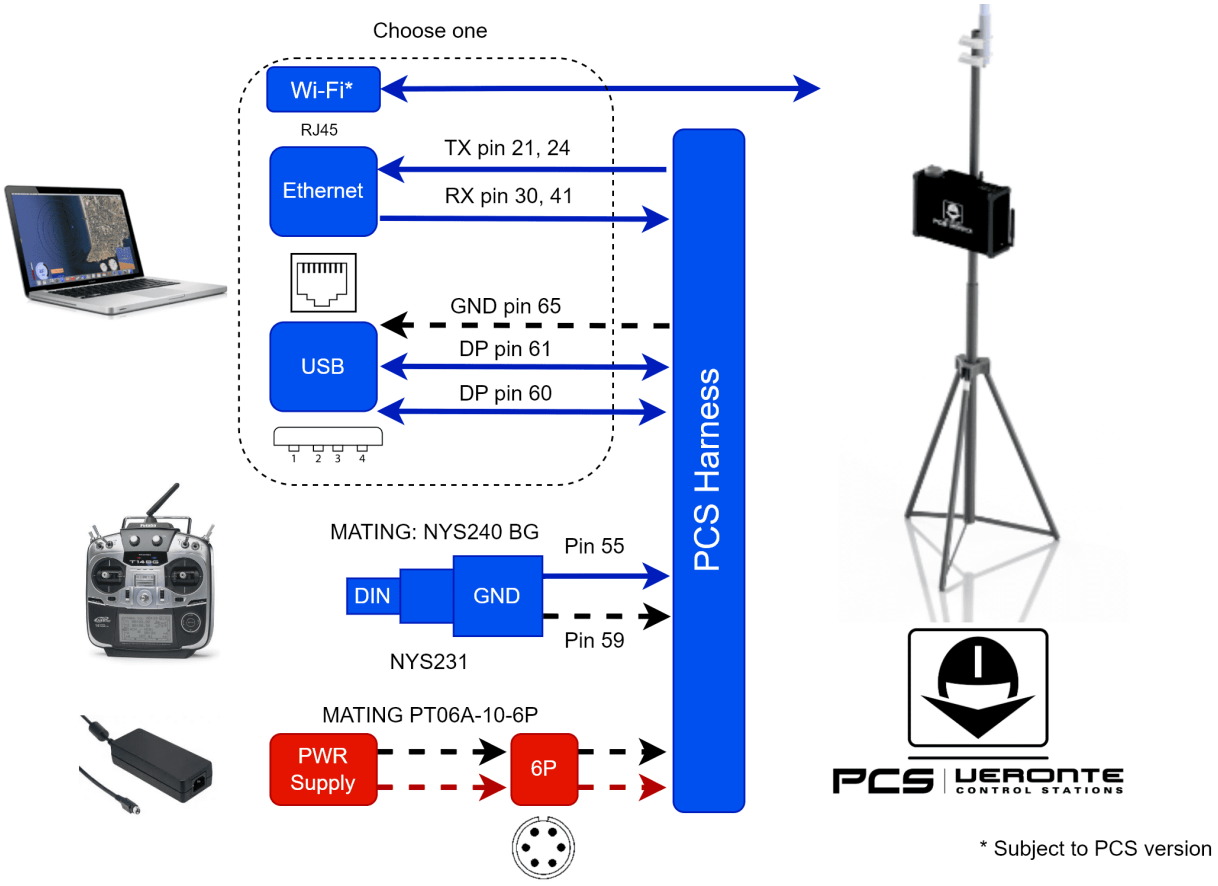


Fig. 2: **BCS with PCS**

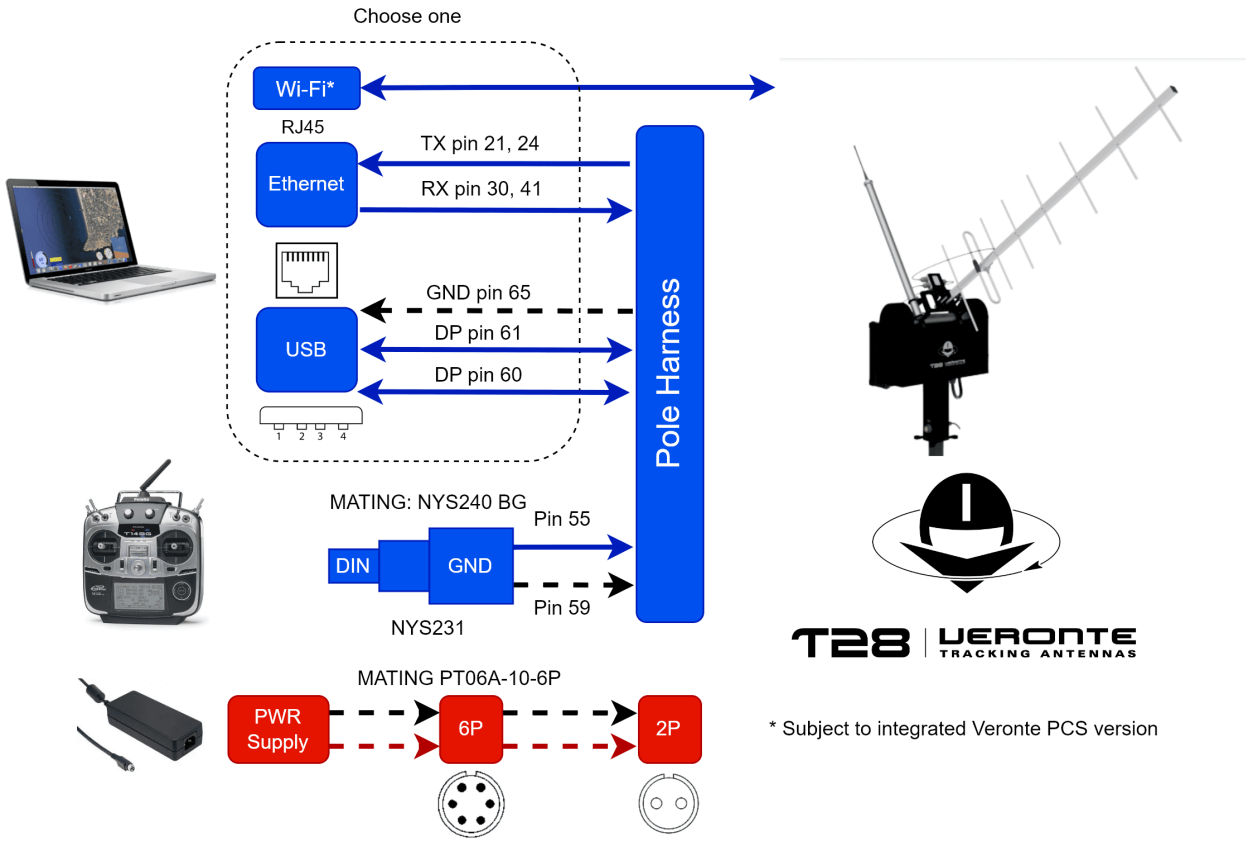


Fig. 3: **BCS with Tracker Ground Station**

