

Ground Loop Suppression

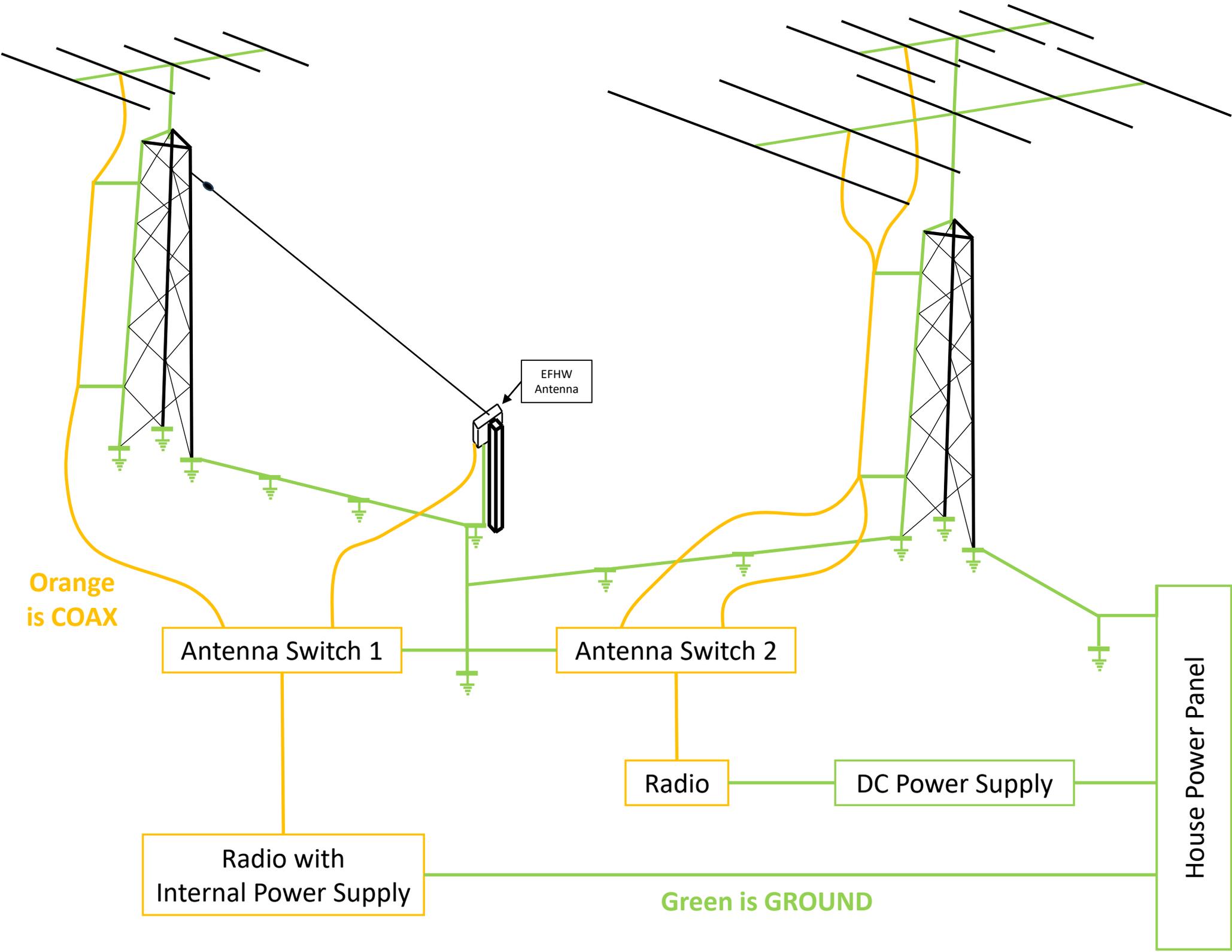
How to support proper power grounding, RF grounding, and lightning grounding, and still eliminate RF loops that impact amateur radio station performance.

www.carshamradio.org/index.php/resources

Paul Kraemer KA4IOX
December 5, 2025

Our Station for analysis

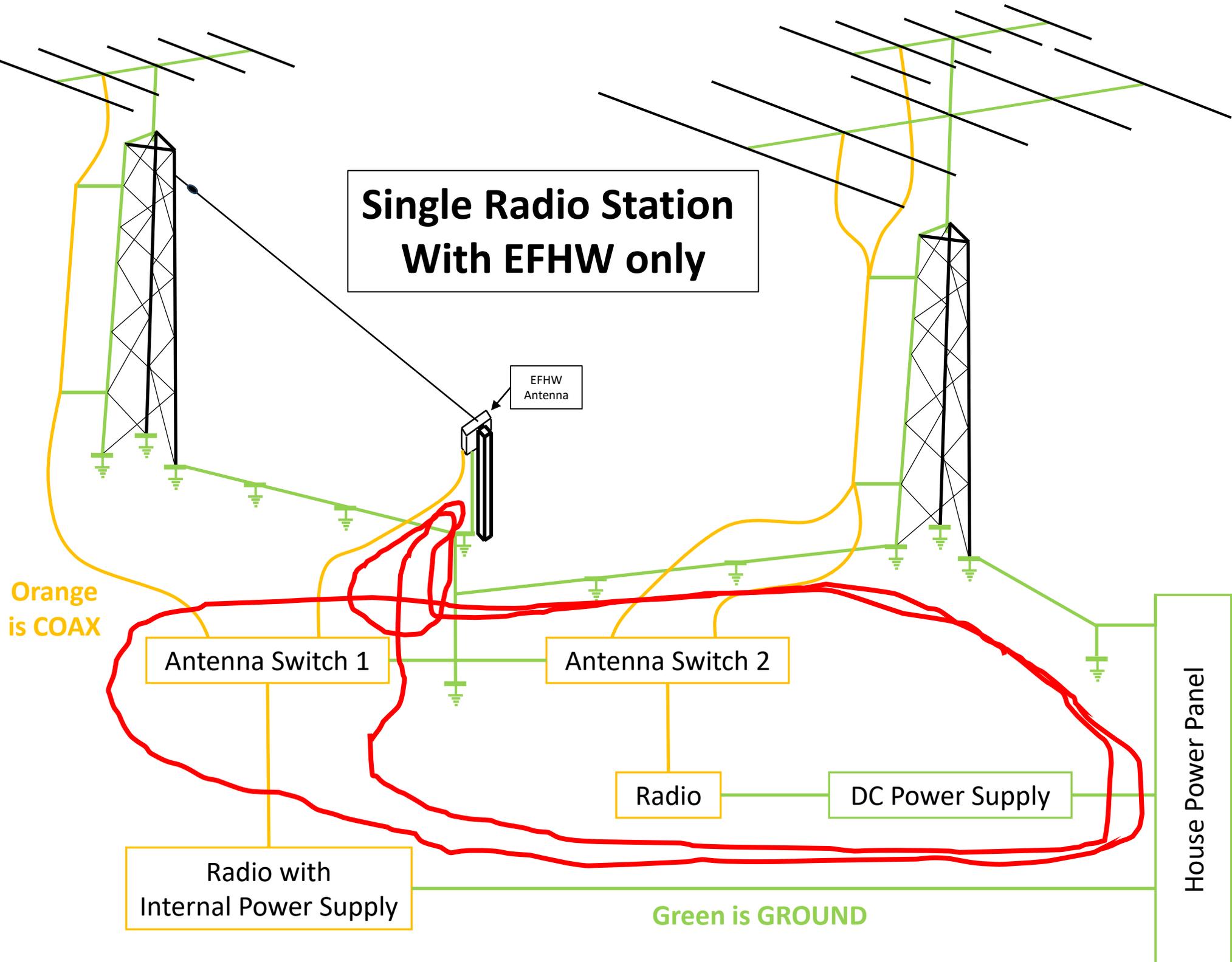
- Coax is in **Orange**
- Ground is in **Green**
- One Radio has a built in Power Supply
- One Radio has a separate DC Power Supply
- Two towers
- Three beam antennas
- One EFHW (End Fed Half Wave) antenna
- Two Antenna Switches
- For graphical clarity Polyphasors and grounded coax feed throughs not included



The Ground Loop Problem

- Ground loops act as antennas.
 - Causing desensitized reception.
 - Causing interference.
- Two major categories of ground loops exist.
 - Loops that include the radio power supply.
 - Loops that do not include the radio power supply.
 - Both loops have solutions.
- Ground loops are shown with **Red circles**.

Single Radio Station With EFHW only



Orange is COAX

EFHW Antenna

Antenna Switch 1

Antenna Switch 2

Radio

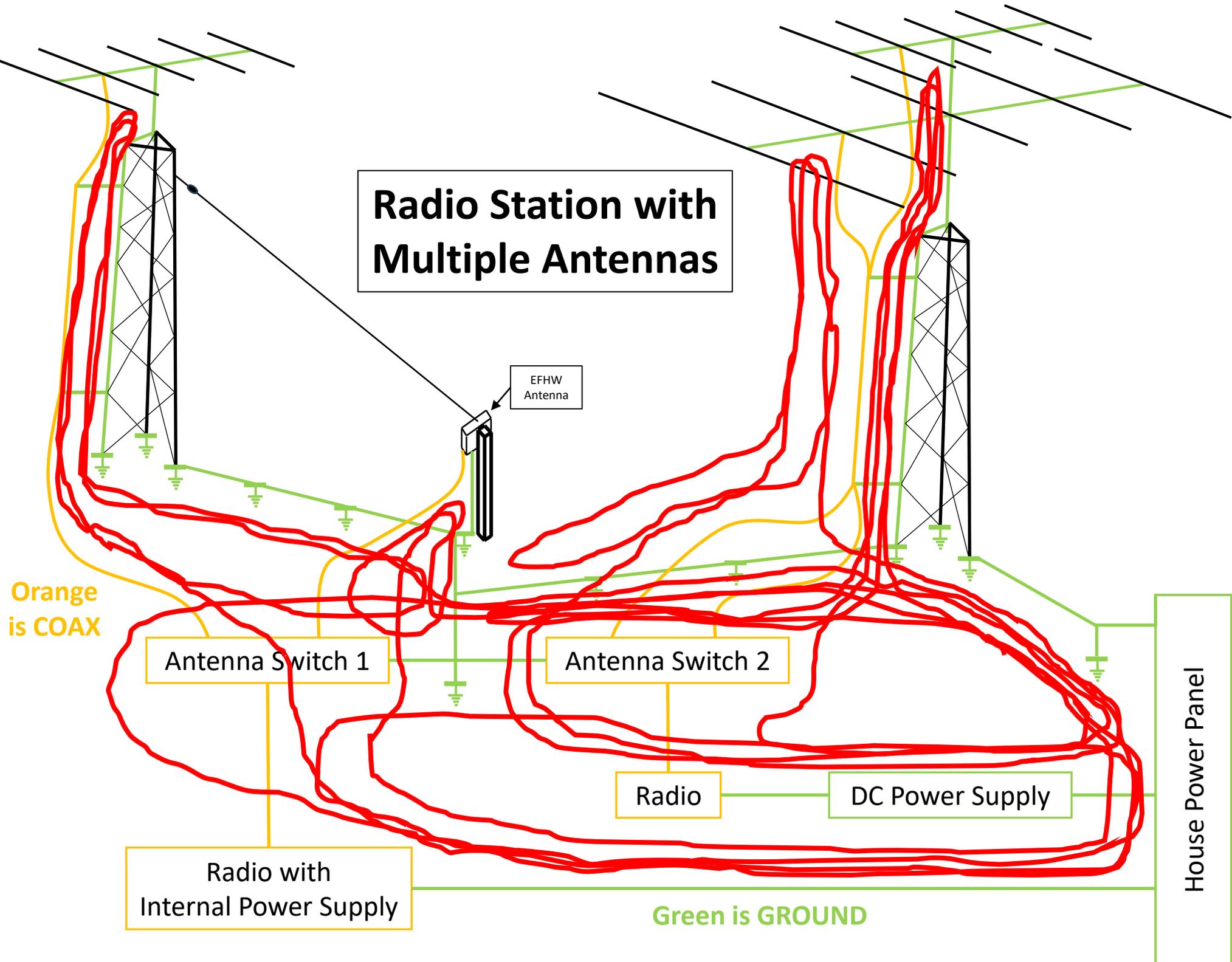
DC Power Supply

Radio with Internal Power Supply

House Power Panel

Green is GROUND

Radio Station with Multiple Antennas



Reasons for Grounding

- Power safety.
 - Radio power supplies require grounding to house power. Improper power grounding can kill.
- RF safety and performance.
 - Many antennas require a RF ground counterpoise or stray RF grounding. RF burns can hurt.
- Lightning safety.
 - Lightning can take both your radio equipment and you out, permanently.

Effective grounding of all three types is required for safety, and proper operation of your radio station.

Power Grounding

- Required to assure voltages present inside the radio power supply are not present on the external chassis of the radio.
- Code does not allow interruption of the ground connection to house power.

