

User Guide for HAT Boards with RtkBase

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Description

ELT_RTKBase is a stationary **GNSS** base station built on multi-constellation, multi-frequency receivers such as the **Unicore UM980**, **Bynav M20** or **Septentrio mosaic-X5**. It offers advanced connectivity options over the internet or local networks. The package includes detailed documentation, making it user-friendly even for beginners.

ELT_RTKBase can operate as an **NTRIP** server (2 connections), **NTRIP** caster, **TCP** server, or **TCP** client (2 connections as well), record measurements, and allow downloading in **RTCM3** and **RINEX** formats.

Typical Use Cases:

- Cryptocurrency mining with base station networks like **Onocoy** and **RtkDirect**
- Local base station for dozens or hundreds of rovers (e.g., drones or tractors)
- Survey-grade base station (excluding systems using the Bynav M20 receiver)

Advantages:

- **Rich Functionality**

ELT_RTKBase is like a Swiss Army knife among base stations. We believe that if a feature is needed by 1% of users today, it will be used by 10% in the next 10–20 years. Over 80% of users will end up using at least one additional feature during the device's lifetime. That's why we keep adding features, even if currently relevant to a small group of users—to increase system flexibility and versatility.

- **Open Source & Customization**

Since **ELT_RTKBase** is [open source](#), advanced users can make custom modifications and add new capabilities. This makes it highly adaptable for specific needs, with all changes shared back with the community under the [AGPL 3.0](#) license.

- **User-Friendly Design**

It's built not only for professionals but also for beginners. One of the project's goals was to lower the entry barrier into **GNSS** base station technology. That's why our documentation is extremely detailed and full of illustrations—making our station easier to set up compared to other solutions.

- **Modern Technology at an Affordable Price**

ELT_RTKBase uses cutting-edge multi-constellation, multi-frequency receivers for high-quality performance and precise **RTK** corrections—at a price that makes it accessible for **GNSS** mining, surveying, drone ops, and agriculture.

Types of CORS Stations

CORS stands for “Continuously Operating Reference Station”. So when we talk about **CORS**, we mean a stationary **GNSS** base station with an antenna installed on a roof. When we say **GNSS** base station without context, we usually refer to a portable surveying **GNSS** base—a receiver with an antenna.

The software is the same between these two types. However, portable base stations usually include a radio or cellular modem, while stationary **CORS** stations typically connect via **Ethernet** and **WiFi**.

Professional CORS Stations. These cost between €10,000 and €20,000. A typical example is the [Trimble Alloy GNSS CORS receiver](#). Features can include a built-in **UPS**, hot-swappable batteries for power outages, multiple I/O options, advanced software capabilities, and top-tier measurement quality.

Linux-Based CORS Stations. These are primarily **ELT_RTKBase** units, but also include simpler DIY systems based on **RtkBase**. With **Linux** offering a wide range of software, these stations provide great functionality, including built-in **VPN**. They typically use portable **Linux** computers like **Raspberry Pi**, **Orange Pi**, **Banana Pi**, etc. We offer 6 models: [ELT0231](#), [ELT0233](#), [ELT0631](#), [ELT0633](#), [ELT0731](#), [ELT0733](#), built on three different receiver types.

CORS Based on Septentrio Mosaic. The **Septentrio Mosaic X5** provides a minimal but complete set of base station features—calculating base coordinates (via **RTK** or 24-hour **RINEX** processing), manually entering geodetic coordinates, sending data to an external **NTRIP** caster, and using an internal **NTRIP** caster to stream corrections to rovers. **ArduSimple** and **SparkFun** produce such stations. From this category of stations, we offer the [ELT0728](#) and [ELT0718](#) with **Ethernet** and **PoE**, as well as the [ELT0722](#) **USB** dongle, which can also be used as a station of this type.

Basic Miners. These aren't full base stations or **CORS** units. They lack coordinate determination/input and don't have their own **NTRIP** caster. Instead, they operate solely as **NTRIP** servers sending data to an external caster that handles coordinate computation—e.g., **GeodNet** and **Onocoy**. Most use **ArduSimple WiFi NTRIP Master** clones based on **ESP32-XBEE** (e.g., **NTRIP-X** from **GNS Electronics**, **Onolink**, **LOCOSYS Technology**), but many **DIY** versions exist. We offer a **USB** dongle ([ELT0222](#)) that works with [WinRtkHost](#), and soon [WinRtkHost](#) will also support the [ELT0622](#) **USB** dongle.

Feature list

ELT_RTKBase Features:

- 1) Two **NTRIP v1** servers, which can also function as **TCP** clients.
- 2) Documentation with many screenshots tailored for beginners.
- 3) **NTRIP v1** caster supporting hundreds of clients (for connecting rovers directly to the device).
- 4) **TCP** server.
- 5) Data output to a connected **USB-COM**.
- 6) Measurement logging in **RTCM3** and **RINEX** formats.
- 7) A choice of three modern multi-system, multi-frequency receivers from **Unicore**, **Bynav**, and **Septentrio**. If you don't need configuration and detection features, you can use any receiver that outputs **RTCM3** data.
- 8) Built-in **PPP** with coordinate display on a detailed world map for quality evaluation.
- 9) Online version updates via a button in the **web** interface.
- 10) Dynamic (**DHCP**) and static **IP** support

- 11) Dynamic (**DHCP**) and static **IP** options.
- 12) Full Linux computer (**Raspberry Pi**) functionality for other uses (e.g., **ADS-B** mining)
- 13) Antenna coordinate configuration through the **web** interface.
- 14) Four methods for determining base coordinates.
- 15) Antenna type configuration through the **web** interface.
- 16) Selection of **RTCM3** packet types for transmission.
- 17) Built-in **VPN** from [TailScale](#) for remote management, allowing control of the base station even when traveling.
- 18) Ability to operate as a rover (currently only with **Windows**).
- 19) Internet connection status indicator (not just **WiFi**, but actual internet connectivity).
- 20) Temperature monitoring.
- 21)** Disk space monitoring.
- 22) **DIY** mode using your own **Raspberry Pi**. In this case, you only need to buy a **USB** or **HAT** receiver and an antenna.
- 23) User-modifiable functionality with open-source code available on [GitHub](#).
- 24) **NTRIP** server interface indicating disconnection reasons.
- 25) Service logs showing disconnection reasons and extensive technical information.
- 26)** Supports exotic characters in **SSID** and Passwords.
- 27) **WPS PBC** support for initial **WiFi** connection

All [grss.store](#) **CORS** Stations Include:

- 1)** Built-in splitter for triple mining with **Geodnet**.
- 28) **LED** indicator showing internet connection (not just **WiFi**, but actual internet access)

Wired CORS Stations ([ELT0231](#), [ELT0631](#), [ELT0731](#)):

- 1)** **Wired Ethernet**
- 29) **PoE** (Power over Ethernet) or **USB** power, at your choice.
- 30) Dual-band **WiFi** (2.4 GHz and 5 GHz)
- 31) Available **USB** ports
- 32) LED indicator for **1PPS**
- 33) Four mounting options including rack mount

Budget CORS Stations ([ELT0233](#), [ELT0633](#), [ELT0733](#)):

- 1. WiFi** (2.4 GHz only)
- 2. USB** power only
- 3. USB** receiver output for firmware updates or use as a standalone receiver
- 4. LED** showing satellite count
- 5. LED** showing first **NTRIP** connection status

I might have missed something, so don't be too harsh. **ELT_RTKBase** doesn't bake pies or make coffee — yet.

In upcoming versions, we expect:

- **NTRIP 2.0 HTTP.**
- **NTRIP 2.0 RSTP.**
- **NTRIP 2.0 UDP.**
- Five **NTRIP** servers, each capable of operating with five protocols.
- “**MOVED BASE**” mode, enabling simultaneous rover and base operation.
- Automatic shutdown in case of overheating.
- **USB** modem support.

Choosing GNSS Base Station from gnss.store

Choosing a GNSS Base Station for Onocoy

If you want to understand how our stations differ from competitors, see the section “[Types of CORS Stations](#)”.

How to Choose a GNSS Base Station for the Onocoy Network

The first step is to decide whether you need **advanced (wired) GNSS base station** or a **budget (wireless) GNSS base station**. If you need **Ethernet**, **PoE**, or **5GHz WiFi**, choose a wired base station. If **2.4GHz WiFi** is sufficient, a budget station will do. For more details, refer to “[Choosing a Base Station Type](#)”.

Choosing a GNSS Receiver for Onocoy

The second step is to choose the **GNSS** receiver. For Onocoy, we recommend the **Unicore UM980** as the optimal choice with a good balance of quality and price. If you're looking for the cheapest **GNSS** receiver, there is the **Bynav M20**, but it earns less. If you want maximum quality and interference resistance, choose the **Septentrio Mosaic X5**—a mid-range survey-grade receiver, though more expensive. For more on receiver differences, see “[Choosing a Receiver](#)”.

Choosing an Antenna for a GNSS Base Station

The final step is to select a **GNSS** antenna. For **Onocoy**, we recommend:

- [**Survey 160 mm \(ELT0123\)**](#) – high-quality stationary **GNSS** antenna
- [**Budget 38dB \(ELT0323\)**](#) – a cost-effective stationary **GNSS** antenna
- [**ANN-MB2 \(ELT0317\)**](#) – for the simplest setups where there's no snow, and animals or birds don't perch on the antenna. It's the most affordable **GNSS** antenna.

