



IoT Repair Instructions



Table of Content

REVISION	4
PURPOSE	4
DIFFERENCE 2G VS 4G	5
FIRMWARE UPDATE	6
LIST OF REQUIRED TOOLS	6
COMPUTER SETUP	7
IoT FW FLASH	7
REPLACING ANTENNA	10
LIST OF REQUIRED TOOLS	10
COMPATIBLE ANTENNA SPECIFICATIONS	10
SAFETY	10
ESD PROTECTION	10
GENERAL ADVICE	11
SOP	11
OPENING THE IoT	11
REMOVING THE OLD ANTENNA	12
INSTALLING THE NEW ANTENNA AND TESTING THE FUNCTIONALITY	13
GLUING THE ANTENNA AND CLOSING THE IoT (NECESSARY?)	14
IoT LED INTERPRETATION	15
WOLFENSTEIN	15
CATACOMB	15
IoT POWER INDICATOR	15
BATTERY CHARGING INDICATOR	15
MODEM STATUS INDICATOR	15
NETWORK CONNECTIVITY INDICATOR	15
GPS STATUS INDICATOR	16
SOURCING THE GNSS ANTENNAS FROM V1 IoTS (WORKS MIGHT NEED TO ADD STEP TO SEE IF ANTENNA WORKS)	16
CONCLUSIONS AND CONTINUOUS WORK	17
WOLFENSTEIN IoT REBOOTING, V4 AND V3x	18
COMPUTER/J-LINK AND NRF COMMAND LINE SETUP	18
V4 WOLFENSTEIN IoT REBOOTING:	18

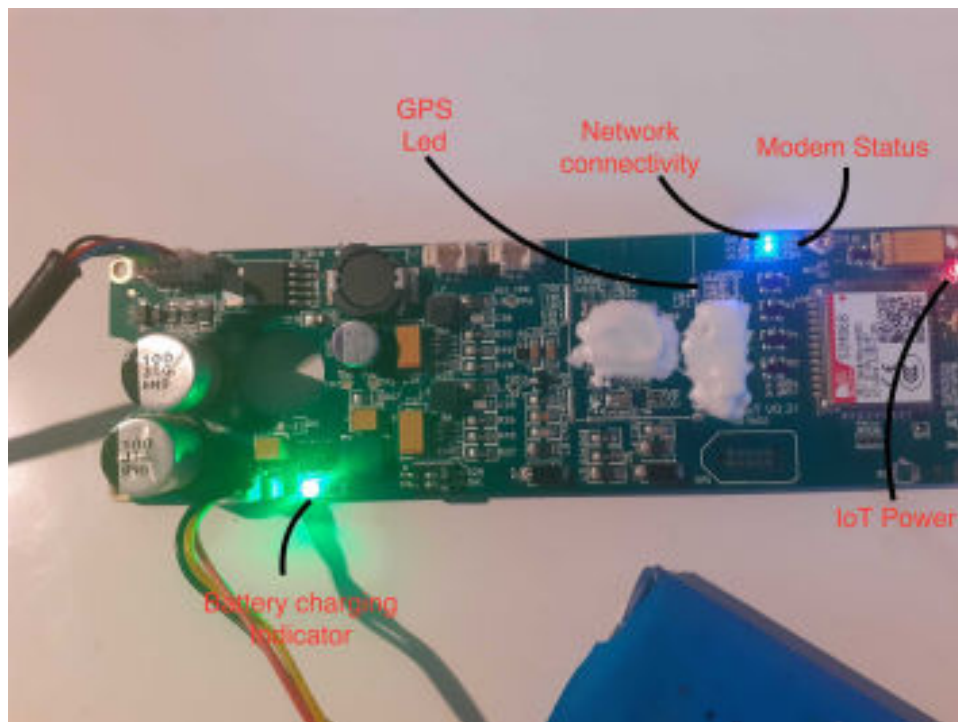


V3x WOLFENSTEIN IoT REBOOTING:

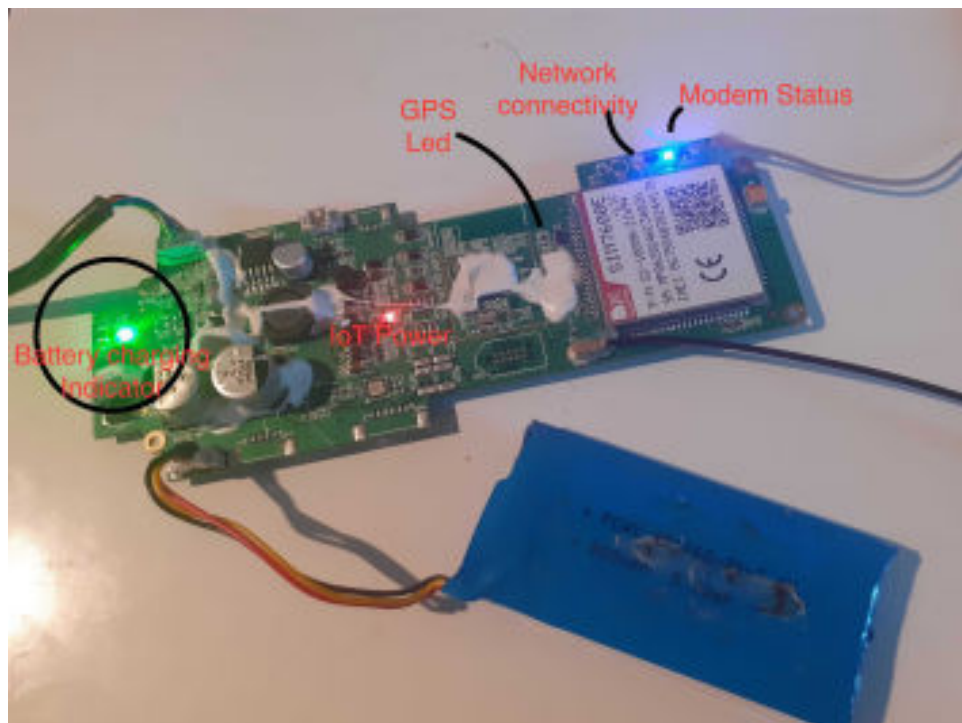
19

Difference 2G vs 4G

2G



4G





Firmware update

List of required tools

These are the tools needed when updating the firmware of the IoT:

- TC2050-IDC-NL 10-Pin No-Legs Cable with Ribbon connector ([Link](#))
- J-Link BASE (8.08.00) ([Link](#)) (Includes a USB cable, and a 20-pin, 0.1" JTAG/SWD ribbon cable for ARM/Cortex devices)
- Voi custom adapter board (20-pin to 10-pin)
- TC2050-CLIP-3PACK Retaining CLIP board for TC2050-NL cables – 3 Pack ([Link](#))





Computer setup

- 1: Download and install the latest version of the NRFtools and J-Link drivers.

J-Link Software and Documentation Pack:

<https://www.segger.com/downloads/jlink#J-Link Software And Documentation Pack>

nRF Command line tools:

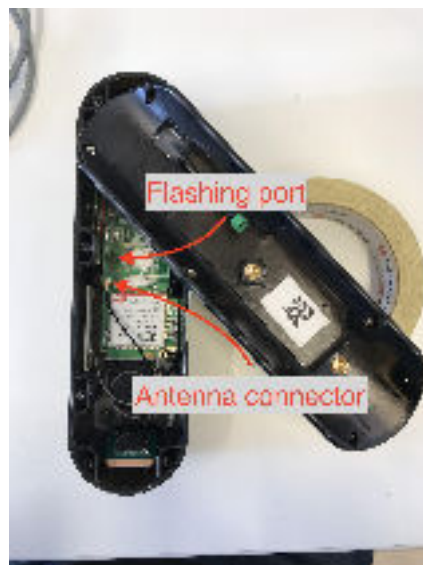
<https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Command-Line-Tools/Download>

- 2: Download the IoT firmware files(slim.hex) and store them in an easy-to-access location.