Lightning Grounding

- Florida lightning has twice the power of the lightning in the Northern CONUS.
- Lightning occurs frequently in Florida.
- Lightning does not need to strike your antenna to damage radio equipment.
 - Static fields and EMPs alone from lightning can damage radio equipment.
- Lightning has a major energy component at approx. 1 MHz

Lightning Grounding (continued)

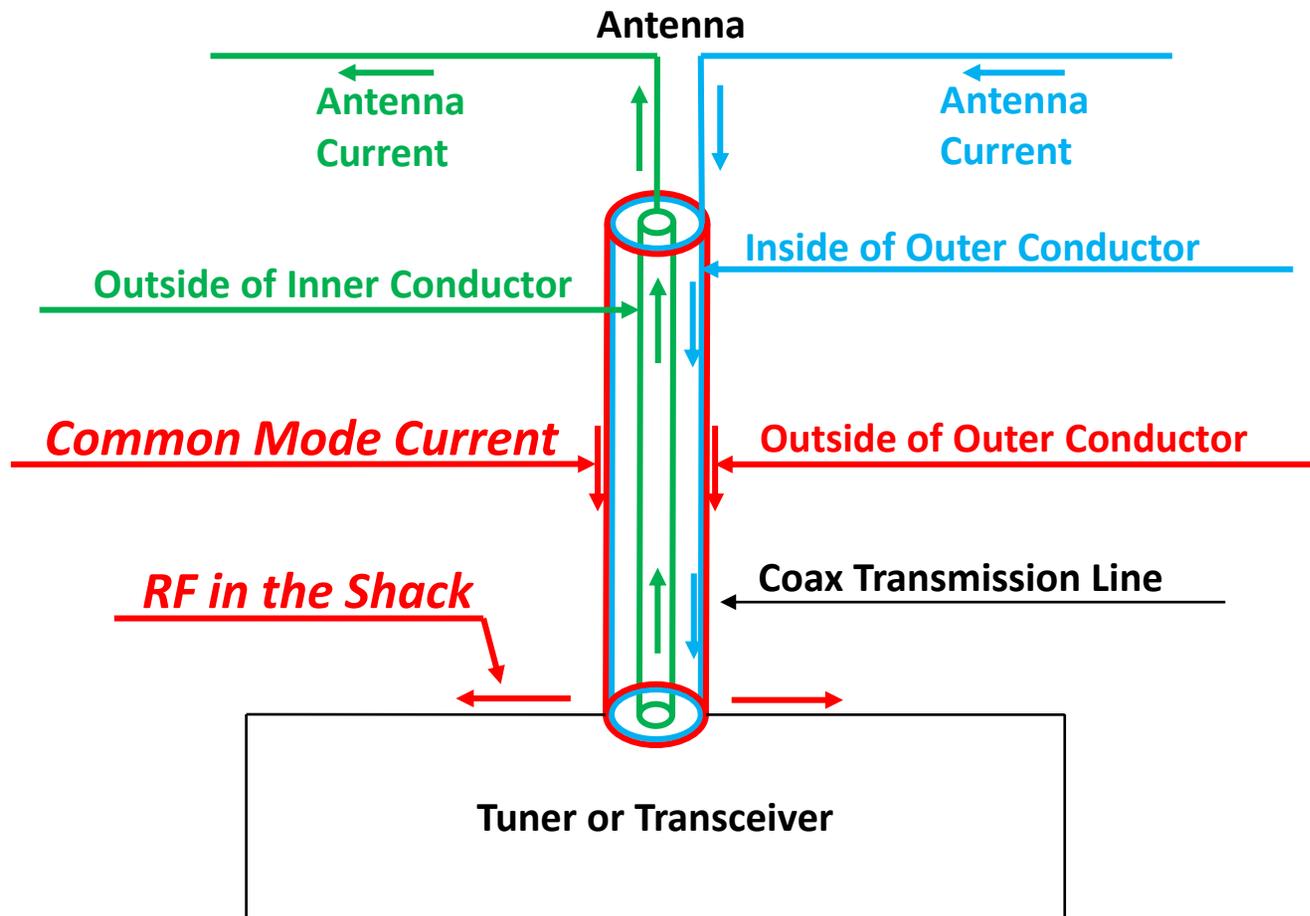
- Effective lightning protection is required, *otherwise your radio becomes a lightning fuse.*
 - Antenna grounds must have a low inductance connection to the radio power ground.
 - Eight foot grounding rods have an effective range of eight feet.
 - Space rods 16 feet apart to maintain their effectiveness.
- Lightning always finds the easiest path to ground.
 - *Make a path away from your radio the easiest!*

RF Grounding

- Antenna Designs
 - Many require grounding as part of the antenna design for safety, and/or performance.
- Common mode signals received by ground loops.
 - Causes desensitized reception.
 - Causes reception interference.
 - A common mode signal received by a loop with coax creates an RF current on the outside skin of the coax shield. The RF current on the outside skin of the coax shield creates a magnetic field which induces an RF current on the inside skin of the coax shield. The induced RF current on the inside skin of the coax mixes with the received RF current from the antenna causing desensitized reception and interference.

What is a Common Mode Choke?

- A Common Mode Choke provides high impedance to common mode current to reduce RF in the Shack.



The Ground Loop Solution

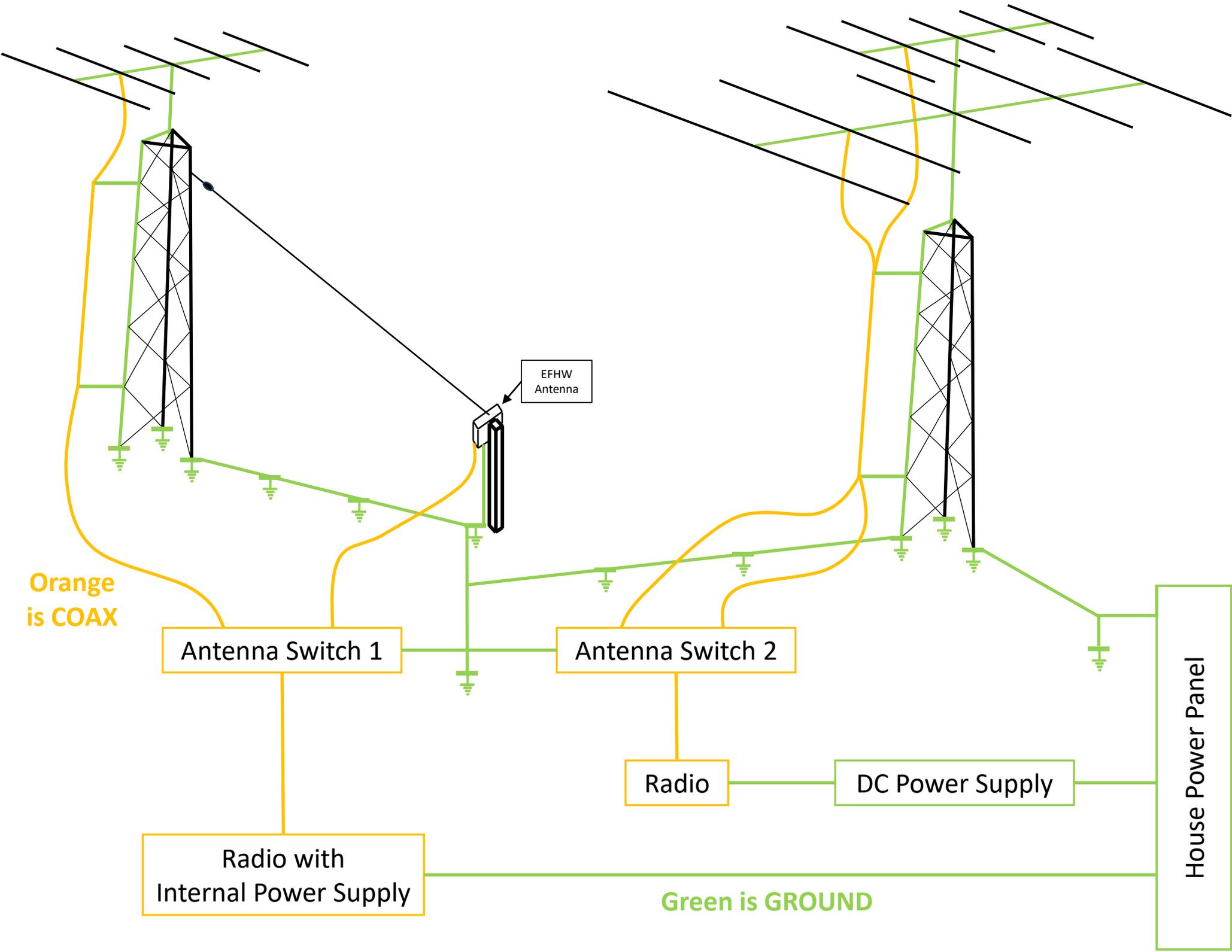
- Use common mode chokes effective for the band of operation.
 - Add common mode RF chokes where loops exist.
- Each ground loop needs a common mode choke in it.
 - Choose locations where a common mode RF choke does not impact either station operation nor safety performance.
- EFHW antennas may use the feed coax as a counterpois.
 - Therefor the common mode RF choke must be some distance from the 49 to 1 unun, often 17 feet.
- Beam antenna's may have a grounded counterpoise.
 - The counterpois of most beam antennas are connected to their boom, which is connected to ground. This creates loops that need to be addressed.

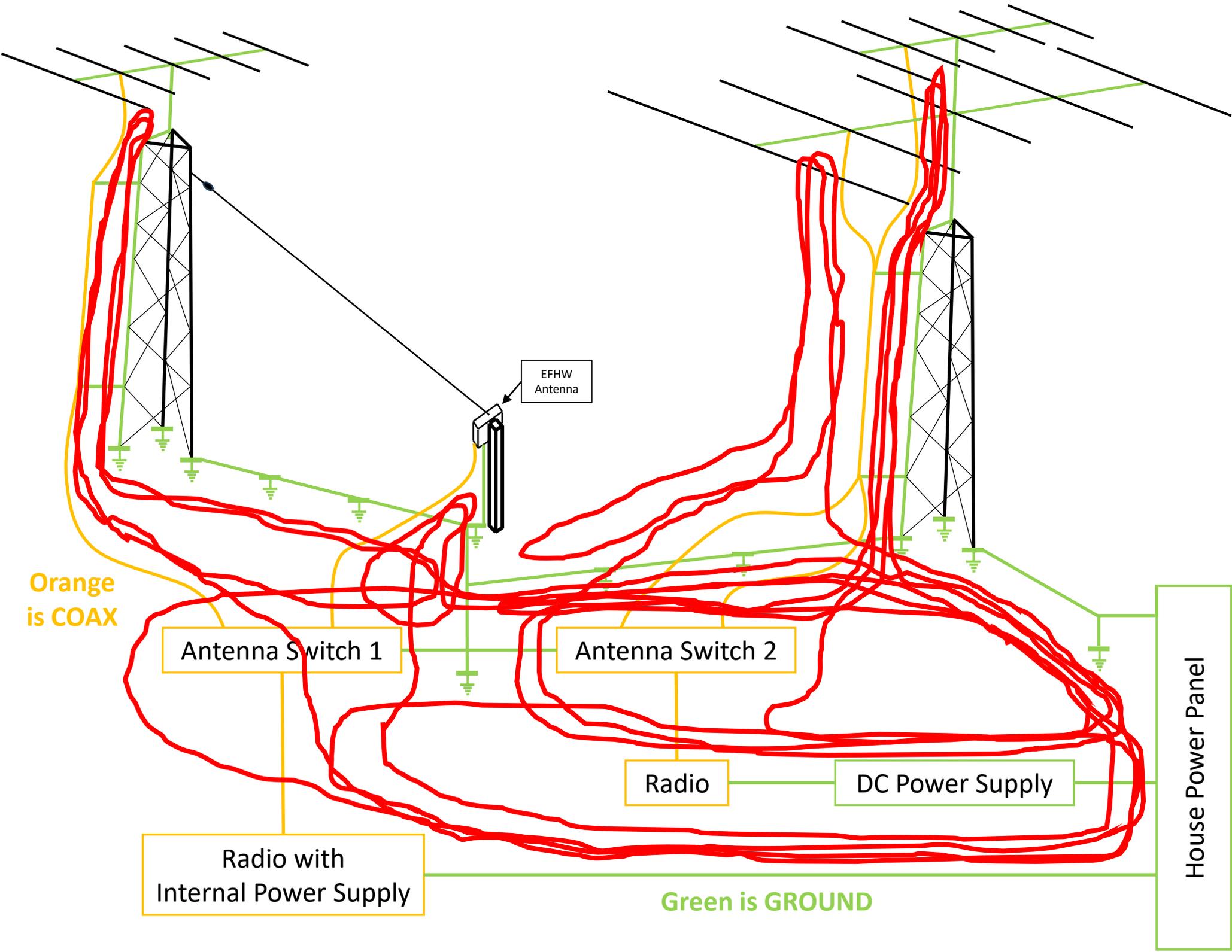
The Ground Loop Solution (cont')

- Option A uses common mode RF chokes on feed lines.
 - Coax common mode RF chokes that may consist of a number of turns of tightly coupled transmission line coax. Low bands require more, high bands require less.
 - Other effective common mode RF choke designs may also be used.
- **Orange circles** represent common mode RF chokes on feed lines.
- Polyphasors are grounded.
 - Add another connection of antenna coax shield to ground, creating more loops.
- Coax feed-throughs are grounded.
 - They are often used on towers and add another connection of antenna coax shield to ground, creating more loops.