Antenna selection is covered in more detail in the section “[Choosing an Antenna](#)”.

Table 1: GNSS Base Station Prices as of April 1, 2025

Receiver	Base Price (no antenna/power)		Typical Price	
	Budget	Advanced	Budget	Advanced
Bynav M20	229.99 €	299.99 €	359.99 €	494.99 €
Unicore UM980	299.99 €	369.99 €	429.99 €	564.99 €
Mosaic X5	539.99 €	669.99 €	599.99 €	794.99 €

Prices exclude **VAT** and shipping. **VAT** and shipping costs depend on the buyer's country. Outside the **EU**, import duties may also apply. [Full station list](#) available on our website.

Choosing a Base Station Type

We offer two types of base stations: **advanced** and **budget**.

Advanced (Wired) Station:

- Supports Ethernet, 2.4GHz and 5GHz **WiFi**
- Powered via **USB** adapter or **PoE**
- Based on **Raspberry Pi 4B**
- Can be rack-mounted (standard 19-inch rack)

Budget Station:

- Connects via 2.4GHz **WiFi** only
- Powered by **USB** adapter only
- Based on the compact **Raspberry Pi ZERO 2W**
- Features an **NTRIP** LED and **USB** output from the receiver

Note: **WiFi** without an external antenna can be weak. It will work best in the same room as the access point or maybe one wall away. This is especially true for 2.4GHz, which tends to be overcrowded in apartment buildings. So either get a wired station and connect it via **Ethernet**, or before purchasing a budget station, disable 5GHz on your smartphone and check **WiFi** quality where the station will be installed.

Aside from the ability to place a wired station far beyond **WiFi** range, the **budget station offers better functionality overall**. That's because it also acts as a **GNSS** receiver. If you don't need the base station features, you can simply disable the "Main Service" and use it as a high-quality **USB GNSS** receiver.

Choosing a Receiver

The [base stations from gnss.store](#) differ in the type of **GNSS** receiver they use.

Unicore UM980 – This is an entry-level survey-grade receiver, comparable to those used by other manufacturers of **Onocoy**-compatible miners. The only differences are likely to be in configuration and firmware version. A typical Onocoy base station using this receiver is [LVARIGRIG10](#). On average, it receives 145 signals with a quality score of 0.976. Many survey receivers have been built on the **UM980/UM981** platform, such as the [Sfaira One](#), [NetBOX2](#), [Stonex S900](#).

Bynav M20 — a simpler and cheaper receiver. It tracks slightly fewer signals and provides a slightly lower reward. Compared to **UM980**, it lacks signals such as **GPS L1C** and **L2P(Y)**, **Galileo E6**, **Beidou B1C** and **B2b**, and **QZSS L1C**. Fortunately, for **Onocoy**, only the absence of **Galileo E6** matters. This receiver is not survey-grade and is suitable as a base for tractors, drones, or **GNSS** mining. It's not recommended for serious geodetic work. Example base station: [LVARIGRIG11](#). It typically tracks 126 signals with an average quality of 0.906.

Septentrio Mosaic X5 – A high-quality mid-range survey receiver. It features **AIM+** technology for interference mitigation and spoofing protection, as well as **OSNMA** to distinguish real signals from spoofed ones. It receives two more signals (**Galileo E5ab** and **QZSS L6**) than the **UM980**. However, it can only track 60 satellites simultaneously, so it needs to be regionally optimized. Otherwise, you might get a lower reward—or one similar to **UM980**. Our base station is tuned for Europe. For India and surrounding regions, it should be reconfigured to include **IRNSS**. A typical **Onocoy** base station using this receiver is [LVARIGRIG9](#). On average, it receives 170 signals with a quality score of 0.964. Survey-grade receivers based on Mosaic include [Galaxy G1 Plus](#), [AntaRx-Si3](#) and [PolaRx5](#).

	Bynav M20	Unicore UM980	Septentrio Mosaic X5																																																																																																												
Satellites	48	47	46																																																																																																												
Signals	126	145	170																																																																																																												
Quality	0.906	0.976	0.964																																																																																																												
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If you're interested in the reward, it depends on the number of "green circles"—which directly affects your station's positioning.

[ELT0631](#) and [ELT0633](#) with **Bynav M20** – These are the most affordable full-featured multi-frequency base stations and the lowest-cost miners on the market. Ideal for those who prioritize price.

[ELT0231](#) and [ELT0233](#) with **Unicore UM980** – A great balance of price and performance. Perfect for users who understand that over 10–20 years they'll need more than just mining functions—possibly two dozen features not available from competitors.

[ELT0731](#) and [ELT0733](#) with **Septentrio Mosaic X5** – The most affordable base stations with Mosaic X5 on the market. Ideal for perfectionists and for those needing a high-quality station for professional geodetic work.

Choosing an Antenna

We're often asked: is it okay to use the [ANN-MB2](#) antenna (ELT0317)? Here's a checklist of questions to help you decide if this antenna suits your needs. If the answer to **all** the questions (except the last one) is **no**, then [ANN-MB2](#) will likely work just fine for you. If you answer **yes** to any of them, a different antenna may be a better choice.

Are you a professional surveyor? Do you need a top-tier antenna? Then you'll want the [Choke Ring 380 mm](#) antenna (ELT0314). Just €2800—and it's yours. 😊

What's the climate like where you'll install the antenna? Do you get snow? Could water flood the antenna? Could birds perch on it? What about cats? Raccoons? Monkeys? Kangaroos? Pythons? If so, go with the **Survey 160 mm** antenna (ELT0123). It's not the cheapest, but its shape offers excellent protection from weather and wildlife. If the price feels a bit steep, consider the more budget-friendly **Budget 38dB** antenna (ELT0323). It has a shorter warranty and slightly lower performance, but it still provides protection from the elements and curious animals.

Do you need high accuracy—specifically a low phase center offset? Do you have a long antenna cable and require high gain? Then the best choice for you is the **MultiPatch 100 mm** antenna (ELT0194).

Are there buildings or trees nearby that could reflect GNSS signals and cause multipath interference? Then you'll need an antenna that effectively suppresses multipath, ideally one designed with **HELIX technology**. Your choice here is the **Quad Helix Antenna** (ELT0316).

Looking for the most affordable option? That's the **ANN-MB2** antenna (ELT0317).

Getting started

Quick Start

Important: **all connections must be made while the base station is disconnected from power!**

1. Mount the antenna on the roof and connect its cable to the base station's **IN** connector (**SMA** type).
2. Only for **ELT0×31**: If you wish, you can mount the base station to a table, a wall, or a rack.

Ethernet with PoE (Only for **ELT0×31**)

3. Plug Ethernet into the port.

Ethernet without PoE (Only for **ELT0×31**)

3. Plug Ethernet into the port.
4. Plug the power cable into the **USB Type-C** port on the right.
1. Plug the base station's power adapter into an electrical outlet.

WiFi

3. Plug the power cable into the **USB Type-C** port on the right.
4. Plug the base station's power adapter into an electrical outlet.
1. Wait for the “Internet” **LED** to start blinking, then press the **WPS** button on your **WiFi** access point. Within 10–20 seconds, the blinking will stop and the “Internet” **LED** will light up solid.
2. Wait 2-3 minutes.
3. Open <http://rtkbase.local/>
4. On the web page that opens, enter the default password **admin**.
5. Verify that everything is working.

More Details: Getting Started

First, determine how you will connect the base station. There are three options: via **Ethernet** (if available), via **WiFi** using **WPS**, or via **WiFi** without **WPS**. If you are connecting via **WiFi**, check whether your access point has a **WPS** button.

If you are connecting via **WiFi** without **WPS**, need a static **IP** address (and know what that is), want **SSH** access (and understand why), or don't have **DHCP** (another rare case for experts), you'll need to configure the system first. Instructions are in the section "[Advanced Base Station Configuration](#)".

Mount the antenna on the roof and connect its cable to the base station's **IN** connector (**SMA** type). If you are connecting via **Ethernet**, plug it into the port. Then insert the power cable, but **do not** plug it into the wall socket yet. Details can be found in the "[Connection](#)" section. On advanced (wired) stations, plug the power cable into the **USB Type-C** port on the right. On budget (wireless) stations, plug the power cable into the **PWR IN** connector.

Important: **all connections must be made while the base station is disconnected from power!** See the "[Connection](#)" section for more.

If you wish, you can mount the base station to a table, a wall, or a rack, as described in the "[Mounting](#)" section.

Plug the base station's power adapter into an electrical outlet. If you are connecting via **WiFi** using **WPS**, wait for the "Internet" **LED** to start blinking, then press the **WPS** button on your **WiFi** access point. Within 10–20 seconds, the blinking will stop and the "Internet" **LED** will light up solid.

If this is your first time connecting and you didn't press the **WPS** button within the two-minute window, wait an additional three minutes, power off the station, count to 10, and power it on again. For the other two connection types (**Ethernet** or **WiFi** without **WPS**), the **LED** will not blink. You can find more information on **WPS** in the section titled "[WiFi Setup Using WPS PBC](#)".

Once the "Internet" **LED** turns solid, wait another 2–3 minutes. Then, open a browser and go to <http://rtkbase.local/>, as explained in "[Base Station Address on Local Network](#)".