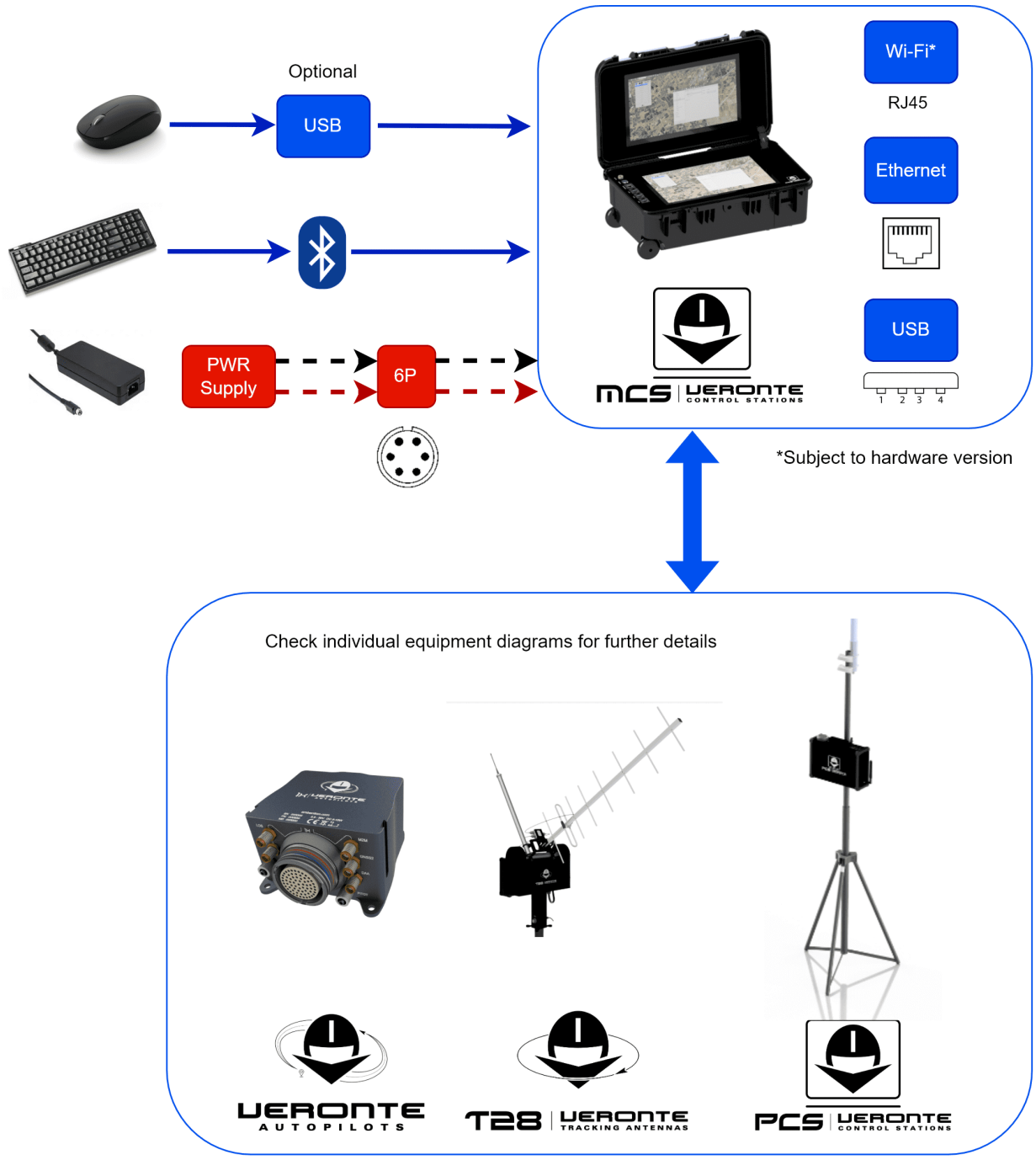


Fig. 4: **MCS Ground Station**

Warning: **Veronte BCS** equipment harnesses have specific pin layouts. Only use their own matting connectors, do NOT mix harnesses: misuse can lead to destruction.

9.2 Radios

Integration examples of different radios with **BCS** and **1x** can be found in 1x user manual -> Radios.