The Ground Loop Solution (cont')

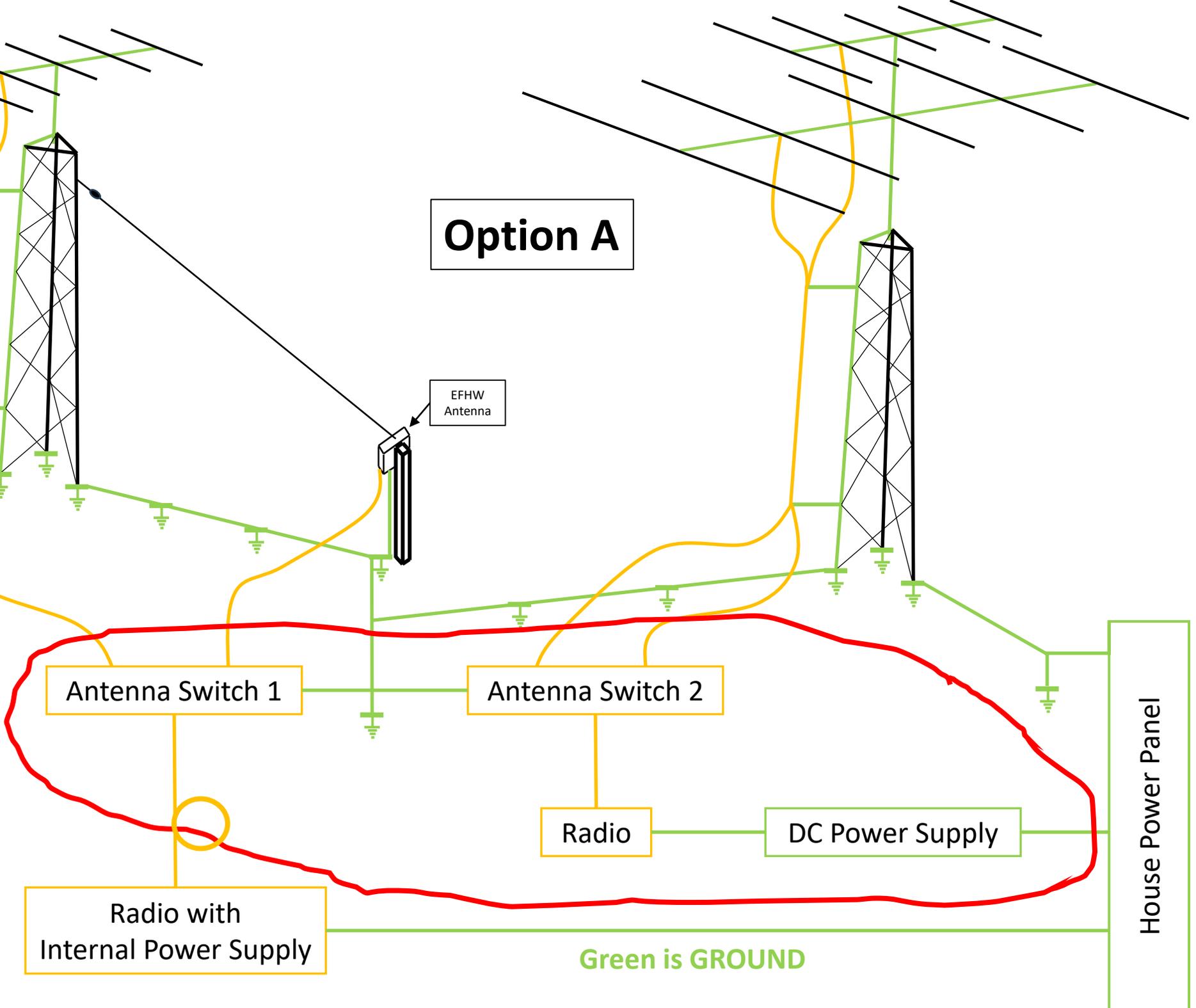
- Option B uses common mode RF chokes on both feed and power lines.
- **Green circles** represent common mode RF chokes on power lines.
- When power supply is separate from radio.
 - Use a common mode RF choke on the DC power cables between a radio and its DC power supply.
 - If an isolated power ground does not exist, most of the time the negative lead also carries a ground. Make a common mode choke by adding 6 to 12, type 31 clamp-on ferrites on the power supply cord to the radio.
- When power supply is built into radio.
 - Isolate the house power ground and install an insulated wire rapped around a type 31 ferrite in series with the ground.
 - The two power leads can be common mode wrapped around another ferrite.
 - Power considerations are needed here, commercial products are available for this very purpose.