Enter the default password **admin** and change it following the instructions in "[Changing the Password](#)".

Check that everything is working correctly, as described in the section "[Checking Satellite Reception](#)". If you'd like, you can also set approximate coordinates, following the same instructions in that section.

If you want to earn cryptocurrency by contributing to the **Onocoy** base station network, refer to the detailed guide in "[NTRIP Configuration for Onocoy](#)". If that's all you need, your setup is now complete — **Onocoy** automatically determines the base station's precise coordinates.

If you wish to connect to **NTRIP** casters other than **Onocoy**, then you will need to enter precise coordinates using one of the methods in the "[Determining Coordinates](#)" section.

If you want to use **RtkDirect** instead, refer to "[NTRIP Configuration for RtkDirect](#)" for the full setup process.

If you plan to connect rovers directly to your base station, configure the built-in **NTRIP caster** as described in “[NTRIP Caster Setup](#)”.

If you encounter any issues, refer to the relevant section or consult “[Troubleshooting](#)”.

Connection

All connections — including the antenna, power supply, **SD card**, and **Ethernet** — must be made **only when the base station is unplugged from the power outlet**. If you connect the antenna while the base station is powered, you risk burning out not only the antenna power circuitry but even the **GNSS** receiver itself.

This is a common issue with all **GNSS** receivers powered from the electrical grid when used with fixed outdoor antennas. The reason is that most power adapters produce a voltage of 110 volts (half the mains voltage) on the device chassis. The resulting current is very small and harmless to people. However, fixed **GNSS** antennas are often mounted on grounded or electrically bonded building structures — or may come into contact with them accidentally. Similarly, the **Ethernet** cable may be grounded.

Unfortunately, modern electronics are more vulnerable to voltage than current. And while lightning protection can suppress brief surges, it will fail against sustained voltage differences. That’s why, **before connecting a fixed antenna or Ethernet cable, always unplug the base station from the wall outlet**.

Obviously, this warning does not apply to portable antennas. They can be connected while the device is powered. If you’re running the base station on battery power, it’s also generally safe to connect everything — **except the SD card**, which should always be inserted or removed with the power off.

First, you need to mount the antenna on the roof or a high pole. For details on antenna installation, refer to [our blog](#). The key is to give the antenna as much open sky as possible and minimize reflected satellite signals. The antenna itself is sealed, but its connector is not. Therefore, it is recommended to seal the connection point between the antenna and the cable with heat shrink tubing or special self-vulcanizing tape.

If you previously removed the **SD card**, your first step is to insert it into the right-hand slot. The **SD card** should be inserted with the metal contacts **facing away from you and toward the board**. If the text on the enclosure is upright (not upside down), then “toward the board” means the contacts face **downward**, and the printed label on the card faces **upward**.



Next, connect the antenna to the **IN** port (**SMA** type). The **OUT** port (also **SMA** type) is the output of the built-in signal splitter. You can use it to connect an additional **GNSS** receiver, for example, one used for **GEODNET**.



If you haven't yet reviewed the differences between advanced (wired) and budget (wireless) base stations, refer to the sections "[Choosing a Base Station Type](#)" and "[Feature list](#)".

If you're using an **advanced (wired) station** and connecting via **Ethernet**, plug the **Ethernet** cable into the left-hand port. Then plug the power cable into the **USB Type-C** port on the right. The two **USB Type-A** ports on these stations are native **Raspberry Pi** connectors and can be used to attach peripherals such as radio transceivers, **USB** Ethernet adapters, or **USB 5G** modems. The **HDMI** ports on these models are **disabled**.



For **budget (wireless) stations**, the power cable should be plugged into the **PWR IN** port. The **USB Type-C** port on these models is the **GNSS receiver's port**. It's used in cases where you need a standalone **GNSS** receiver instead of a full base station. Additionally, this port allows you to **upgrade firmware** or perform **advanced configuration** of the receiver.



The **LED indicators** on the front panel show whether the station is powered on, whether there is an Internet connection, and whether satellite signals are being received. Details about these indicators can be found in the "[LEDs](#)" section.

And finally — **plug the power supply into an electrical outlet**. The included power supply comes with **interchangeable plug adapters** and supports most outlet types worldwide. For detailed steps on what to do after powering on the unit, refer to the section "[Getting started](#)".



Important: After first powering on the base station, **do not turn it off for at least five minutes**. During this time, the system performs initial setup and configuration of the receiver, which can take a little while.

WiFi Setup Using WPS PBC

Starting from version 1.7.8, **ELT_RTKBase** supports **Wi-Fi Protected Setup Push-button Configuration (WPS PBC)**. You can read more about **WPS** on [Wikipedia](#), but to put it simply: it's a way to connect a device to a **WiFi** network by pressing the **WPS** button on the router and on the device. The button press can be either physical or software-based.

Beginning with version 1.7.9, **WPS** on the device is activated only when there is no existing network connection. If the device is already connected to a network—whether via **WiFi** or **Ethernet** — **WPS** will not activate. To enable **WPS**, you need to disconnect **Ethernet**, place the device in a location where no known Wi-Fi networks are available, and power it on. When **WPS** mode is active, the base station will indicate it by flashing the “Internet” **LED** for two minutes.

So, if your **WiFi** access point has a **WPS** button, you can connect for the first time (or after relocating the base station) by powering it on, waiting for the “Internet” **LED** to start flashing, and then pressing the **WPS** button on your access point. Within 10–20 seconds, the flashing will stop, and the “Internet” **LED** will turn solid. If you miss the two-minute window to press the **WPS** button the first time, wait another three minutes, then turn off the power, count to 10, and try again.

In version 1.7.8, **WPS** is available, but it’s not indicated by the “Internet” **LED**. If the base station has never connected to a **WiFi** network, **WPS** mode starts about 30 seconds after power-on and remains active for two minutes. During that time, you must press the **WPS** button on the access point. Because this version lacks visual feedback for **WPS** mode, the best thing you can do with version 1.7.8 is upgrade to a newer release. For details about updating to newer versions, refer to the section “[Software Update](#)”.

LEDs

Here’s how the **LED** indicators look on both the wired (advanced) and wireless (budget) base stations:



- **Purple LED** – Indicates that the power is on.
- **Green LED** – Indicates satellite reception.
 - On advanced (wired) stations, it blinks when satellites are being tracked and remains off when there’s no reception.
 - On budget (wireless) models like **ELT0233** and **ELT0633**, it stays lit when more than 30 satellites are being tracked, blinks when fewer than 30 satellites are visible, and turns off entirely when there’s no satellite reception. The blinking pattern is calculated as $33 \text{ ms} \times \langle\text{number of satellites}\rangle$.
- On the budget **ELT0733**, the green **LED** stays on when an autonomous solution is available.
- **Yellow LED** – Indicates that the station has an internet connection. It blinks during **WPS** mode — see “[WiFi Setup Using WPS PBC](#)” for details.
- **Red LED** – Lights up when the first (A) **NTRIP** server has successfully connected to the **NTRIP** caster.

Mounting

The device should be placed in a cool, dust-free, and dry location. Avoid direct sunlight, exposure to rain, snow, hail, and protect it from domestic and wild animals, birds, snakes, fish, and insects.

In addition to simply placing the unit “on a table,” advanced (wired) base stations offer several mounting options. For budget (wireless) base stations, only the “[Rubber Feet pack](#)” is compatible.

“Bent End Plate Bracket”



“Clip On Plastic Bracket”



“Aluminium Extruded Mounting Bracket”



“DIN Rail Clip Kit”



"1U 19" Extruded Aluminum Rack Panel"

This option comes with configurations for mounting one, two, or even three devices.



"Rubber Feet pack"



Base Station Address on Local Network

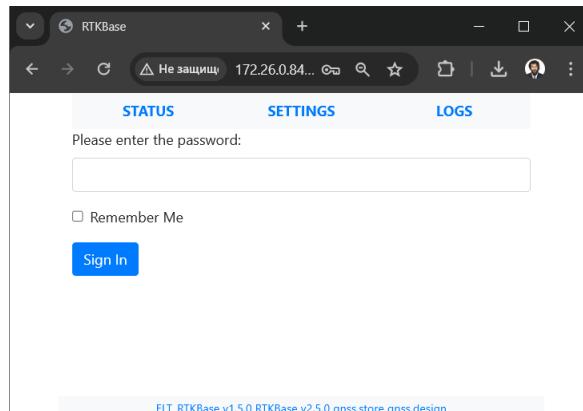
At the end of the installation, **RtkBase** will display the **IP** addresses of **Raspberry pi** on the screen. However, there is another way for modern operating systems — the address [**rtkbase.local**](http://rtkbase.local), which means the site can be opened as [**http://rtkbase.local**](http://rtkbase.local).

Please note — you **must** type the full address as [**http://rtkbase.local**](http://rtkbase.local). If you accidentally enter [**https://rtkbase.local**](https://rtkbase.local), or just [**rtkbase.local**](rtkbase.local), your browser may automatically attempt to use **HTTPS**. This will not work, because the base station only supports **HTTP** (not **HTTPS**). The **HTTP** protocol uses port **80**, while **HTTPS** uses port **443** — and this port is not currently active on the device.