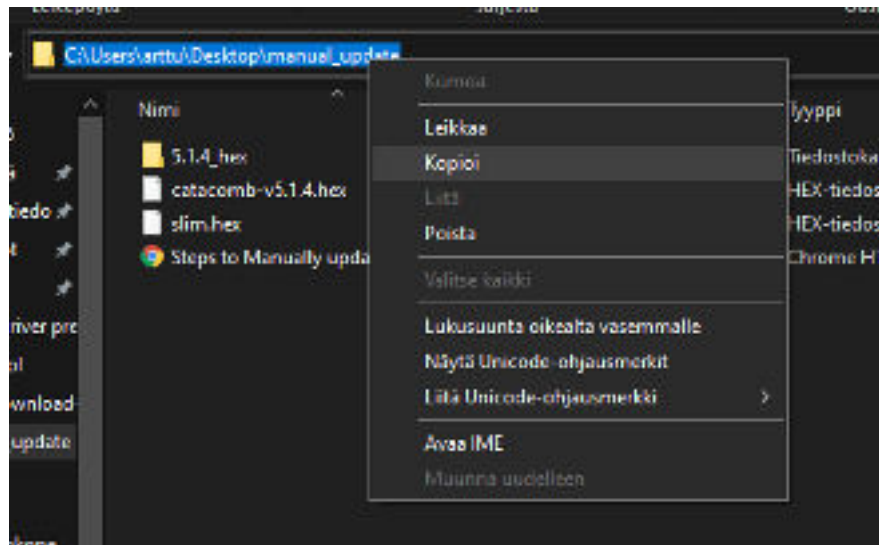
https://drive.google.com/drive/folders/1XlZPtO4Xv3axkodv0zBh_AEYvwMEijh0?usp=sharing

IoT FW flash **NOTE! Never flash Wolfenstein IoT. This instruction only applies to Catacomb IoT!**

- 3: Make sure to have working GPS coverage.
- 4: Open up the IoT, visually verify antenna connection



- 5: Power on device, insert JLink cable, flash hex:
 - a. Power up IoT (You can use battery, controller and controller cable to power IoT)
 - b. Open command prompt as an administrator
 - c. Go to folder where .hex is located
(pro tip: you can copy folder path from windows file manager address bar. [Guide](#))



- d. Hold flashing cable on iot flashing port and enter commands:
- ```
nrfjprog --eraseall
nrfjprog --program slim.hex --chiperase --reset
```







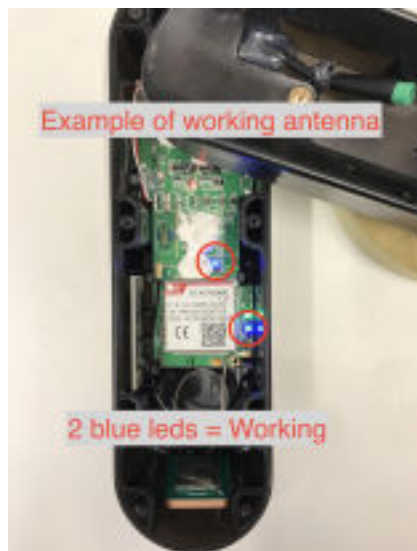
```
Microsoft Windows [Version 10.0.19041.687]
(c) 2020 Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>cd C:\Users\anttu\Desktop\manual_update 1.
C:\Users\anttu\Desktop\manual_update>python prog --eraseall 2.
Erasing user available code and UICR flash areas.
Applying system reset.

C:\Users\anttu\Desktop\manual_update>python prog --program s11a.hex --chiperase --reset 3.
Parsing image file.
Erasing user available code and UICR flash areas.
Applying system reset.
Checking that the area to write is not protected.
Programming device.
Applying system reset.
Run.

C:\Users\anttu\Desktop\manual_update> DONE
```

- 6: Remove the JLink cable
- 7: After about 45 seconds, you should see one solid blue LED and one flashing green LED. If not, the IoT is not salvageable (but antenna might be!)
- 8: Leave IoT powered on for 30 minutes, or until you see TWO blue LEDs on PCB lit  
Make sure GPS coverage is good. You might have to place IoT outside for good coverage.
- 9: If two blue LEDs are lit, the IoT is ready for deployment



- 10: If only one blue LED is lit, cut power, switch antenna, power on the IoT and go to step (6).

**Note:** only step (8) requires good GPS coverage, so this can be performed in bulk outside if the warehouse does not have any spots with good coverage.