Option A

Orange is COAX



EFHW Antenna

Antenna Switch 1

Antenna Switch 2

Radio

DC Power Supply

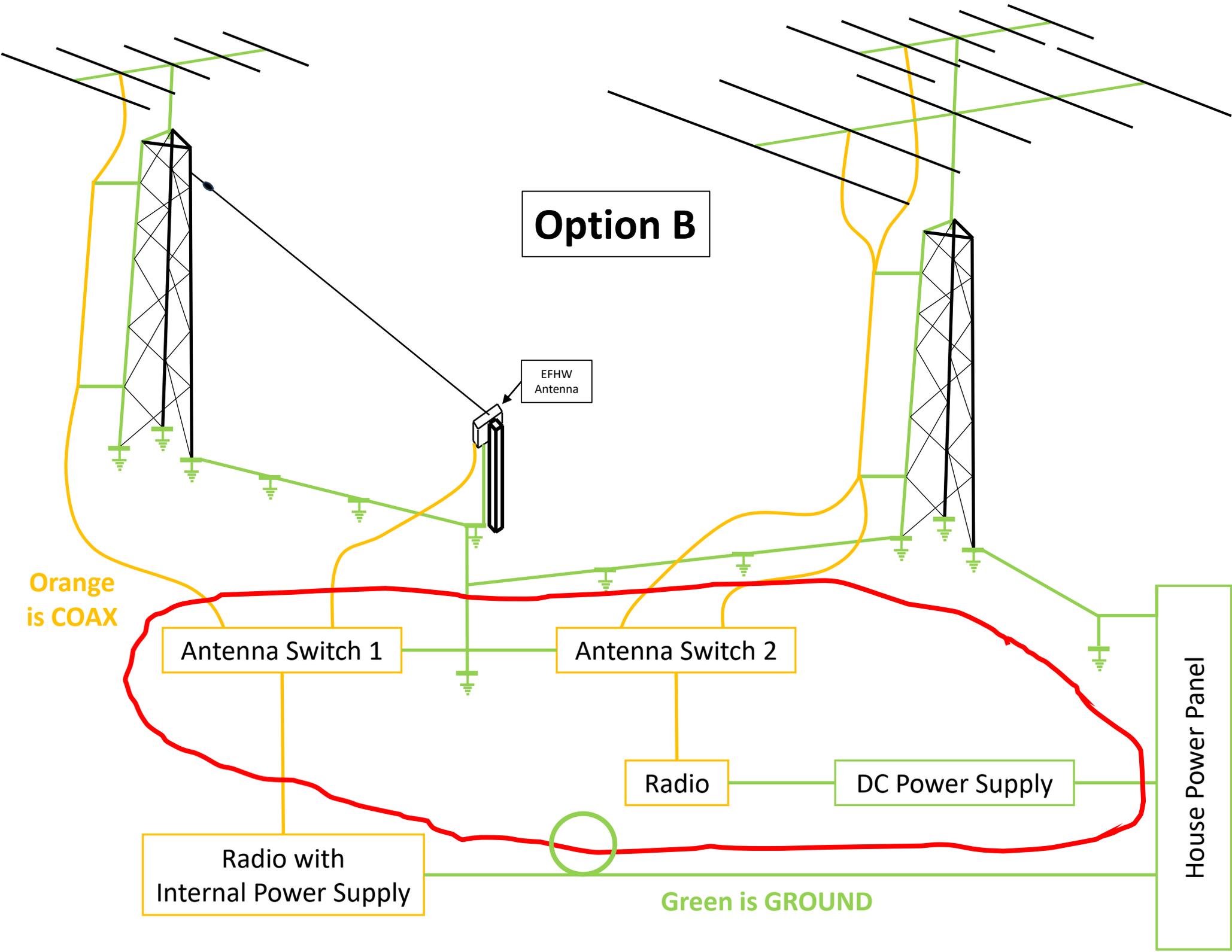
Radio with Internal Power Supply

Green is GROUND

House Power Panel

Option B

Orange is COAX



EFHW Antenna

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

Radio

DC Power Supply

House Power Panel

Green is GROUND

Option A

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio

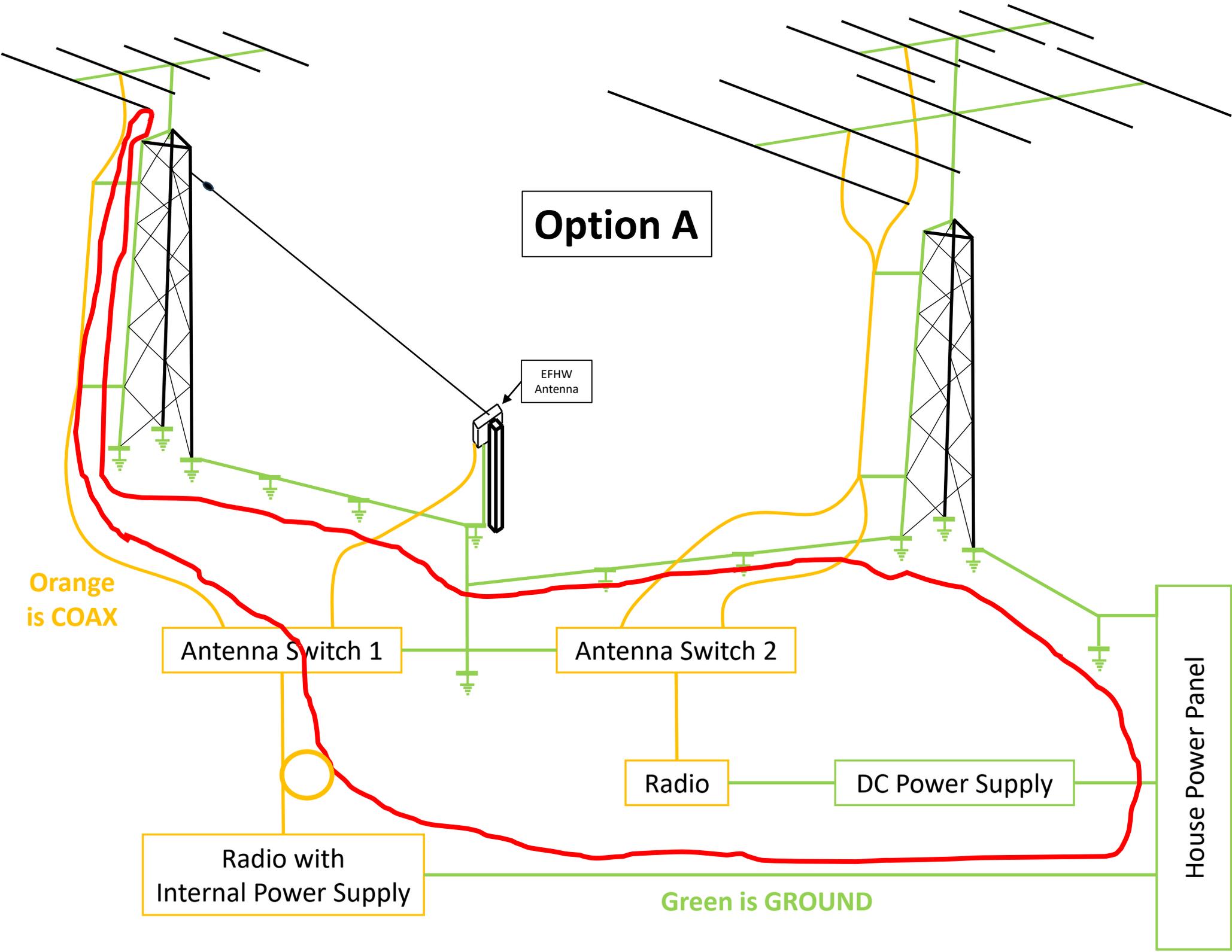
DC Power Supply

Radio with Internal Power Supply

Green is GROUND

House Power Panel

EFHW Antenna



Option B

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

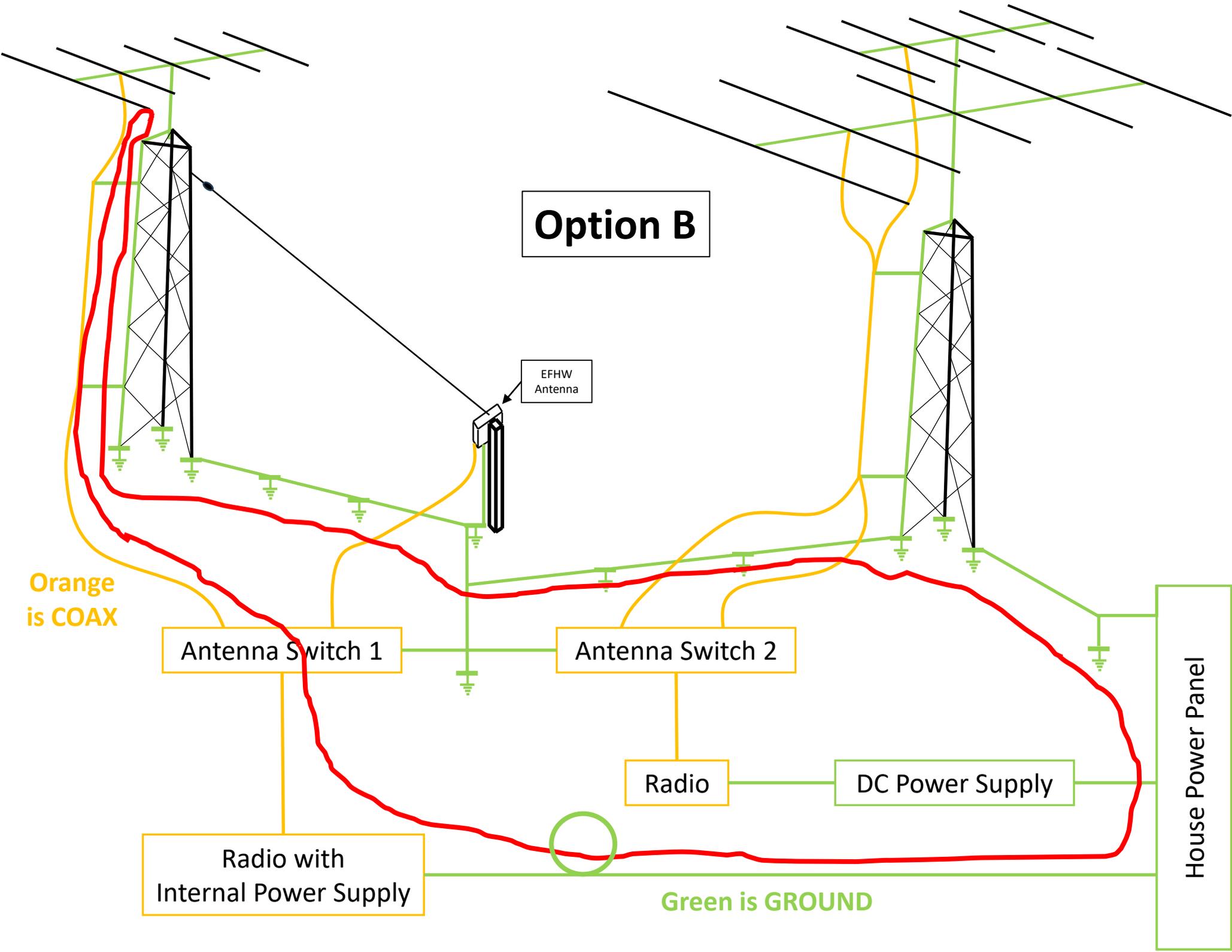
Radio

DC Power Supply

House Power Panel

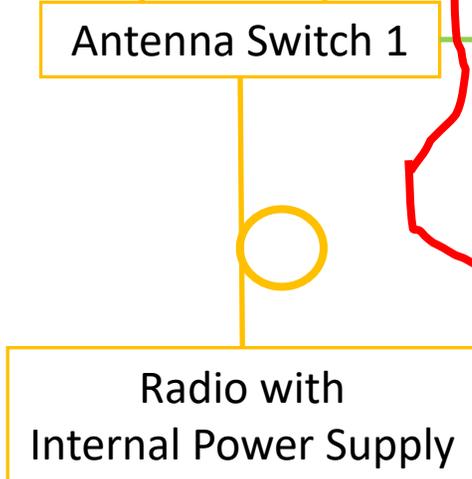
Green is GROUND

EFHW Antenna

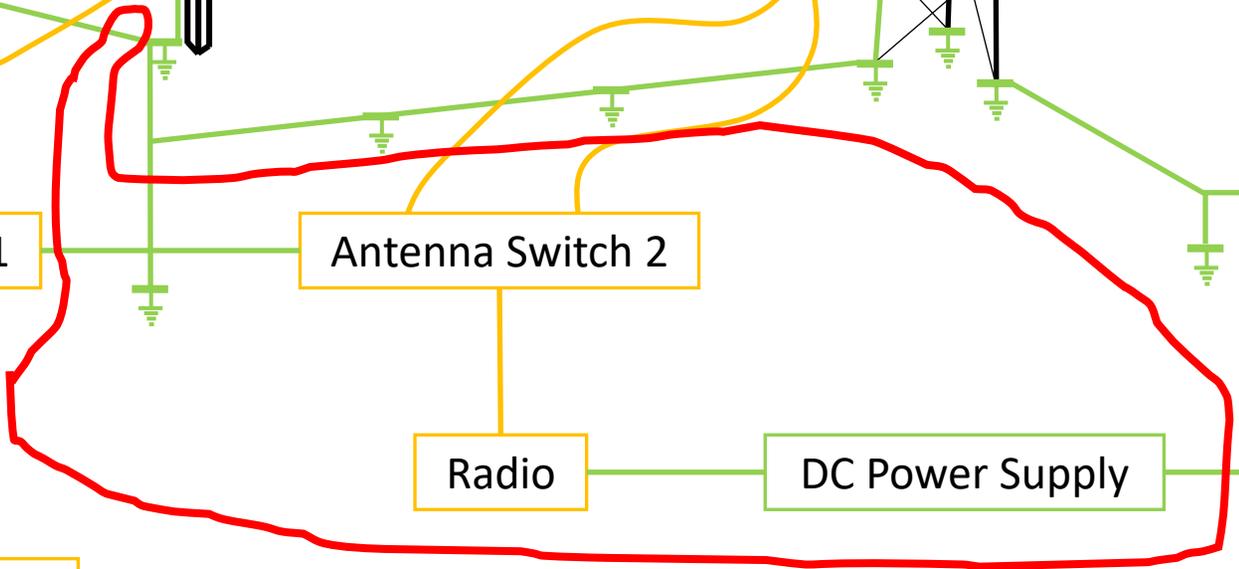


Option A