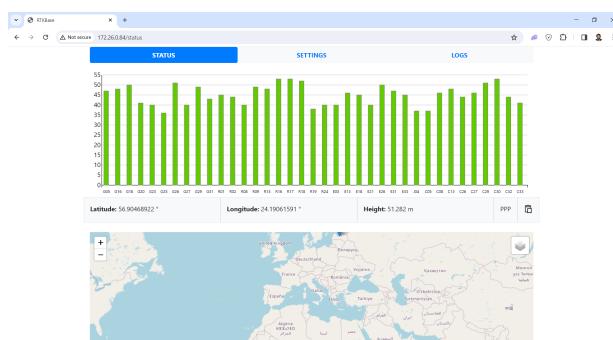
Unfortunately, this method only works **inside your local network**. That means if you're trying to access the base station from your phone, you'll need to connect to the **same Wi-Fi network** and (ideally) **disable mobile data** to ensure the browser stays on the local connection.

Changing the Password

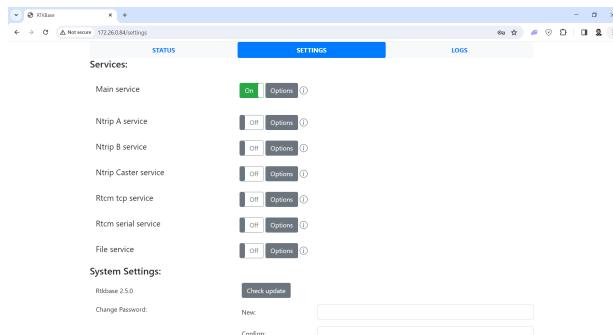
Log in to the site for the first time (using <http://rtkbase.local> as the address).



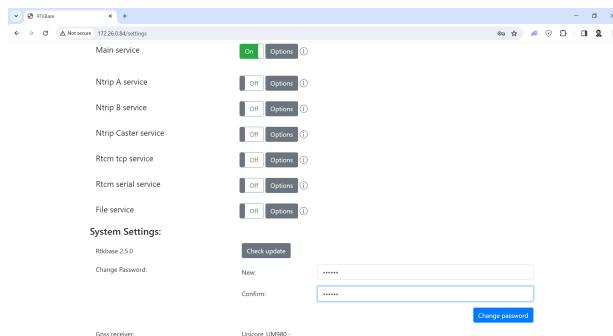
Enter the password “**admin**”.



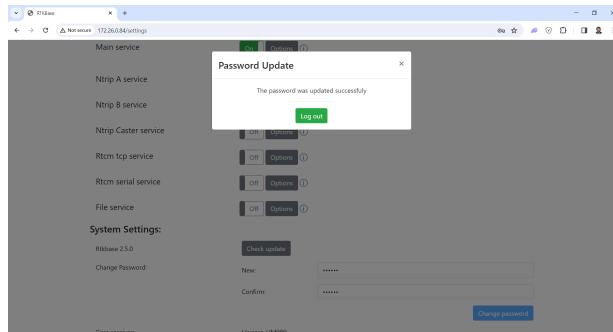
Click on **Settings** at the top.



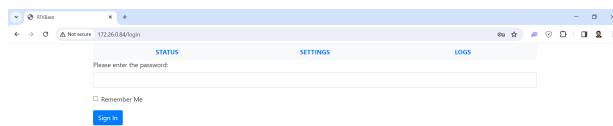
At the bottom, in the “System Settings” section, find “**Change Password**” and enter the new password.



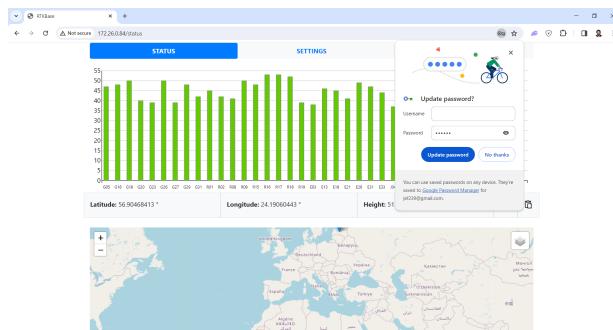
Click on the “**Change Password**” button and see the message on the screen. Now click on the “**Log Out**” button and log out.



You will end up on the login screen again. Enter the new password and check the “**remember me**” box.

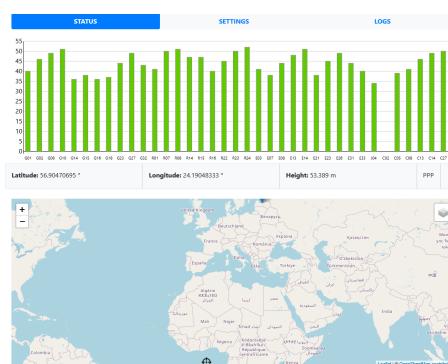


You will be taken to the **Status** page.



Checking Satellite Reception

Open <http://rtkbase.local> in your browser and go to the **Status** page.

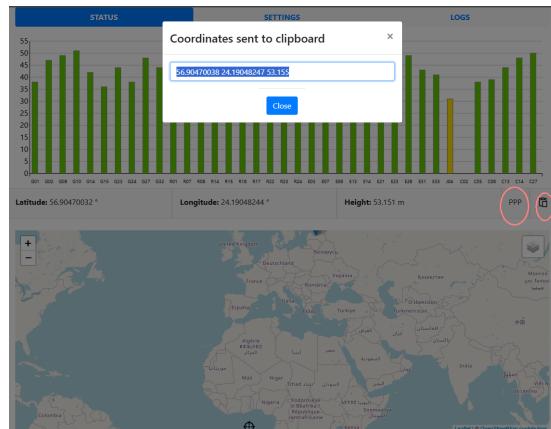


First, check that green satellite bars appear **within 3–5 seconds** after opening the **Status** page. Then make sure the bars are **slightly moving** — this indicates the data is being updated regularly. If anything seems wrong, refer to the section “[**Troubleshooting**](#)”.

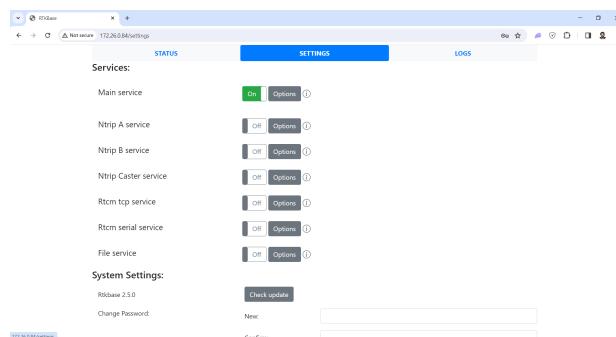
Next, check the **average signal strength (SNR)**. It should be **35 or higher**. If it's lower, check the antenna cable and connectors for issues. Then, check whether **PPP mode** is active. Built-in **PPP** works only with satellites having a signal level of **at least 33**. You'll need at least **10 such satellites** — otherwise, a **PPP** solution won't be available.

At the bottom of the **Status** page, you'll see a map with your **current coordinates** marked as a **blue dot**, and your **configured base station coordinates** shown as a **cross-hair**. If no base coordinates have been configured yet, the map will appear with limited detail.

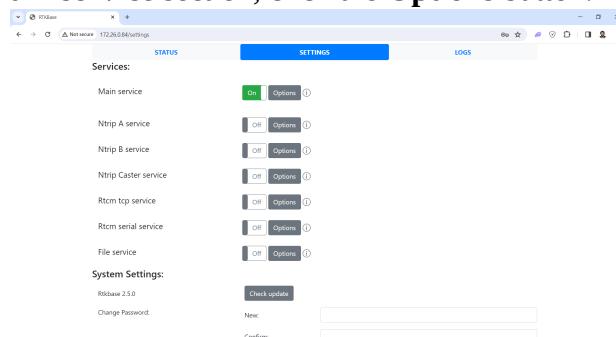
Let's fix that. Click the **copy coordinates** button on the right side of the page. Note: if **PPP** is not active, these coordinates may be inaccurate.



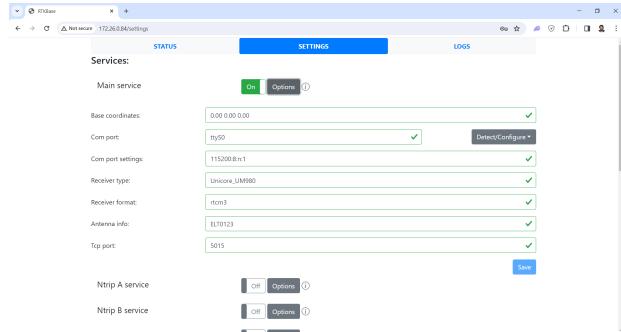
Now click **Close** and go to the **Settings** page.



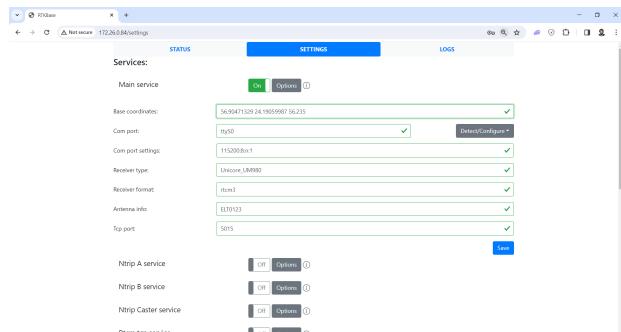
On the right side of the **Main service** section, click the **Options** button.