## Replacing Antenna

### List of required tools

- PH1 Bit Long (Würth [0614176774](#), screws are really PH2)  
Alternatively, you may have a 4mm PH2 bit. These are usually part of some precision mechanics sets, such as Würth [0613 489 5](#) . You can then use a 4mm adaptor like [this](#).
- Electric drill screwdriver (Würth [5701101002](#))
- Snipe nose pliers (Würth [071501 567](#))
- U.FL Connector removal tool  
(<https://www.digikey.co.uk/product-detail/en/hirose-electric-co-ltd/U-FL-LP-N-2/H9159-ND/513008>)
- ESD protection mat and wrist strip, for example  
<https://www.conrad.de/de/p/quadrios-esd-tischmatten-set-grau-l-x-b-650-mm-x-500-mm-245931.html> For U.K. market the plug socket should be this one:  
<https://uk.rs-online.com/web/p/esd-grounding-accessories/2983884/>(recommended, read below regarding ESD protection)
- Boxes for placing IoT screws and antennas

### Compatible antenna specifications

GNSS Antenna with single feedpoint, 12cm coax. cable and U.FL connector G54-glonass, 25mm x 25mm x 6.5mm 1 2.95 2.95 , AND Technologies co.,Ltd.

The antennas can also be sourced from V1 IoTs, available from our Supply Chain; this solution is more labour intensive.

## Safety

### ESD Protection

While replacing the antennas, an antistatic mat and wristband should be used: they avoid that electrostatic charge accumulated on our body can discharge on the electrical components soldered on the IoT board, permanently damaging them. Wristband and mat should be connected to a grounded metal part, or eventually to a wall plug with ground connection through the accessories and cables provided in the kit. Please follow manufacturer instructions.

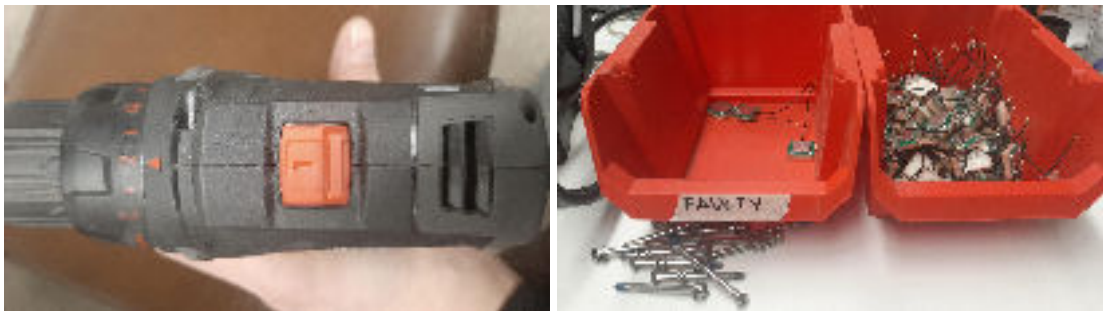
In case you do not have an ESD protection kit at your disposal, just touch the metal body of any electrical appliance connected to a wall plug with ground connection before touching the printed circuit board inside the IoT. The metal structure hosting scooter chargers should fit perfectly to this purpose, since it should be grounded.



Avoid touching any other part of the PCB aside from the GNSS antenna and its connector. Do not use a carpet under your table (increased risk of ESD). Synthetic fibers and wool, as well as gum soles in your shoes, increase the risk of ESD.