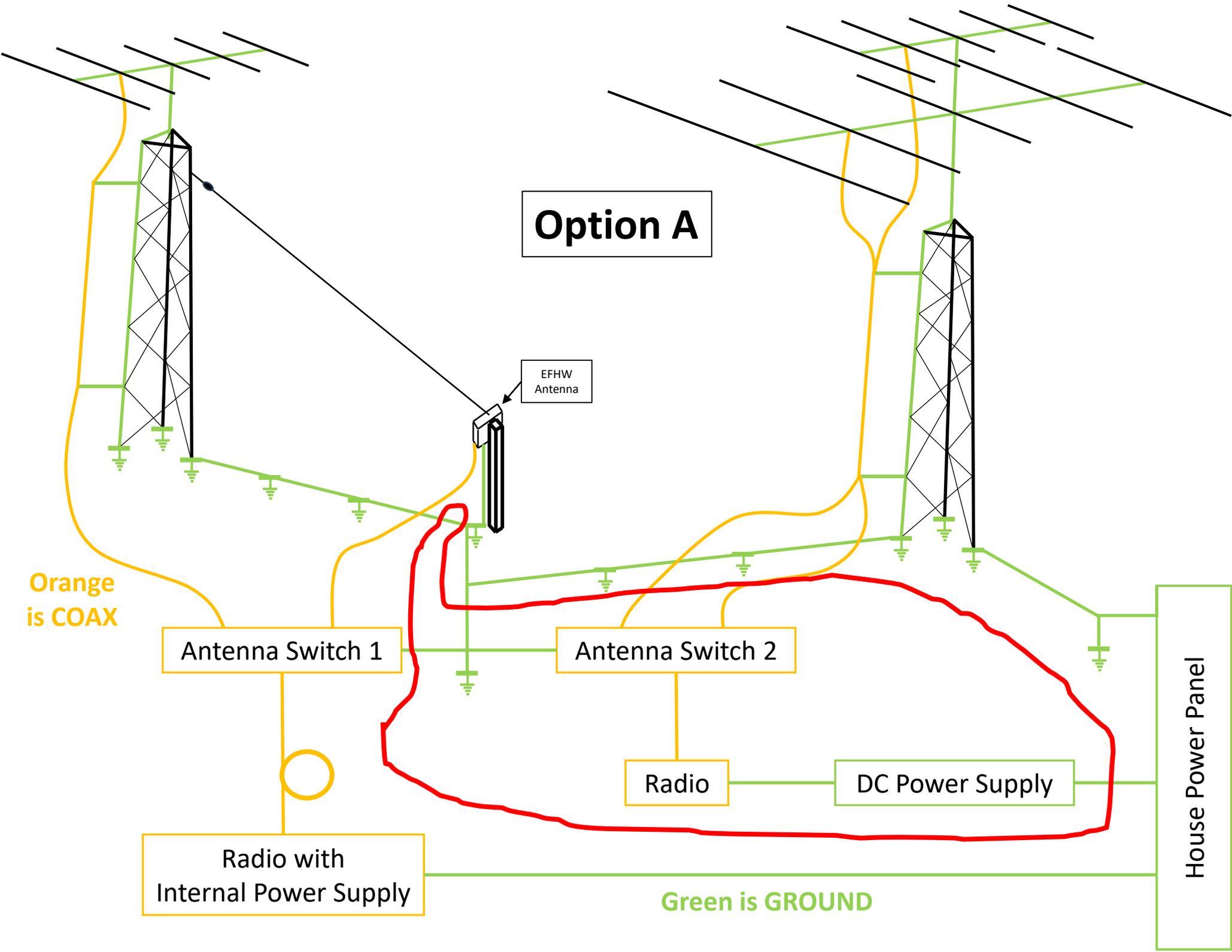
Orange is COAX



EFHW Antenna



Green is GROUND



Option B

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

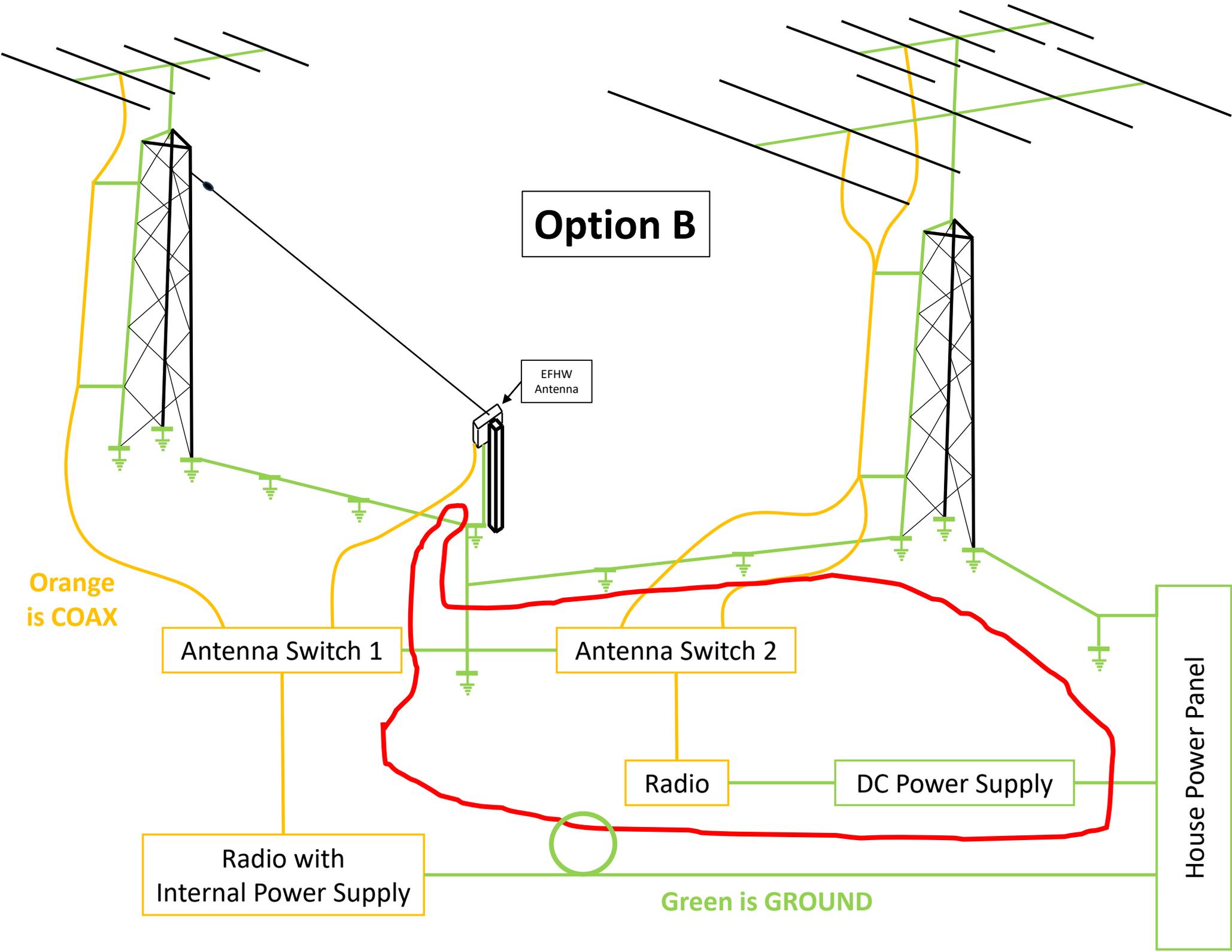
Radio

DC Power Supply

House Power Panel

Green is GROUND

EFHW Antenna



Option A

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

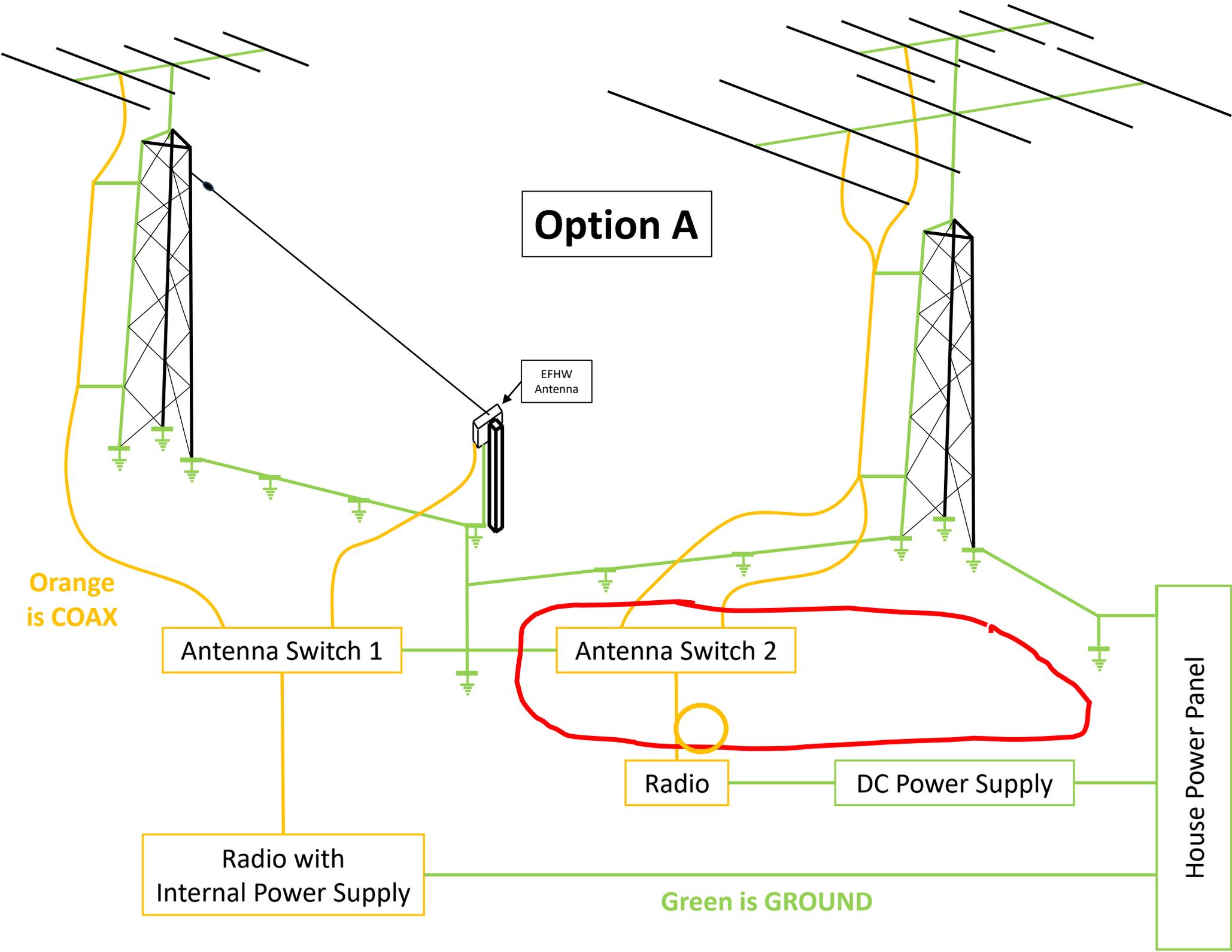
Radio

DC Power Supply

House Power Panel

Green is GROUND

EFHW Antenna



Option B

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

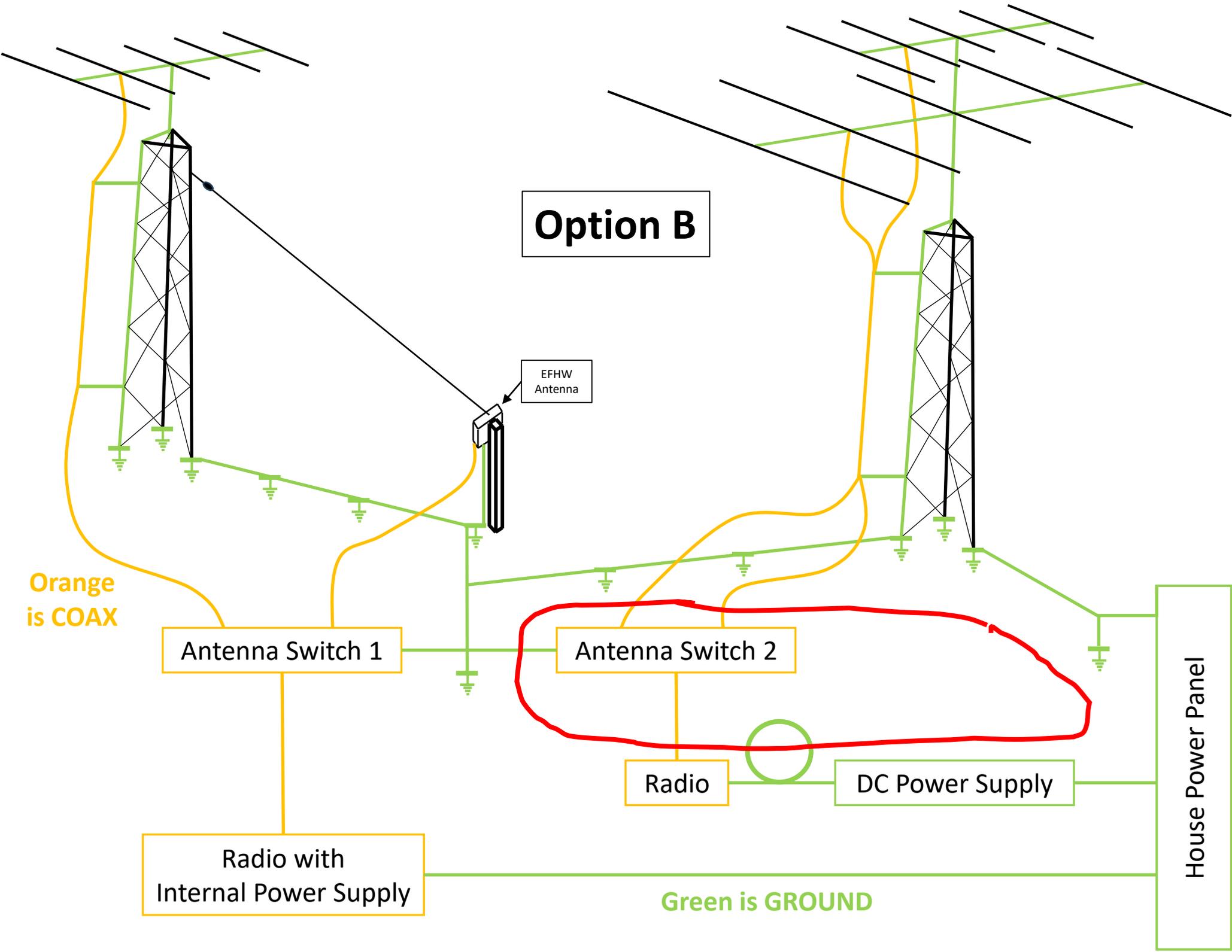
Radio

DC Power Supply

House Power Panel

Green is GROUND

EFHW Antenna



Option A

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

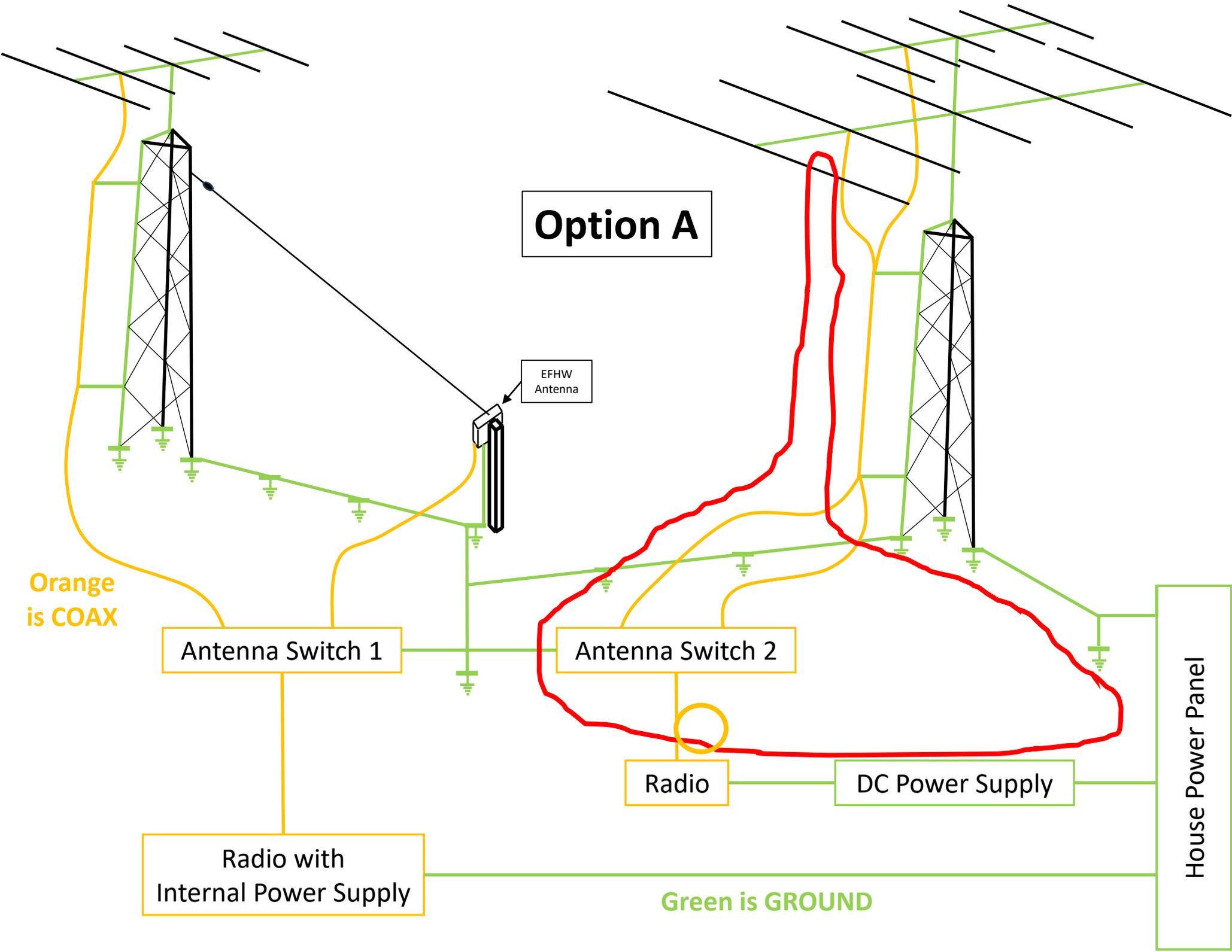
Radio

DC Power Supply

House Power Panel

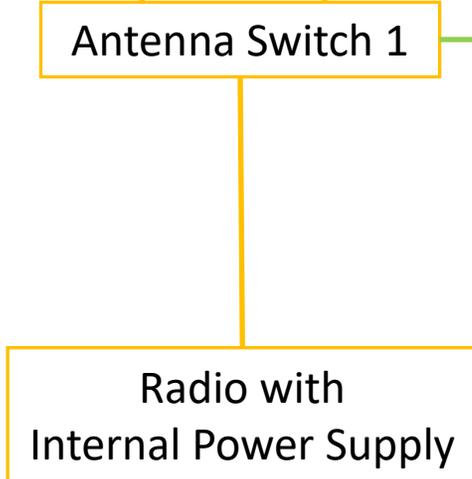
Green is GROUND