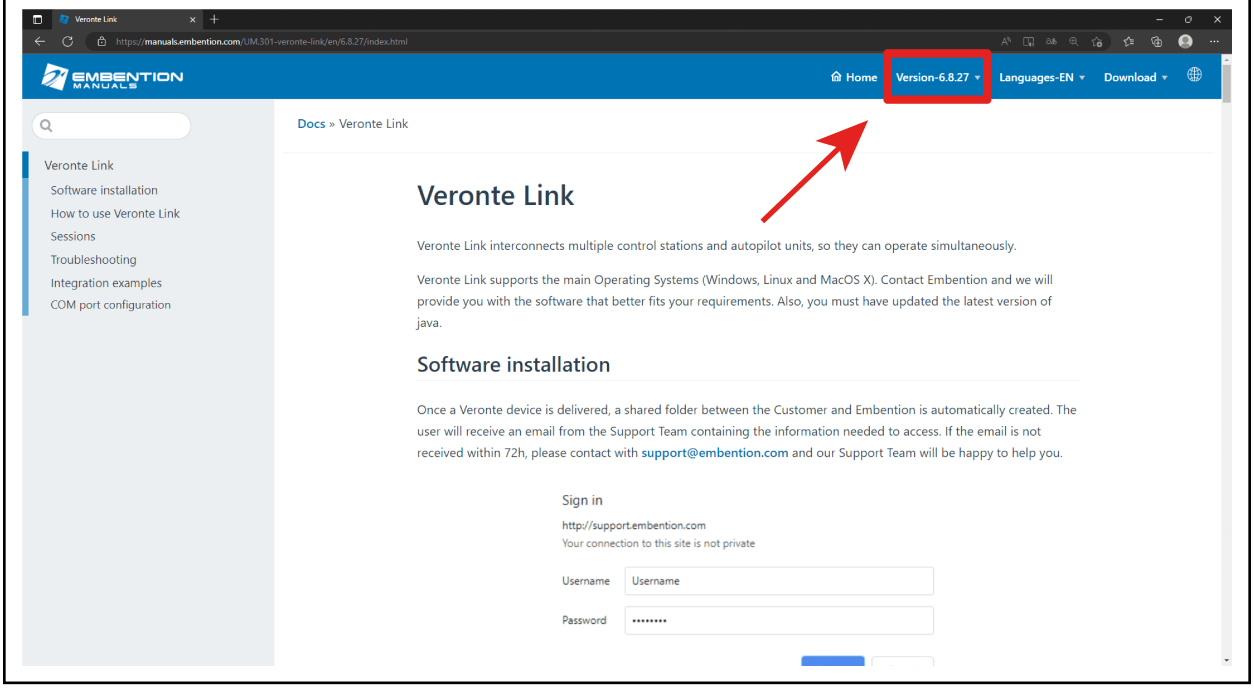
CHAPTER

TEN

TROUBLESHOOTING

In case of any issue with software, read BCS PDI Builder user manual -> Troubleshooting.

Warning: Select your version before reading any user manual for software. The following image shows where to select a version from any Embention user manual.



10.1 Maintenance mode

Maintenance mode is the main troubleshooting tool that **BCS** puts at the user disposal. While in **maintenance mode**, all communication channels are enabled by default, so it is possible to connect with **BCS** through any of its interfaces, no matter its current configuration.

The main use of **maintanance mode** is to solve issues related to the current configuration, mainly with communication or memory writting issues.

While in **maintenance mode**, it is possible to perform actions such as force the load of a new configuration file.

If at some point the communication with **BCS** is lost, it is possible to use **maintenance mode** to go back to a previous state of the configuration.

Tip: It is heavily recommended to always use **maintenance mode** to load a new configuration that is very different from the current one.

10.2 How to enter in maintenance mode

There are two ways to enter in **maintenance mode**: using software or forcing it.

10.2.1 Using software to enter in maintenance mode

To enter in **maintenance mode** using software, read BCS PDI Builder user manual -> Maintenance Mode.

10.2.2 Forcing maintenance mode

There are two ways to force the maintenance mode: using power supply or using the I2C pins.

10.2.2.1 Using the power supply to force maintenance mode

When communication with the unit is lost, it is possible to active **maintenance mode** by power input.

In order to active **maintenance mode**, power cycle the **BCS** repetively with a period of 1 second. After 30 cycles, the autopilot will enter in **maintenance mode**.