### General advice

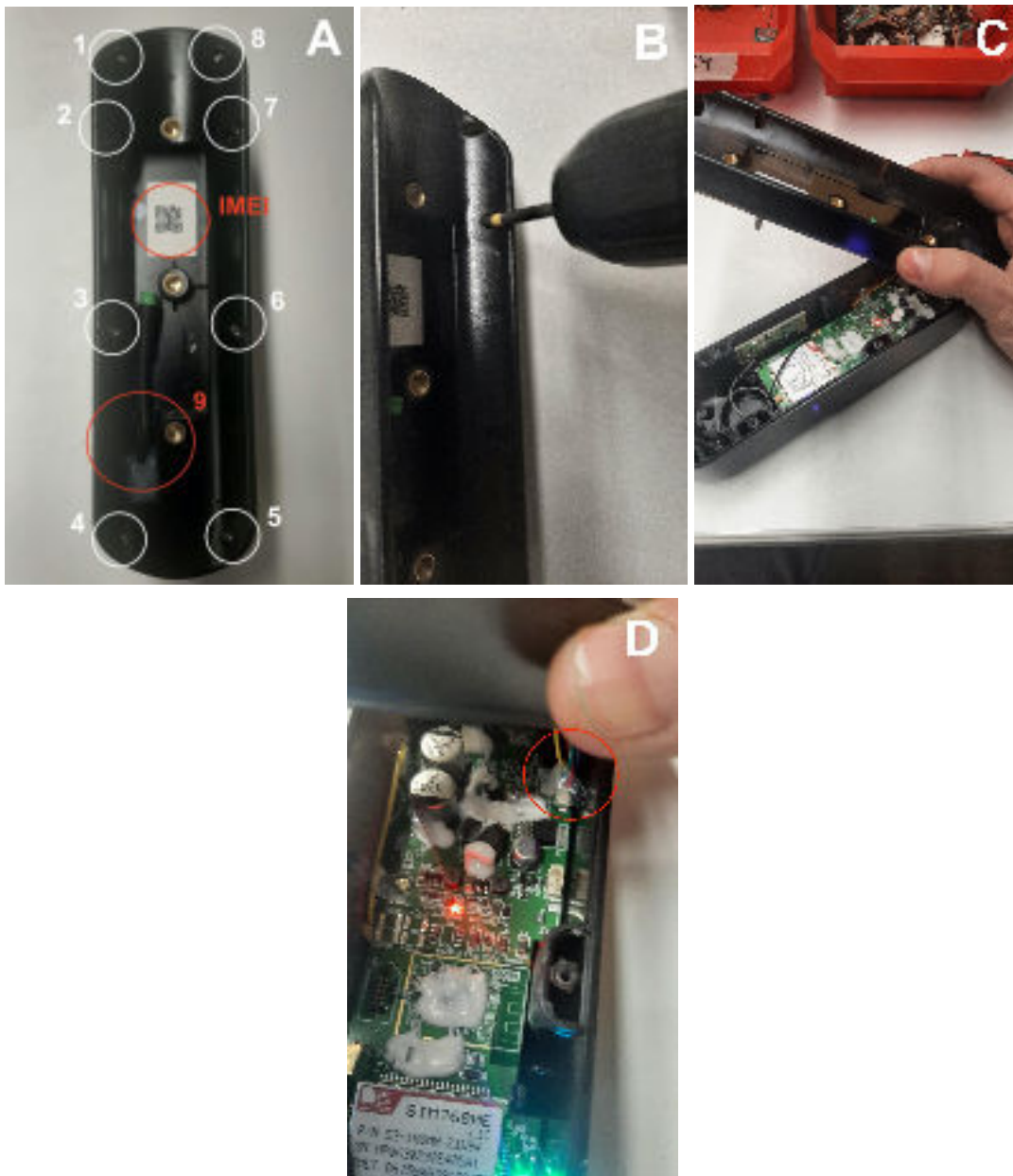
- Mark the IoTs with the QR code of the respective scooter before removing them, this will speed up the process
- It is advisable to keep track of the processed IoTs: set up a spreadsheet with the QR code associated to the scooter to which the IoT is provisioned, the IMEI code of the IoT and an indication about the success/failure in solving the location problem by replacing the antenna. This will help to track IoTs behaviour once deployed in the market. Adding processing dates can be also useful.
- IoT screws are PH2 screws, but if the correspondent bit does not fit the holes in the IoT, a PH1 bit will have to be used instead; it is mandatory using the electric drill screwdriver at lower speed setting, with max torque of around 2Nm to avoid damaging the screws, especially when closing the IoT.
- Be sure not to mix faulty and new antennas, they are indistinguishable (use labelled boxes).



### SOP

#### Opening the IoT

1. Register the QR code provisioned with the IoT and the IMEI (picture A)
2. Remove the 8 screws on the back of the IoT (1-8 picture A), do not remove the hot glue retaining the IoT cable (9 picture A)
3. Rotate the lid carefully, do not lift it (picture C), pay attention that the connector in picture D is not disconnected during the process
4. Check that the chip on the IoT is the SIM7600, if you find a smaller chip labelled SIM868 you are dealing with a 2G IoT



## Removing the old antenna

1. The GNSS antenna and its connector are shown in pictures E-F
2. If you are not using ESD protection equipment this is the moment to discharge yourself touching some grounded metallic surface
3. It is advisable to disconnect the internal IoT battery connector (PICTURE MISSING, it is the connector visible on the upper left side of picture D, with the yellow-red-black cables running to the back of the IoT). Not mandatory, though.
4. Use the specific tool to disconnect the antenna, prying up the connector (picture missing, picture H shows the process using pliers, which is not recommended).
5. Remove the faulty antenna (picture I) and place it in a labelled box.