EFHW Antenna

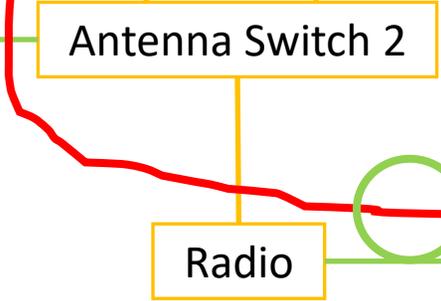


Option B

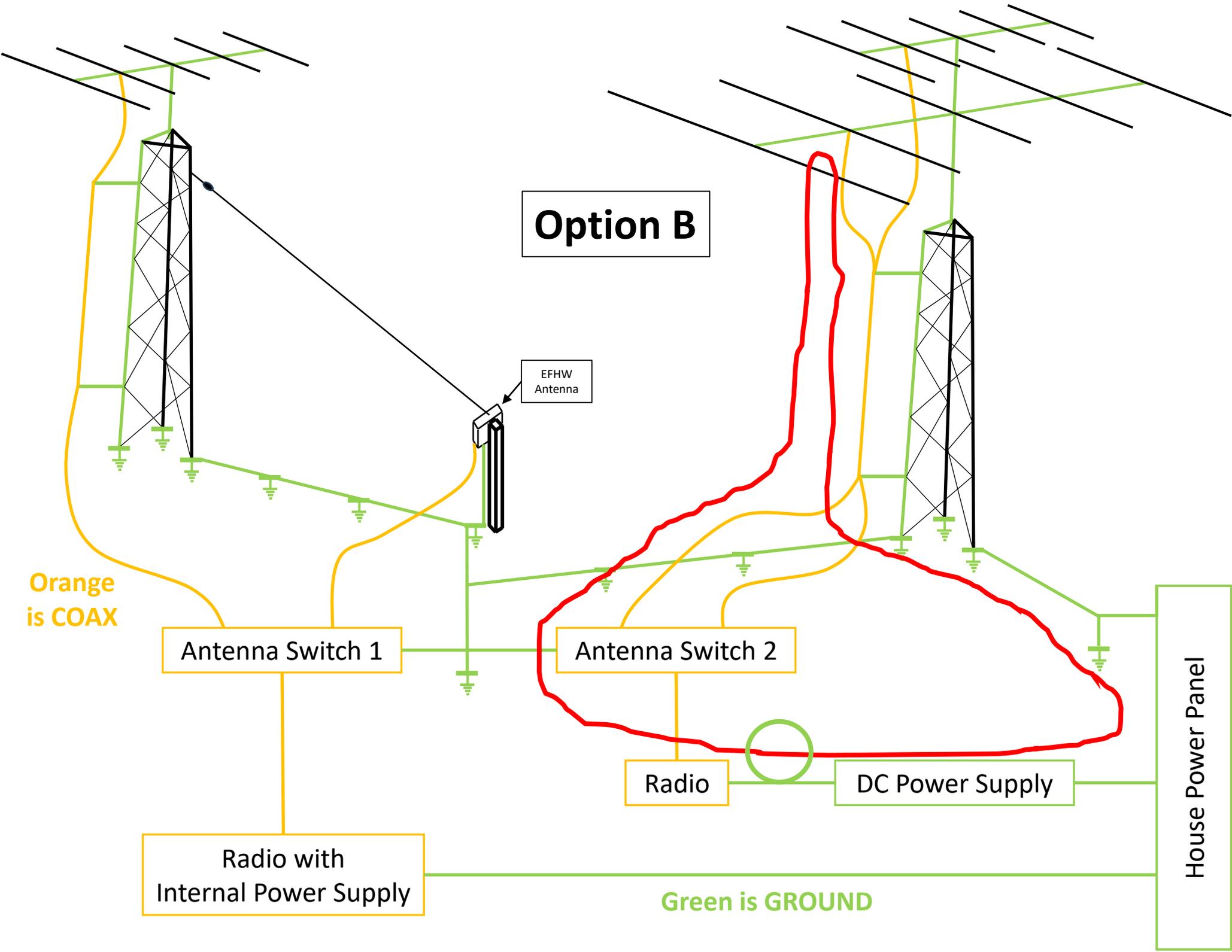
Orange is COAX



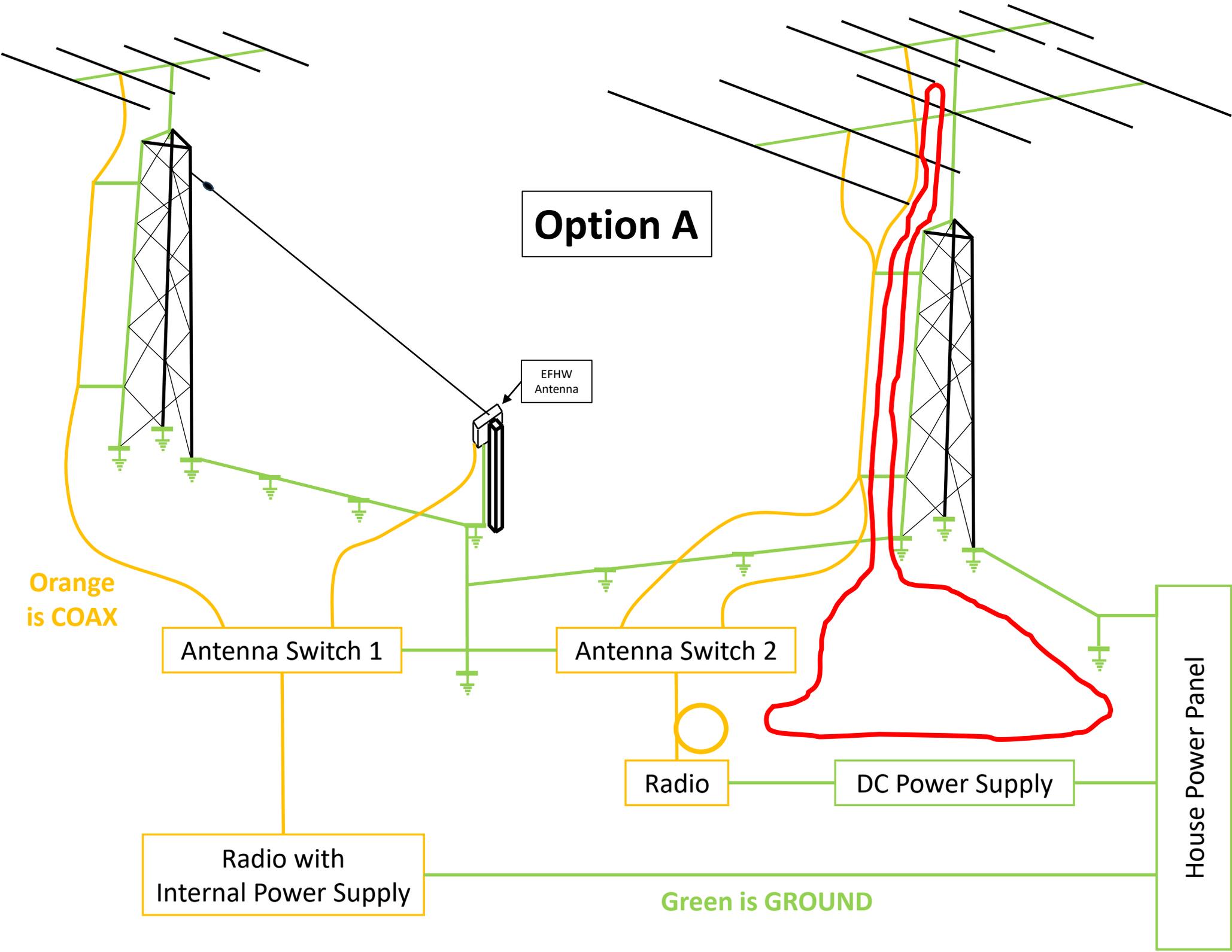
EFHW Antenna



Green is GROUND



Option A



Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio

DC Power Supply

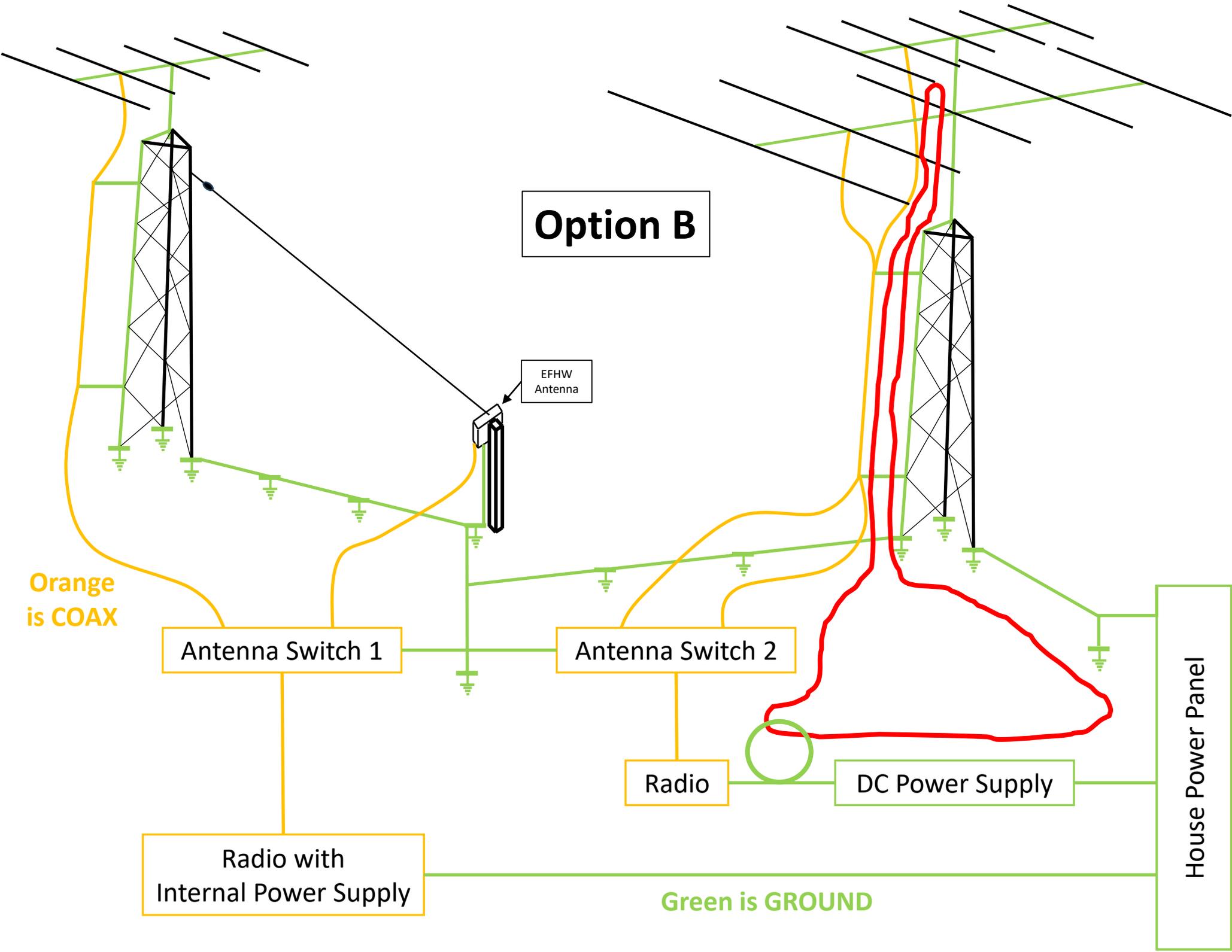
Radio with Internal Power Supply

Green is GROUND

House Power Panel

EFHW Antenna

Option B



Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio

DC Power Supply

Radio with Internal Power Supply

Green is GROUND

House Power Panel

EFHW Antenna

Option A

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

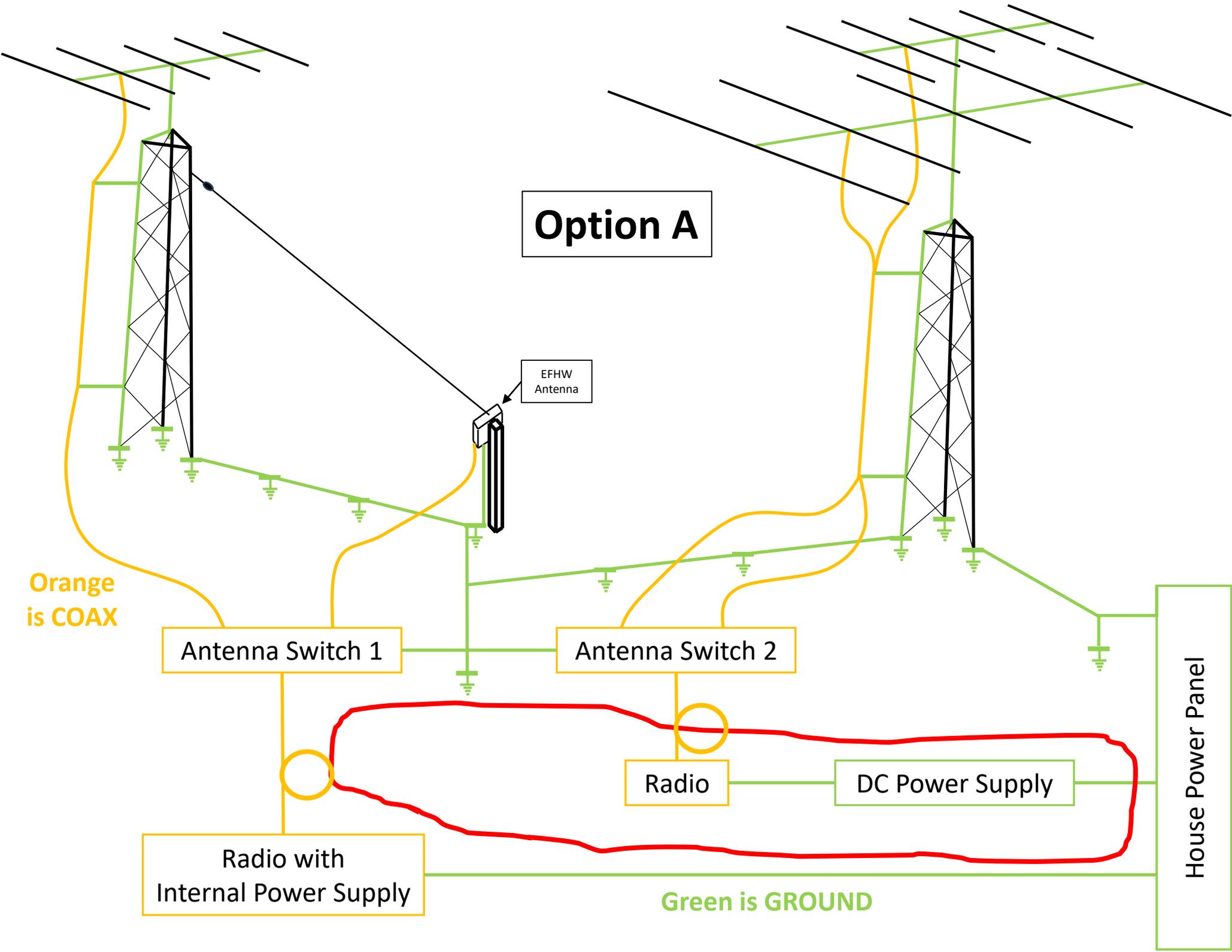
Radio

DC Power Supply

House Power Panel

Green is GROUND

EFHW Antenna



Option B

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio with Internal Power Supply