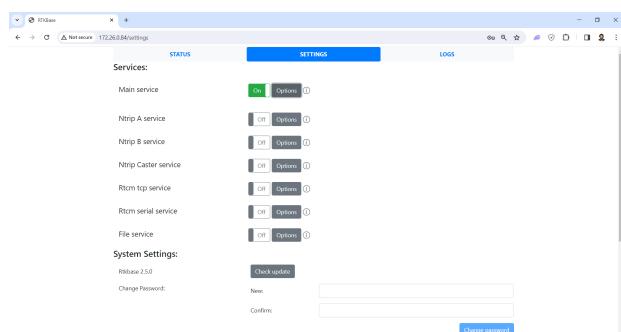
This will open the settings menu.



In the **Base coordinates** field, paste the coordinates from your clipboard (for example, with **Ctrl+V**).



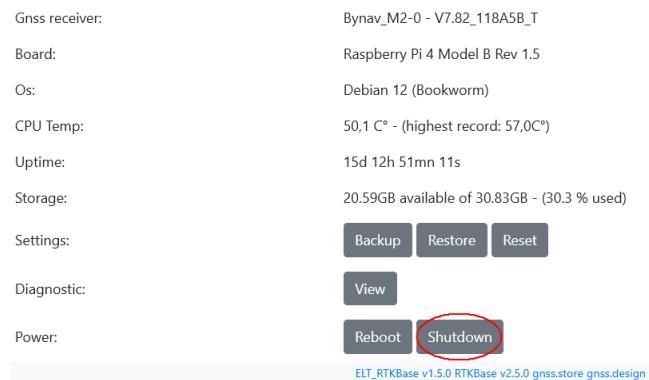
Click the **Save** button, then click **Options** again.



Go back to the **Status** page — now you'll see the **entered coordinates** as a **cross-hair**, and your **current position** as a **blue marker**.

Shutdown

You can turn off the device by disconnecting the power. However, the most gentle method is to press the “**Shutdown**” button in the web interface.



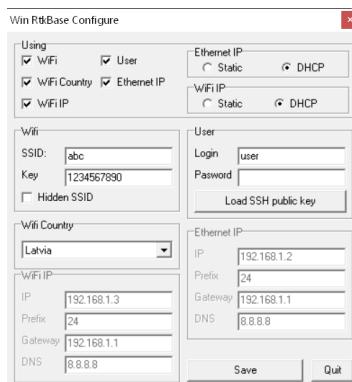
Advanced Base Station Configuration

Most users don't need to read this section. But if your WiFi access point has **no WPS button**, or if you want to set a **static IP address**, or enable **SSH access**, this section is for you.

⚠️ Reminder: Always remove and insert the SD card **only when the base station is unplugged from the power outlet!**

Configuration Using the Windows Application

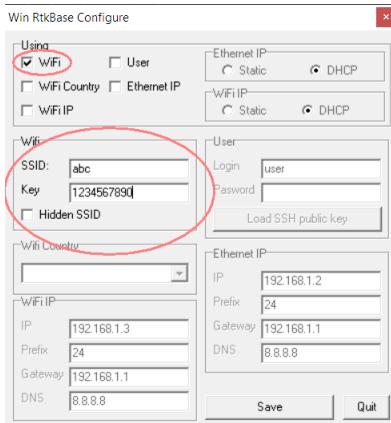
The simplest way to configure the base station is to insert the **SD** card into your computer's card reader (running **Windows**), and launch the **WinRtkBaseConfigure.exe** application. You can find the application on the **SD** card, or download it from our GitHub repository using the [provided link](#).



The app includes five configuration sections, which are described below. Check the boxes for the settings you want to change, then enter your values. When finished, click **Save**. The app will automatically detect the **SD** card and write the configuration to it. Then, reinsert the **SD** card back into the base station.

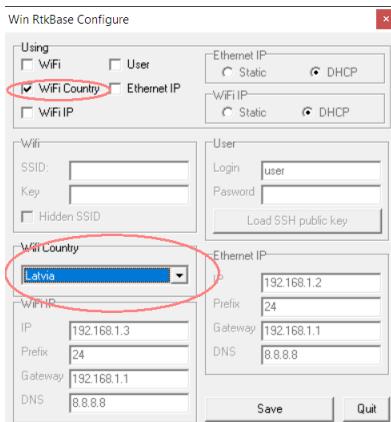
WiFi Network Connection

To configure **WiFi**, check the **WiFi** box and enter your **SSID** and password (key) in the **Key** field. If you're connecting to a hidden network, check the **Hidden SSID** box.



WiFi Region Standard

Different countries allow different WiFi frequencies. To set the correct WiFi frequency range, check the **WiFi Country** box and select your country from the dropdown list.

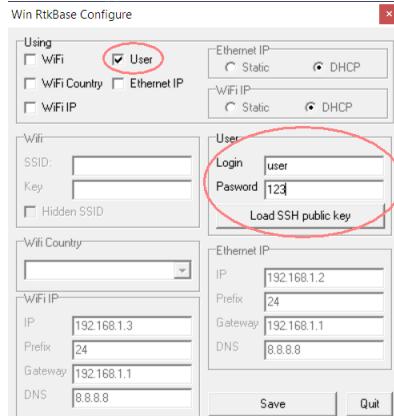


Adding a User

To add a user, check the **user** box and enter:

- **LOGIN** – the username
- **PWD** – the password (optional)
- **SSH** – the user's public **SSH** key (optional)

To load a public **SSH** key, click “**Load SSH public key**”, select your key file, and click **Open**. The app will suggest using your own public key (typically created in the “**.ssh**” directory when installing an **SSH** client), but you can select any key file.



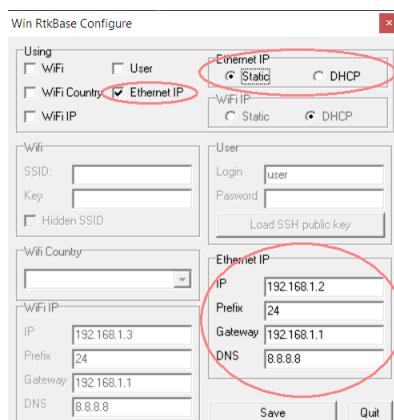
Static IP for Ethernet

This section is for **advanced/professional users** only. Most home users can skip it.

To set a **static IP** for the **Ethernet** interface:

1. Check the **Ethernet IP** box
2. Set the mode to **Static**
3. Enter the following:
 - **IP address** of the base station
 - **Subnet prefix** (typically 24 or 16)
 - **Gateway address** (for internet access)
 - **DNS server address**

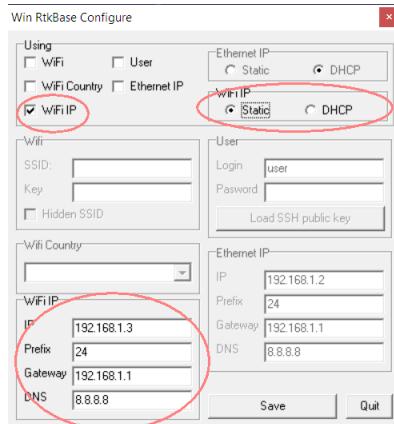
If your network doesn't have internet access, **leave the DNS blank**. If your setup involves a **direct connection** from the base station to a laptop (no router/gateway), **leave the gateway blank**.



Static IP for WiFi

This section is also for **advanced users**. Most home users do not need it.

Setting a **static IP** for **WiFi** works exactly the same as for **Ethernet**. Follow the steps described above in the “[Static IP for Ethernet](#)”.



Configuration via Text File

If you don't have access to a **Windows** computer, or if you prefer to understand the configuration process in more detail, you can configure the base station using a plain text editor.

To configure the system, insert the **SD** card into a card reader and create a file named **system.txt** in the **root directory** of the first partition on the card (this is usually the only visible partition in **Windows**).

This file should contain **parameter-value pairs**, each on its own line, using the format:

```
parameter_name=value
```

If the value contains spaces, the entire value must be enclosed in double quotes. You can use any type of line ending — both **Windows**-style (`\r\n`) and **Linux**-style (`\n`) are supported.

The **system.txt** file is processed at startup by the Base Station, and deleted from the disk after it is applied. You can check whether the configuration was applied successfully (or if there were any errors) by visiting the **Diagnostic** page of the web interface. Scroll down to the section related to the **RtkbaseSystemConfigure** service. See the section “[Diagnostics](#)” for details on how to open the **Diagnostic** page.

WiFi Standard

Different countries allow different frequencies for **WiFi** operation, so the standard is set by choosing the country according to the **ISO 3166-1** two-letter code. For example, the string **country=LV** means **Latvia**. For the **USA**, you should write **COUNTRY=US**.

Connecting to WiFi

The **SSID** (name) of the **WiFi** network is set in the **SSID** parameter, and the key (password) for access to the network is set in the **KEY** parameter (which can be omitted). For a network with a hidden **SSID**, add **HIDDEN=Y**. For example:

```
SSID=$'A B C'  
KEY=$'`$\\`\\|/\\x7F\\u0409\\u00B6'  
HIDDEN=Y
```

The **SSID** and password, as well as the user password, can be defined using [ANSI C string rules](#), allowing the use of characters in both **HEX** and **UNICODE** formats.