BCS might enter in **maintenance mode** if a problem with the power supply is detected upon boot up (voltage or current is out of range).

Fig. 1: **How to power cycle**

10.2.2.2 Using the I2C pins to enter in maintenance mode

To enter in **maintenance mode** with I2C, connect both I2C pins each other, then power up the **BCS**. Both pins are I2C_CLK (number 31) and I2C_DATA (number 32) according to the *pinout*.

CHAPTER

ELEVEN

ACRONYMS AND DEFINITIONS

11.1 Acronyms

16 VAR	16 Bits variables (Integers)
32 VAR	32 Bits variables (Reals)
ADC	Analog to Digital Converter
ADSB	Automatic Dependent Surveillance–Broadcast
AGL	Above Ground Level
AoA	Angle of Attack
ARC	Arcade Mode
AUTO	Automatic Mode
BCS	Basic Control Station
BIT	Bit Variables
BLOS	Beyond Line Of Sight
CAN	Controller Area Network
CAP	Capture Module
CEP	Circular Error Probability
CMB	Climb Phase
CRU	Cruise Phase
DAA	Detect And Avoid
DC	Direct Current
DGPS	Differential GPS
ECAP	Enhanced CAP
ECEF	Earth Centered – Earth Fixed
EGNOS	European Geostationary Navigation Overlay Service
EKF	Extended Kalman Filter
EQEP	Enhanced Quadrature Encoder Pulse
ESC	Electronic Speed Controller
FCS	Flight Control System
FHSS	Frequency Hopping Spread Spectrum
FLR	Flare Phase
FTS	Flight Termination System
GIS	Geographical Information System
GND	Ground
GNSS	Global Navigation Satellite Systems
GPIO	General Purpose Input Output
GPS	Global Positioning System
GS	Ground Speed

continues on next page

Table 1 – continued from previous page

GS	Ground Segment
HLD	Hold Phase
HUM	Hardware User Manual
I2C	Inter-Integrated Circuit
IAS	Indicated Air Speed
ID	Identification
IMU	Inertial Measurement Unit
ISM	Industrial Scientific and Medical
LED	Light-Emitting Diode
LND	Landing Phase
LOS	Line Of Sight
M2M	Machine To Machine
MSL	Mean Sea Level
OPV	Optionally Piloted Vehicle
PFD	Primary Flight Display
PID	Proportional Integral Derivative
PPM	Pulse Position Modulation
PWM	Pulse Width Modulation
QNH	Barometric atmospheric pressure adjusted to sea level
QZSS	Quasi-Zenith Satellite System
RC	Radio Control Mode
RF	Radio Frequency
RPAS	Remotely Piloted Aircraft System
RPM	Revolutions Per Minute
RS 232	Recommended Standard 232
RS 485	Recommended Standard 485
RX	Reception
SMA	SubMiniature Version A Connector
SSMA	Miniature-SMA
STB	Standby Phase
SU	Servo-Output matrix
SUM	Software User Manual
TAS	True Air Speed
TKO	TakeOff Phase
TX	Transmission
UART	Universal asynchronous receiver-transmitter
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
US	Output-Servo matrix
VTOL	Vertical TakeOff and Landing
WGS 84	World Geodetic System 84
WP	Waypoint

11.2 Definitions

- **Control Phase:** The operation is divided into phases in which the UAV has a specific performance. Each of this phases is called a control phase.
- **Control Channel:** It is each of the signals used to control a behaviour or action.
- **Control Mode:** It is possible to make a manual control of the UAV by stick, assisted control and fully automatic control.
- **Actuator:** It is a mechanic device to provide force to move or "act" another mechanical device.

CHAPTER

TWELVE

CONTACT DATA

You can contact Embention if you need further help and support.

Embention contact data is as follows:

Email: support@embention.com

Telephone: (+34) 965 421 115

Address: Polígono Industrial Las Atalayas, C/ Chelín, Nº 16, CP 03114, Alicante (España).