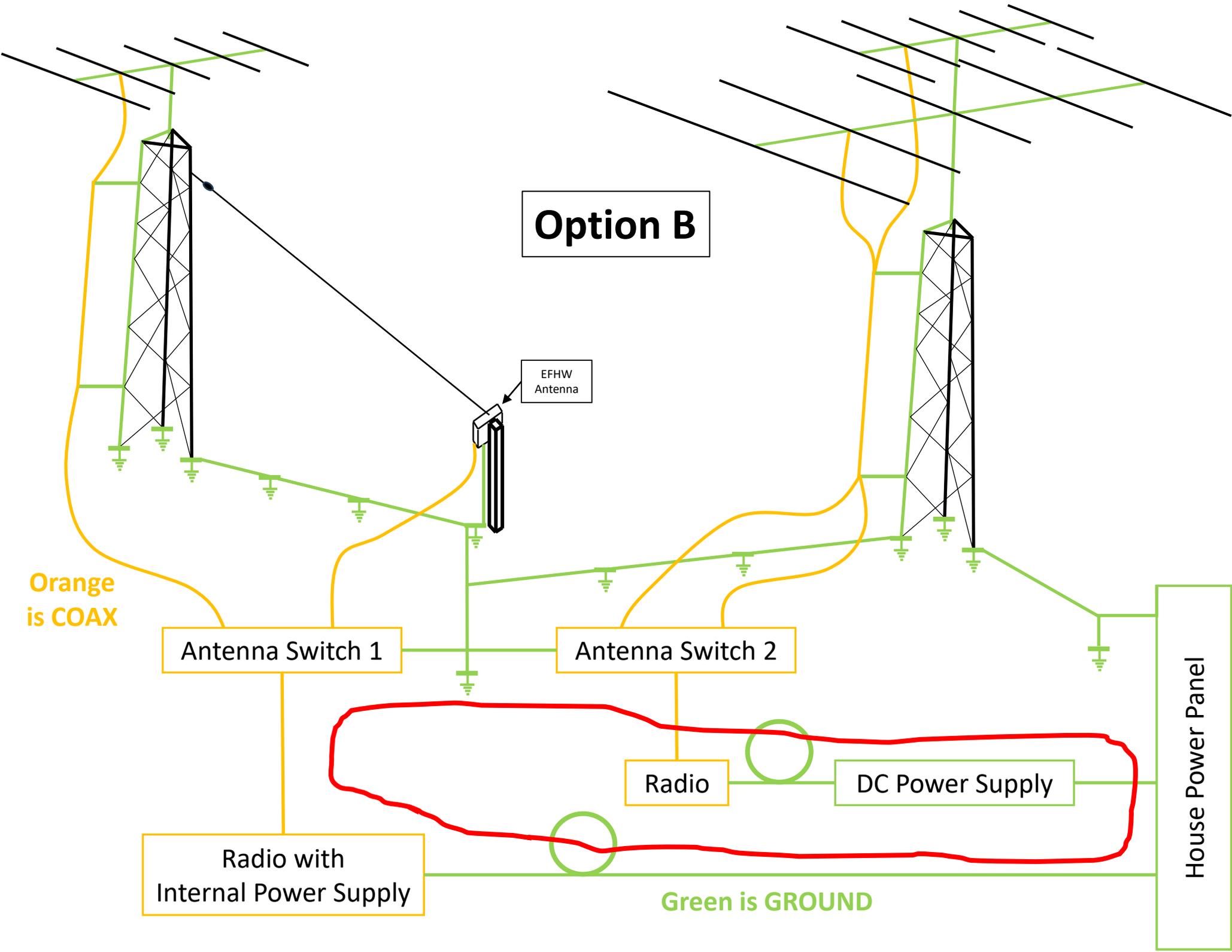
Radio

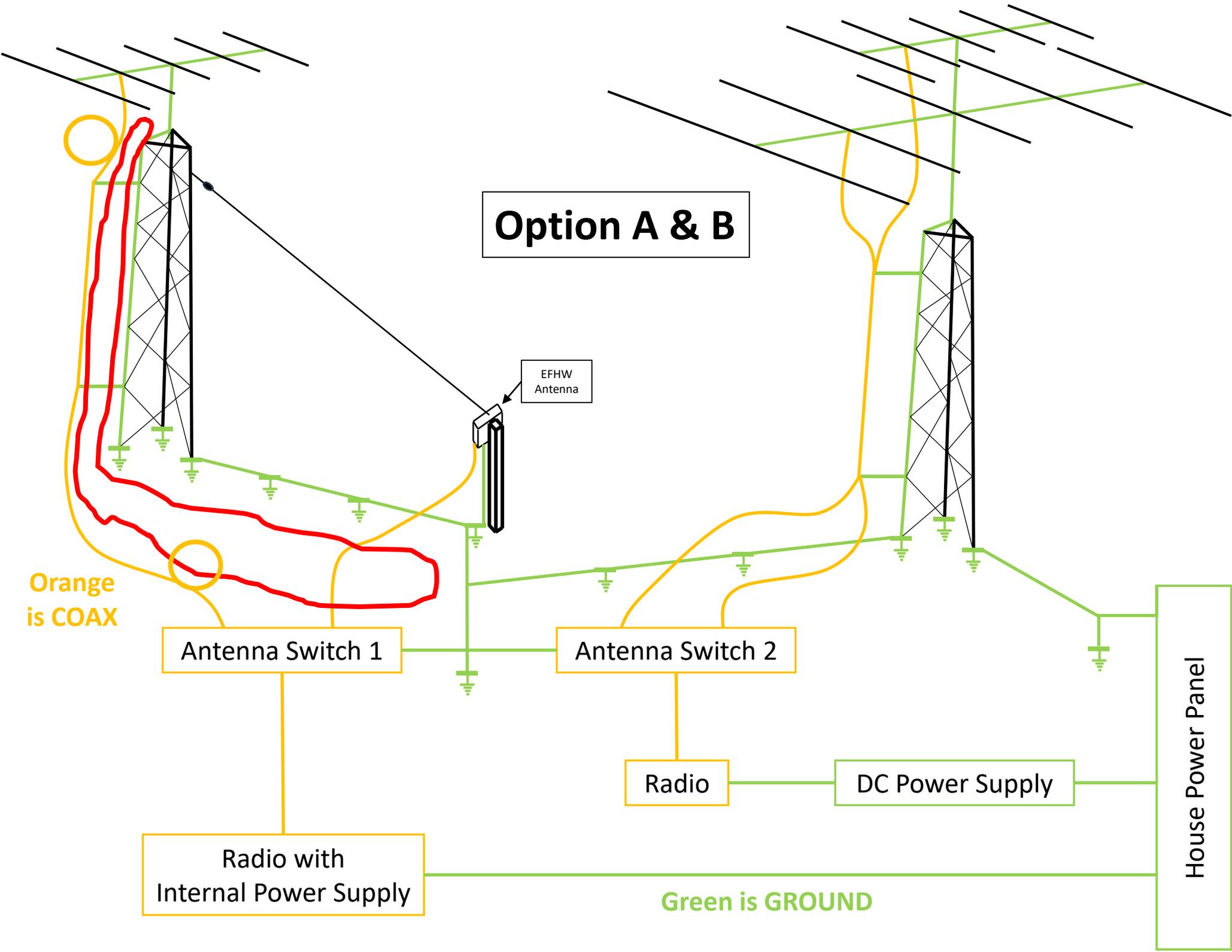
DC Power Supply

Green is GROUND

House Power Panel

EFHW Antenna





Option A & B

EFHW
Antenna

Orange
is COAX

Antenna Switch 1

Antenna Switch 2

Radio

DC Power Supply

Radio with
Internal Power Supply

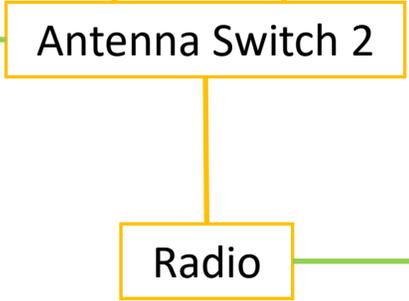
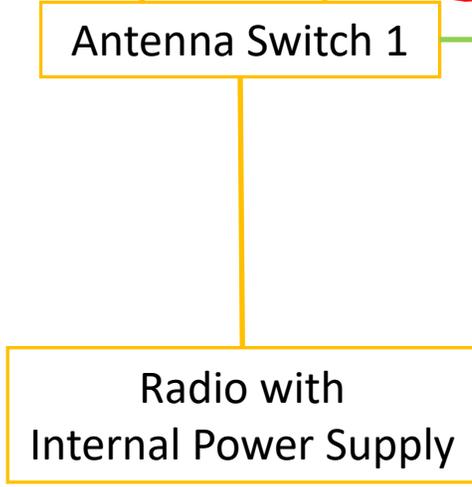
Green is GROUND