Adding Users

To add a user, you need to set their login (**LOGIN**), password (**PWD**), and/or SSH public key (**SSH**) for the user who will log in to the **Raspberry Pi**. For example:

```
LOGIN=abc  
PWD="1 23"  
SSH="ssh-rsa AAAAB3NzaC1yc2ENT8cu66peHViu0U5CQF abc@comp"
```

Quotes for **SSH** are mandatory. The username is specified in lowercase Latin letters and can include numbers, underscores, and hyphens. The password can include **HEX** and **UNICODE** characters and must also follow [ANSI C string rules](#).

Static IP

To assign a static IP, you need to set the static address of the **Raspberry Pi**, the subnet prefix (usually 24 or 16), the gateway address for internet access, and the **DNS** server address. Fields starting with **ETH** are used for Ethernet, and those starting with **WIFI** are used for **WiFi**. For example:

```
ETH_IP="192.168.1.2/24"  
ETH_GATE="192.168.1.1"  
ETH_DNS="1.1.1.1"  
  
WIFI_IP="192.168.1.3/24"  
WIFI_GATE="192.168.1.1"  
WIFI_DNS="8.8.8.8"
```

If you are using the Base Station in a network without internet access, do not specify a **DNS**. If your network has no gateway (for example, a direct connection between the Base Station and a laptop), do not specify a gateway.

Reconfiguration While Running

This section is intended for advanced users and rare professional scenarios. Occasionally, a base station is installed in a remote location where physically accessing the **SD** card is not feasible. For example, you may need to add a new user for **SSH** access, but the station is located far away.

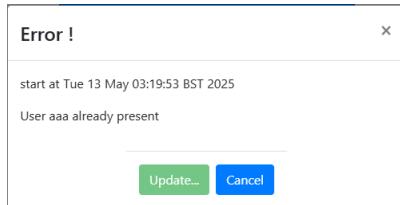
In such cases, you can perform a live reconfiguration by downloading the [**RtkBaseConfigure.sh**](#) file and editing it using a **text editor that preserves line endings** — for example, [Notepad++](#) or [Far Manager](#).

First, review the section titled “[**Configuration via Text File**](#)” Then, uncomment and modify the necessary lines in the script according to your requirements.

Once edited, upload the modified file to the base station using the **manual update** feature. To do this:

1. Go to the following URL: <http://rtkbase.local/settings?update=manual>
2. Click on the “**Check Update**” button.
3. In the form that opens, click “**Choose file**”, select the modified **RtkBaseConfigure.sh** file, and then click “**Submit**.”

You will see a message with the title “**Error!**” — don’t worry, this is expected behavior. The message will contain logs showing whether the configuration was successfully applied. After reading the message, click “**Cancel**” to close the window.



Installation (DIY Only)

If you purchased a pre-configured base station, you can skip this section — it's meant only for **DIY** setups.

There are two ways to install the software: using a system image or installing on an existing system. Installing from a system image is the most universal and recommended method. Installing via script on an existing system is suitable for users who already have a working **Raspberry Pi OS** setup on a **Raspberry Pi**, and who are comfortable running commands from the terminal.

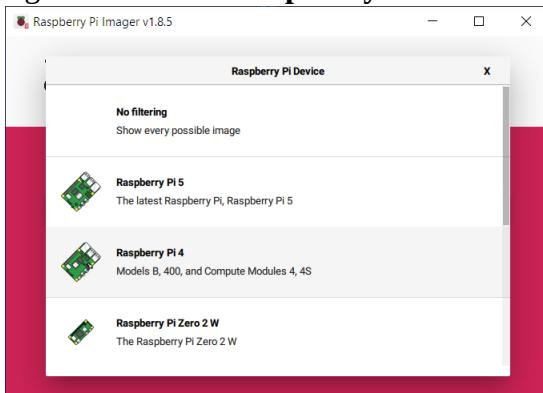
Installing the System Image

This is the most versatile method but requires a **Windows** computer. Buy the most reliable **SD** card from a reputable brand. The size should be at least 8 **GB**. Download [**Raspberry Pi Imager**](#) and the [**system image**](#).

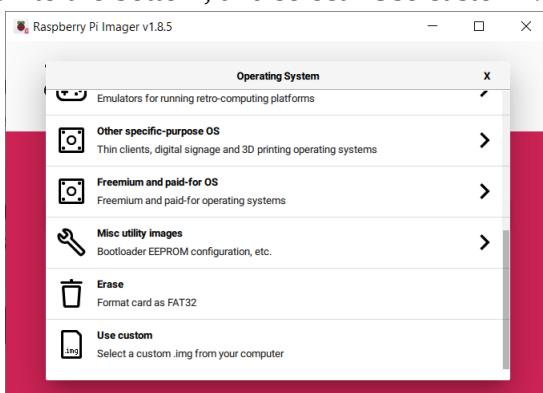
Launch Raspberry Pi Imager.



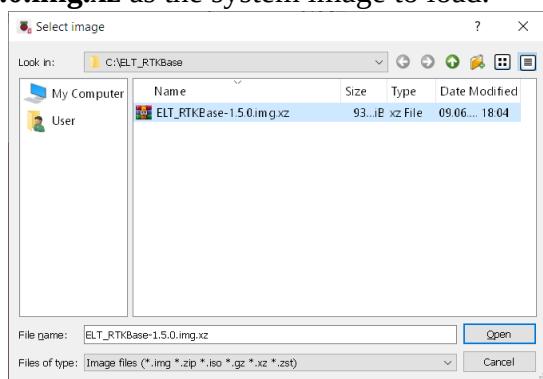
Click the left button of the program and select **Raspberry Pi 4**.



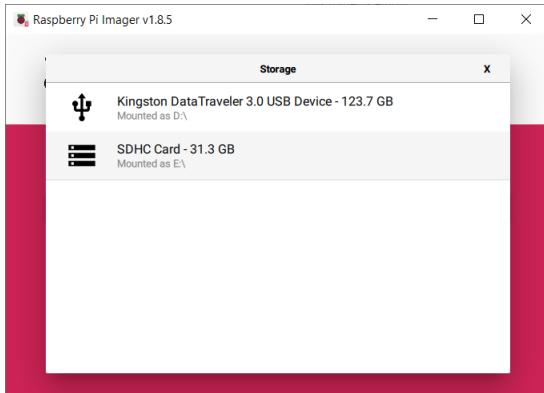
Click the middle button, scroll to the bottom, and select “Use custom”.



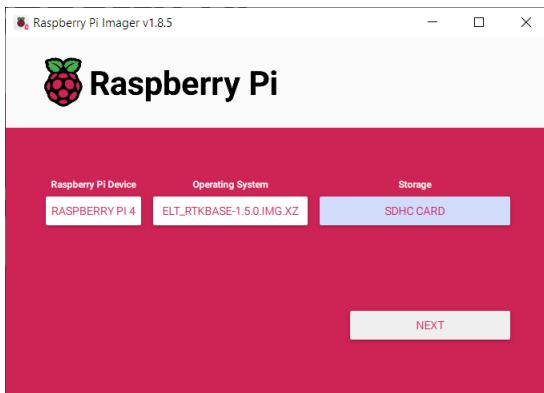
Choose **ELT_RTKBase-1.5.0.img.xz** as the system image to load.



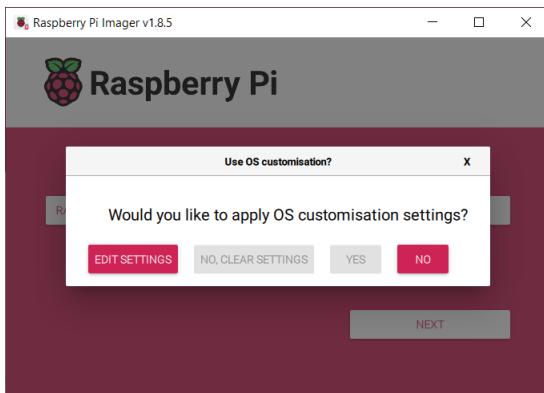
Click the right button and select the SD card.



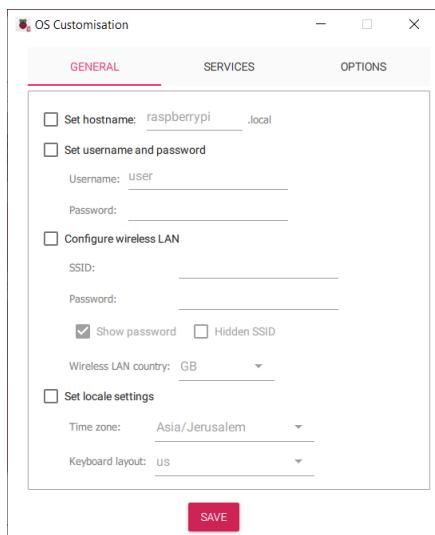
Click **NEXT**.