### Installing the new antenna and testing the functionality

1. Check that antenna connector and the small SMD component in picture J have not been damaged or desoldered during the process (a magnifying glass will help here). If damaged, IoT should be set aside and be repaired.
2. Place the new antenna inside the IoT as shown in picture K
3. Place the connector in position and gently press it using the tip of the pliers (picture L). Do not force it.
4. Do not close the IoT/do not glue the connector yet.
5. Connect the open IoT to the corresponding scooter
6. After 4-5 minutes the scooter should start showing the right location on FM. The following dashboards could also be useful for testing:  
<https://reports.voiapp.io/#/views/whats-in-the-pings-v2/PingDashboard?iid=1>  
<https://reports.voiapp.io/#/views/ScootermovementoverdaysSnowflake/Vehicletelemetrydatasource?iid=2>

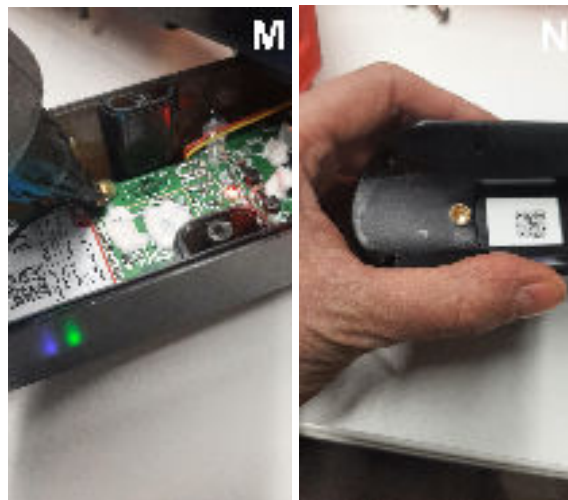
Note: It is recommended to leave the scooter stay overnight to check consistent behaviour.





### Gluing the antenna and closing the IoT (necessary?)

1. If the scooter is showing consistent location you are ready to close the IoT.
2. Secure the antenna connector with a drop of hot glue (picture M), do not use silicone.
3. Check the IoT cable connector in picture D, put the lid back in place, secure the 8 screws, connect the IoT to the corresponding scooter.
4. Update the spreadsheet, deploy the scooter and monitor it for the following few days.





## IoT LED Interpretation

### Wolfenstein

Wolfenstein has a single RGB LED. The usage and colors are yet to be determined.

### Catacomb

The Catacomb PCB (both 2G and 4G) is equipped with a number of status LEDs.

### IoT power indicator

Solid red LED, placed right in the middle of PCB.

### Battery charging indicator

Red LED, placed at the edge of the PCB on the end opposite of the modem. The IoT has a backup LiPo battery which is charged by the scooter battery. When this is charging, the battery charging indicator shines solid red.

### Modem status indicator

Blue LED, on edge of PCB next to the modem. Solid (slightly weak) light when the modem has booted up.

### Network connectivity indicator

Aka NETLIGHT. Green LED, right next to modem. Solid light means modem scanning for cellular networks, flashing means it's connected. A short (200 ms) duty cycle means it's connected to LTE and a long duty cycle (800 ms) means it's connected to 2G/4G.