House Power Panel

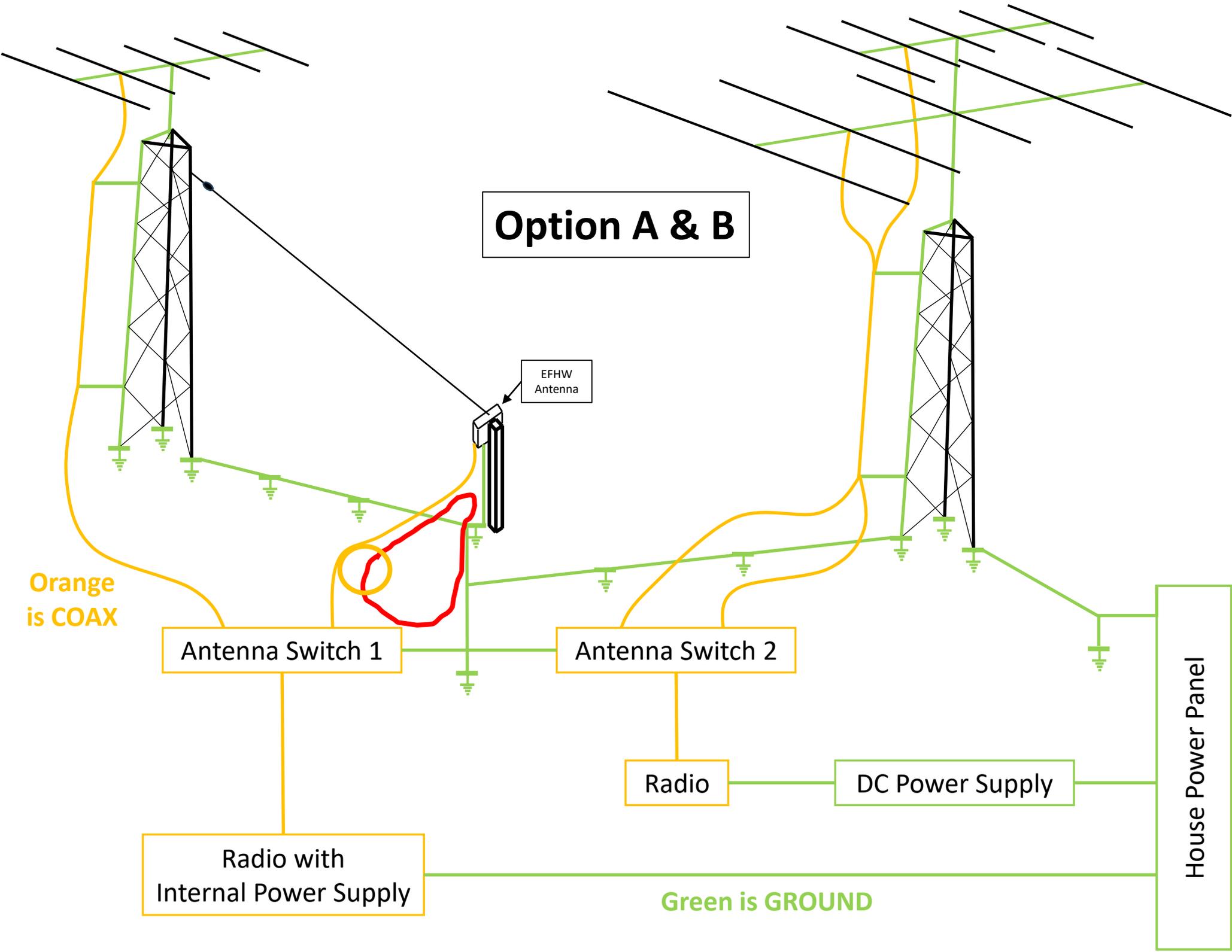
Option A & B

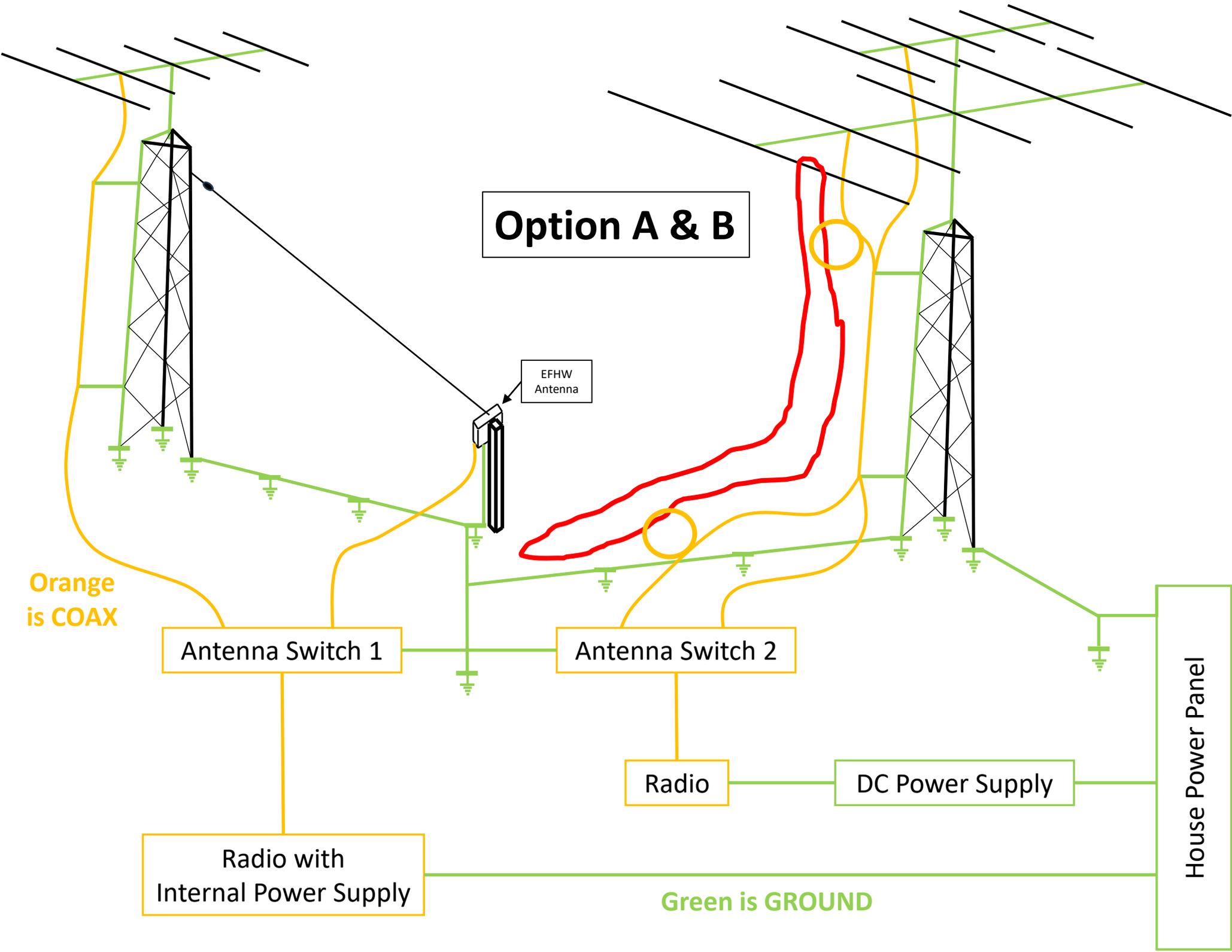
Orange is COAX

EFHW Antenna



Green is GROUND





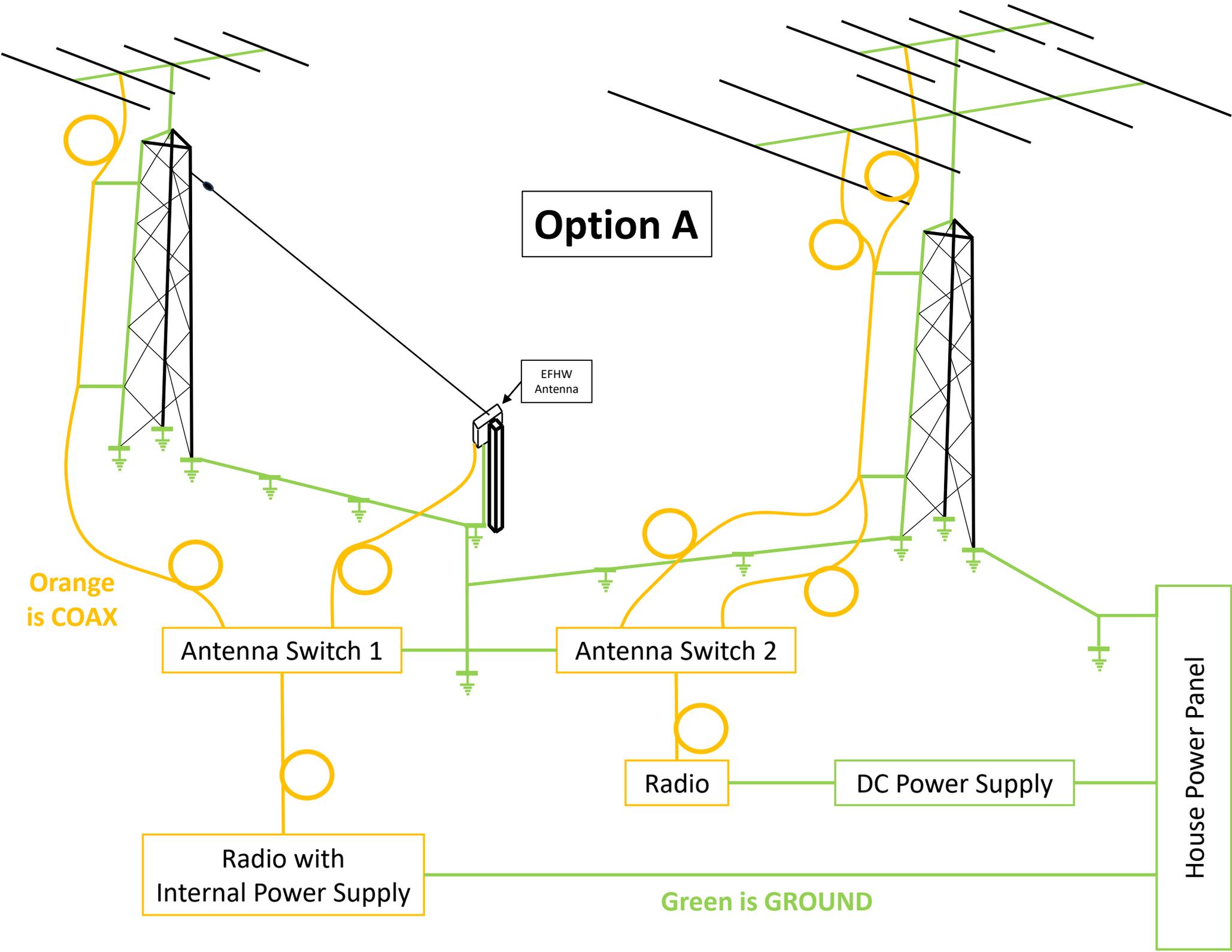
The Ground Loop Solution (cont')

- Next slide is Option A.
 - Which may be easier to implement.
 - Uses common mode RF chokes on feed lines.
 - Shows total number of common mode RF chokes required.
- Second slide is Option B.
 - Incorporating common mode RF chokes on both the feed and power supply lines.
 - Shows total number of common mode RF chokes required.

Option A

Orange is COAX

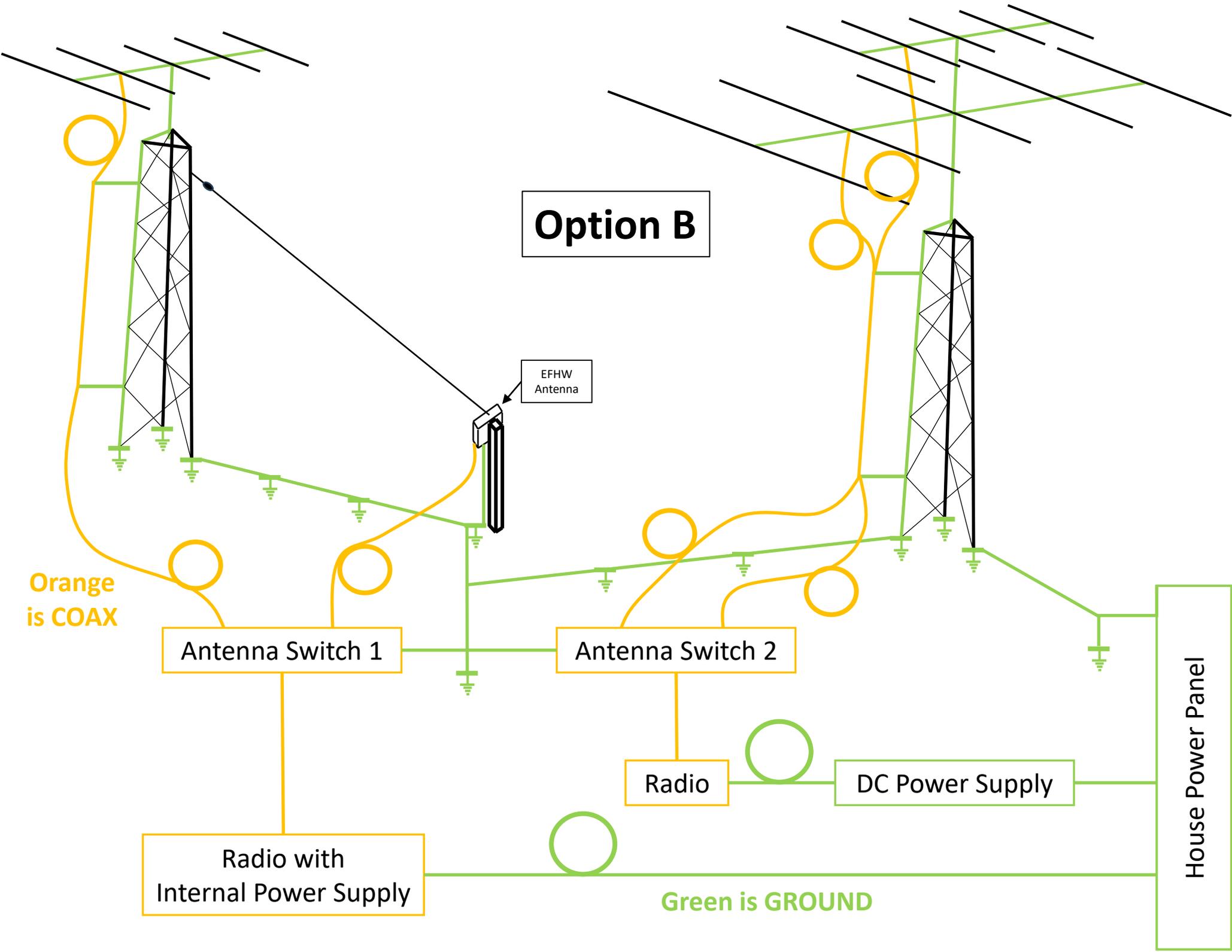
Green is GROUND



Option B

Orange is COAX

Green is GROUND



Antenna Switch 1

Antenna Switch 2

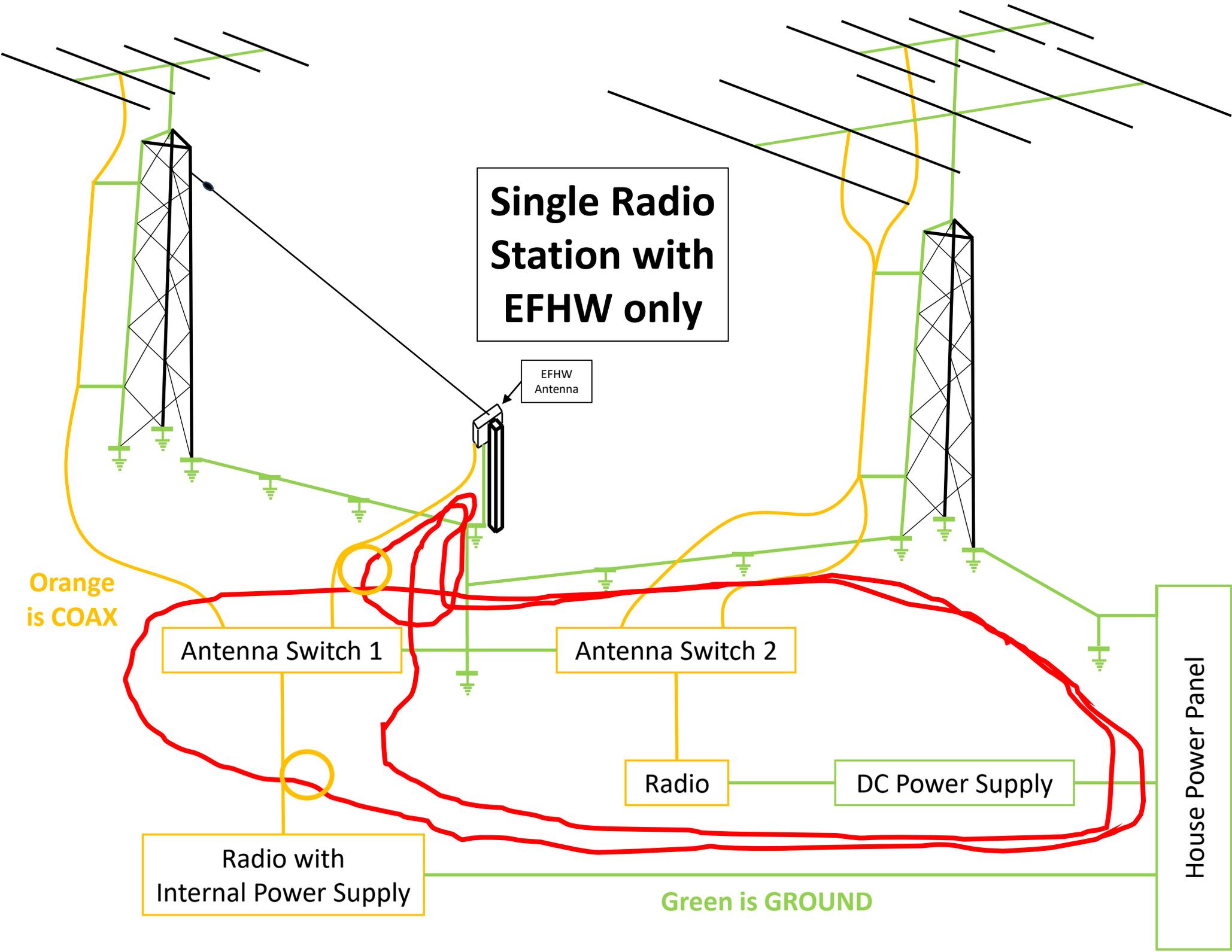
Radio with Internal Power Supply

Radio

DC Power Supply

House Power Panel

EFHW Antenna



Single Radio Station with EFHW only

EFHW Antenna

Orange is COAX

Antenna Switch 1

Antenna Switch 2

Radio

DC Power Supply

Radio with Internal Power Supply

Green is GROUND

House Power Panel

Summary of take-aways

- All properly grounded stations have ground loops
 - Determine the ground loops in your station
 - Determine the best locations for common mode chokes
- Identify all coax shield contact points with the ground system
 - Each point most likely creates at least one more ground loop
 - Beam antenna counterpoise
 - Tower connected coax pass-throughs
 - Polyphasors, or lightning suppressors
 - Wall or window grounded pass-throughs
 - Antenna switches
 - Radios