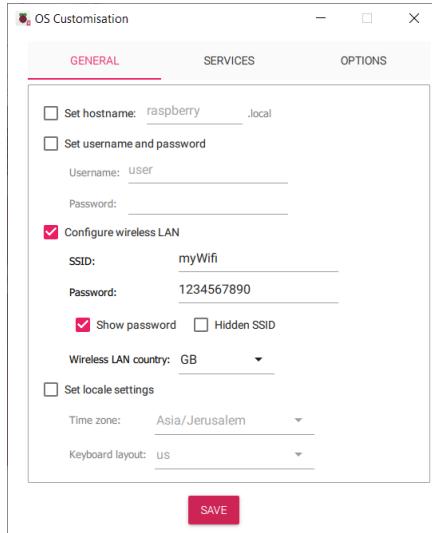
Click “**EDIT SETTINGS**”.



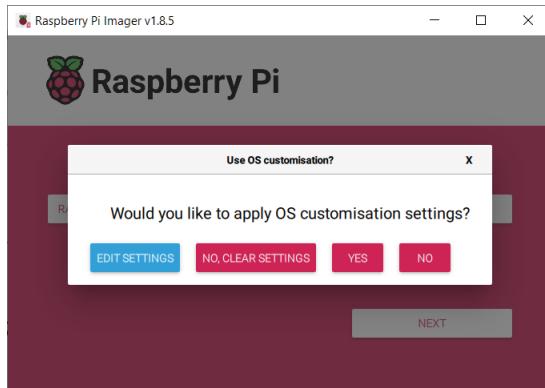
The settings editor opens.



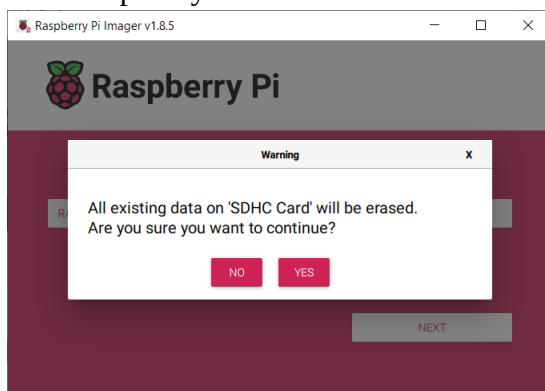
Fill in the “**General**” page. If you will connect the **Raspberry Pi** via **WiFi**, enter the **WiFi SSID** and password, and whether the **SSID** is hidden. If you do not enter a **hostname**, you can access it as <http://rtkbase.local>. If you do enter a hostname, access it by the entered name with the suffix local, <http://myname.local>.



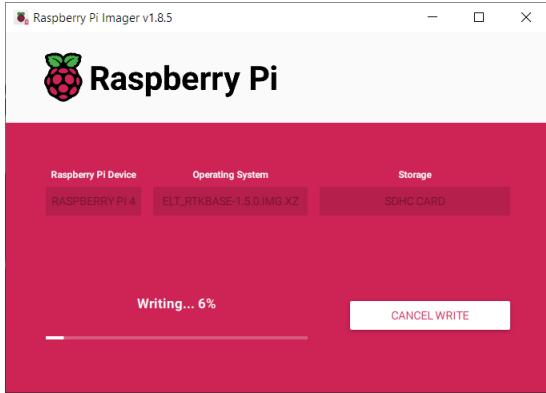
After editing, click **SAVE**, then **YES**.



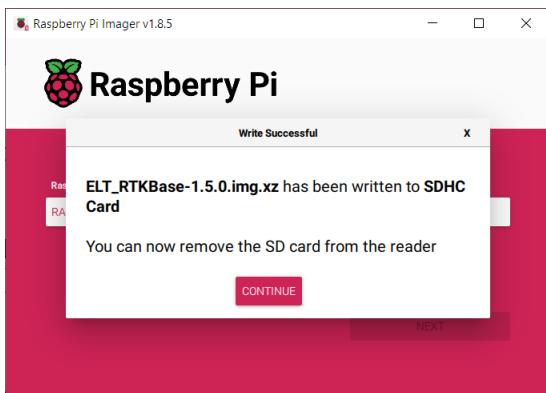
Confirm that the **SD** card will be completely erased.



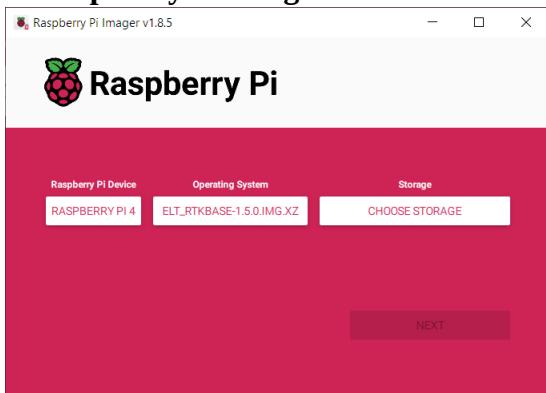
The writing process to the card begins.



After writing completes, a message appears.



Click **CONTINUE**, then close **Raspberry Pi Imager**.

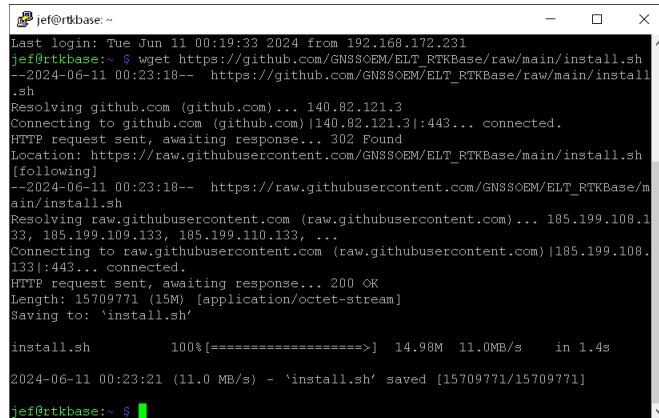


Disconnect the power from the **Raspberry Pi**. Remove the **SD** card from the computer and insert it into the **Raspberry Pi**. Turn it on and **wait a few minutes** (do not disconnect the power during this time). **RtkBase** will appear on the local network at <http://rtkbase.local> (if you changed the hostname, the name will be different).

Installation on an Existing System

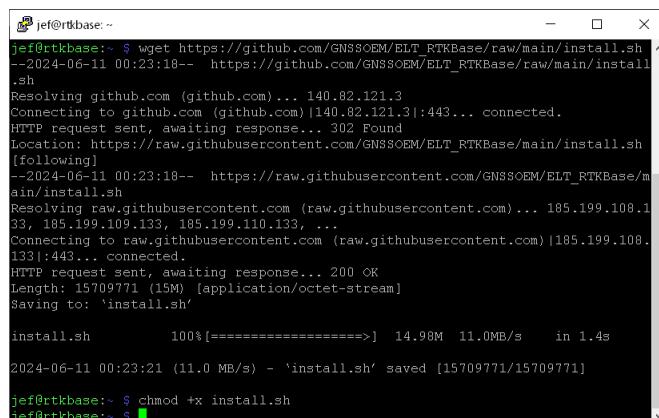
This method is for geeks who know how to use the **Linux** command line. No special knowledge is required, just the ability to access the command line and copy commands into it. **Attention!** Before installation, make sure **to connect** the **GNSS** receiver to the **Raspberry Pi**. The installation is designed for **Raspberry Pi OS** version **12** with **aarch64** (64-bit) or **armv7l** (32-bit) architecture, meaning an **ARMv8A** processor.

First, download **install.sh** using the command
wget https://github.com/GNSSOEM/ELT_RTKBase/raw/main/install.sh



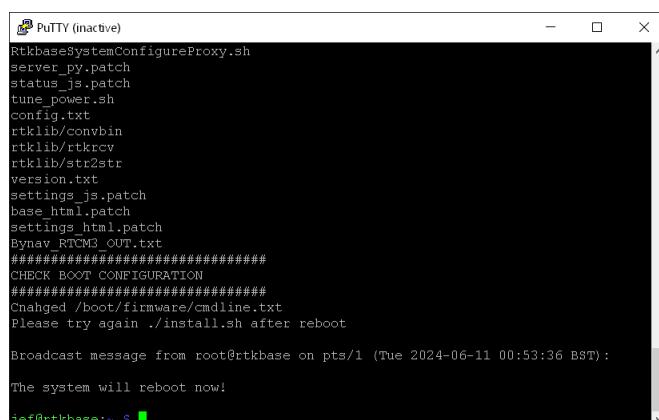
```
jef@rtkbase:~  
Last login: Tue Jun 11 00:19:33 2024 from 192.168.172.231  
jef@rtkbase:~$ wget https://github.com/GNSSOEM/ELT_RTKBase/raw/main/install.sh  
--2024-06-11 00:23:18-- https://github.com/GNSSOEM/ELT_RTKBase/raw/main/install.sh  
.sh  
Resolving github.com (github.com)... 140.82.121.3  
Connecting to github.com (github.com)|140.82.121.3|:443... connected.  
HTTP request sent, awaiting response... 302 Found  
Location: https://raw.githubusercontent.com/GNSSOEM/ELT_RTKBase/main/install.sh  
[following]  
--2024-06-11 00:23:18-- https://raw.githubusercontent.com/GNSSOEM/ELT_RTKBase/main/install.sh  
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.108.1  
33, 185.199.109.133, 185.199.110.133, ...  
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.108.1  
33|:443... connected.  
HTTP request sent, awaiting response... 200 OK  
Length: 15709771 (15M) [application/octet-stream]  
Saving to: 'install.sh'  
  
install.sh      100%[=====] 14.98M 11.0MB/s   in 1.4s  
  
2024-06-11 00:23:21 (11.0 MB/s) - 'install.sh' saved [15709771/15709771]  
jef@rtkbase:~$
```