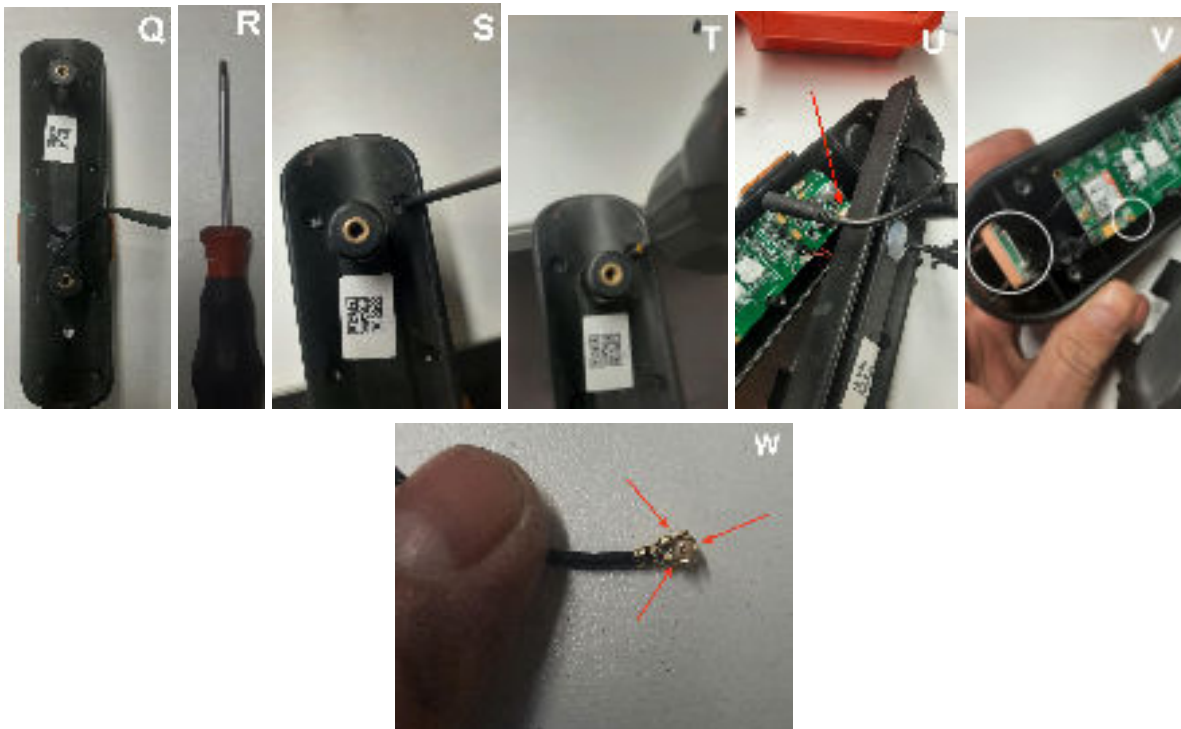


## GPS status indicator

Note that as of time of writing, Catacomb 2G does not implement GPS status indication. When this changes, the behavior should be identical to Catacomb 4G. On Catacomb 4G, this is a blue LED. It's located next to the modem but closer to the center of the PCB. If this is solid blue AND modem status is solid blue, then the device has GPS coverage. If modem status is not solid blue, this LED tells you nothing.

## Sourcing the GNSS antennas from V1 IoTs (Works might need to add step to see if antenna works)

1. V1 IoT is shown in picture Q.
2. With a small flat screwdriver (picture R) remove the black silicone from screw holes (picture S) before removing them (picture T)
3. The procedure follows the one used to open the V3X IoT, GNSS antenna and its connector are shown in picture V
4. After removing the antenna, check that the 3 tiny metal tongues in the connector are not bent (picture W), in case they can be gently bent back using pliers, to ensure tight connection. The antenna is then ready to be used.







### **Conclusions and continuous work**

The first trials and tests of these instructions have been successful. The total success rate of both trying to update the firmware and replacing the antenna has been over 95%, but however the total amount of IoT's tried so far is still just below 500 pcs. Just updating the firmware gives a success rate of approximately 50% of the non working IoT's.

Future improvements for similar work that can be done is finding a proper instruction for quicker identification of what's the real issue with the IoT, so we directly know if a firmware update is needed or if the antenna is the issue and need to be swapped.

For this purpose a process for quicker checking antennas would also be helpful, since there's a risk of damaging antennas when removing it from old IoT's.



## Wolfenstein IoT rebooting, V4 and V3x

### Computer/J-Link and nRF Command line setup

Download and install the latest version of the NRFtools and J-Link drivers. NRF Command line tools are needed to send different commands to IoT through J-Link box.

J-Link Software and Documentation Pack:

<https://www.segger.com/downloads/jlink#J-Link Software And Documentation Pack>

nRF Command line tools:

<https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Command-Line-Tools/Download>



## V4 Wolfenstein IoT rebooting:

### Needed tools:

|                         |                   |
|-------------------------|-------------------|
| Segger J-Link BASE      | NBM-IOT.0003      |
| IOT Auxiliary Connector | NBM-AB.50.0008.19 |
| 20-pin to 8-pin adapter | NBM-IOT.0007      |

1. Make sure IoT is powered. If IoT has been unused connect the IoT to a scooter for a few minutes to make sure it has enough power. You can also perform rebooting while the IoT is connected to the scooter.
2. Connect J-link box to IoT with auxiliary cable. (IoT auxiliary port is a round 8-pin connector found behind the IoT that's not connected to anywhere and has a rubber cap on.)



3. Open command prompt on PC.
4. On command prompt write debugger reset command: **nrfjprog -d**  
For successful reboot you get "Applying debugger reset"

```
C:\Users\teemu>nrfjprog -d
Applying debug reset.

C:\Users\teemu>
```

5. Unconnect auxiliary cable and test the IoT with Protest tool. Note that after reboot IoT should receive OTA update if IoT firmware is old. Scooter might give error 32 or error 56 for a moment after connecting the IoT.



### V3x Wolfenstein IoT rebooting:

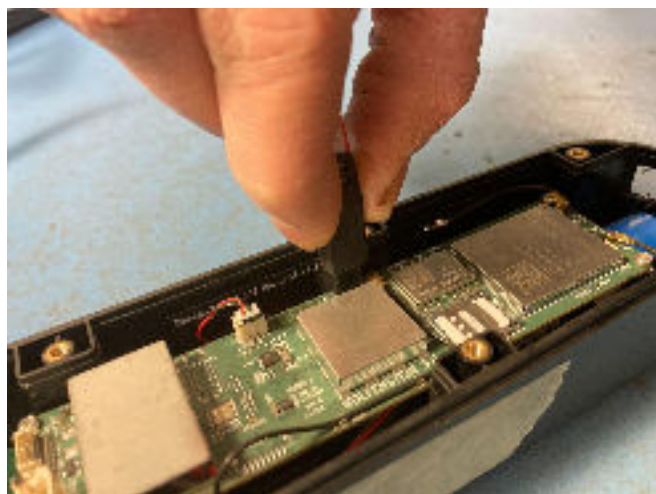
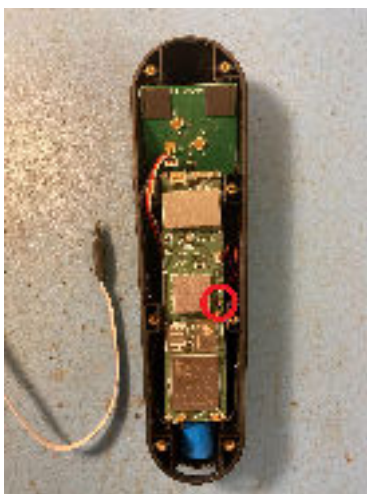
#### Needed tools:

|                                   |                         |
|-----------------------------------|-------------------------|
| Segger J-Link BASE                | NBM-IOT.0003            |
| 6-pin Cable with Ribbon connector | NBM-IOT.0008            |
| 20-pin to 6-pin adapter           | NBM-IOT.0009            |
| Retaining Clip                    | NBM-IOT.0010 (optional) |
| Phillips screwdriver              |                         |
| (ESD protection recommended)      |                         |

1. Make sure IoT is powered. If IoT has been unused connect the IoT to a scooter for a few minutes to make sure it has enough power.
2. Undo 8 screws on the back of the IoT and carefully open the IoT. Be careful with cables connected to the board. If using a drill etc. use low torque to avoid mangling the screws.



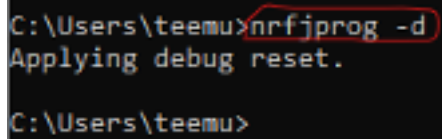
3. Connect J-link box to IoT with the 6-pin ribbon cable to the 6 pin connector on the PCB. Press and hold the connector firmly on the board.



4. Open command prompt on PC



5. On command prompt write debugger reset command: **nrfjprog -d**  
For successful reboot you get "Applying debugger reset"



```
C:\Users\teemu>nrfjprog -d
Applying debug reset.

C:\Users\teemu>
```

6. Unconnect the cable and screw the back of the IoT back on. Check rubber sealing around the edge to make sure it's in place to avoid any future water damage.
7. Test the IoT with Protest tool. Note that after reboot IoT should receive OTA update if IoT firmware is old. Scooter might give error 32 or error 56 for a moment after connecting the IoT.