Give it execution rights with the command **chmod +x install.sh**



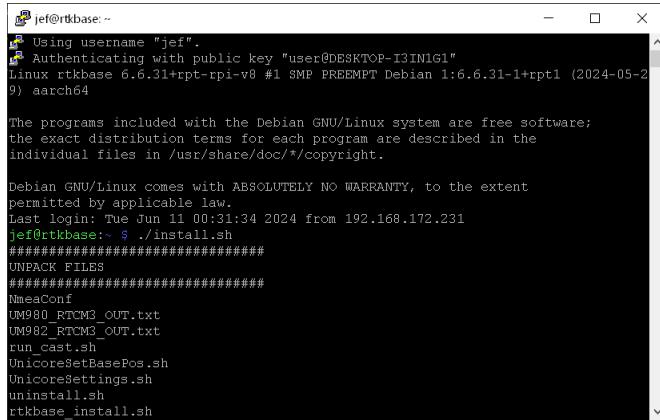
```
jef@rtkbase:~$ wget https://github.com/GNSSOEM/ELT_RTKBase/raw/main/install.sh  
--2024-06-11 00:23:18-- https://github.com/GNSSOEM/ELT_RTKBase/raw/main/install.sh  
.sh  
Resolving github.com (github.com)... 140.82.121.3  
Connecting to github.com (github.com)|140.82.121.3|:443... connected.  
HTTP request sent, awaiting response... 302 Found  
Location: https://raw.githubusercontent.com/GNSSOEM/ELT_RTKBase/main/install.sh  
[following]  
--2024-06-11 00:23:18-- https://raw.githubusercontent.com/GNSSOEM/ELT_RTKBase/main/install.sh  
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.108.1  
33, 185.199.109.133, 185.199.110.133, ...  
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.108.1  
33|:443... connected.  
HTTP request sent, awaiting response... 200 OK  
Length: 15709771 (15M) [application/octet-stream]  
Saving to: 'install.sh'  
  
install.sh      100%[=====] 14.98M 11.0MB/s   in 1.4s  
  
2024-06-11 00:23:21 (11.0 MB/s) - 'install.sh' saved [15709771/15709771]  
jef@rtkbase:~$ chmod +x install.sh  
jef@rtkbase:~$
```

Run the script with the command **./install.sh**. The first run may cause a reboot, do not be alarmed.



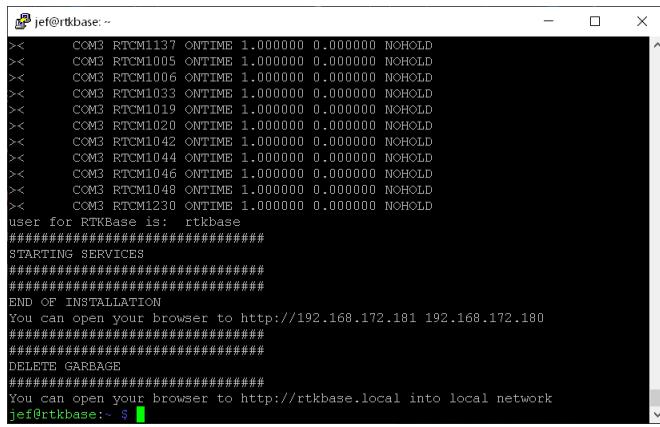
```
PuTTY (inactive)  
RtkbasesystemConfigureProxy.sh  
server_py.patch  
status_js.patch  
tun_power.sh  
config.txt  
rtklib/convbin  
rtklib/rtkrccv  
rtklib/st2str  
version.txt  
settings_js.patch  
base_html.patch  
settings_html.patch  
Bynav_RTCM3_OUT.txt  
#####  
CHECK BOOT CONFIGURATION  
#####  
Changed /boot/firmware/cmdline.txt  
Please try again ./install.sh after reboot  
  
Broadcast message from root@rtkbase on pts/1 (Tue 2024-06-11 00:53:36 BST):  
The system will reboot now!  
jef@rtkbase:~$
```

The next run of **./install.sh** begins the installation.



```
jef@rtkbase:~  
Using username "jef".  
Authenticating with public key "user@DESKTOP-I3INIG1"  
Linux rtkbase 6.6.31+rpi-rpi-v8 #1 SMP PREEMPT Debian 1:6.6.31-1+rpi1 (2024-05-29) aarch64  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/*copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Tue Jun 11 00:31:34 2024 from 192.168.172.231  
jef@rtkbase:~$ ./install.sh  
#####  
UNPACK FILES  
#####  
NmeaConf  
UM980_RTCM3_OUT.txt  
UM982_RTCM3_OUT.txt  
run_cast.sh  
UnicoreSetBasePos.sh  
UnicoreSettings.sh  
uninstall.sh  
rtkbase_install.sh
```

After it completes, you can proceed with the configuration.



```
>< COM3 RTCM1137 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1005 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1006 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1033 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1019 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1020 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1042 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1044 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1046 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1048 ONTIME 1.000000 0.000000 NOHOLD  
>< COM3 RTCM1230 ONTIME 1.000000 0.000000 NOHOLD  
user for RTKBase is: rtkbase  
#####  
STARTING SERVICES  
#####  
#####  
END OF INSTALLATION  
You can open your browser to http://192.168.172.181 192.168.172.180  
#####  
#####  
DELETE GARBAGE  
#####  
You can open your browser to http://rtkbase.local into local network  
jef@rtkbase:~$
```

Configuring the Receiver

Receiver configuration is performed automatically during installation. Manual configuration is needed only when replacing the receiver.

USB Receivers

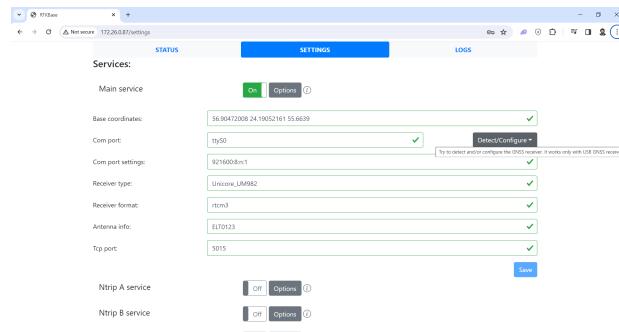
In the current version, the power to the **USB** ports is always on, so there are no specific considerations for **USB** receivers.

However, in previous versions, the power to the **USB** ports was turned off to reduce energy consumption. If you are using version 1.6.0 or earlier and want to use a **USB** receiver, set the “**Com port**” field to **ttyUSB0** (or any other **USB** port) in the settings, save the settings, and reboot the **Raspberry Pi**. After rebooting, power will be supplied to the **USB** ports, and detection and configuration will complete successfully.

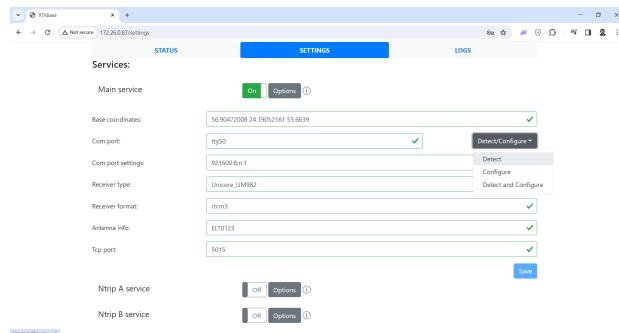
Detection

To detect a USB receiver, you need to perform the “**Detect**” operation in the settings.

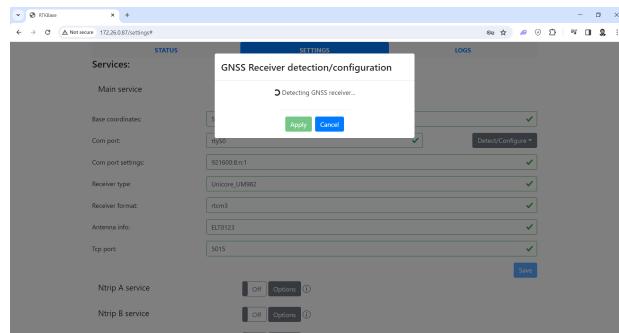
Go to the **Settings** page, and to the right of “**Main service**”, click the **Options** button.



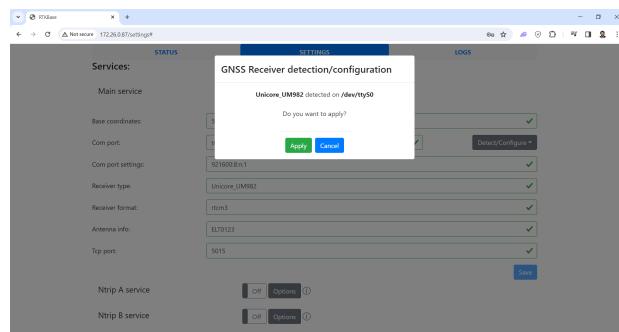
Click the “**Detect/Configure**” button and select “**Detect**” from the drop-down menu.



Detection is in progress.



The receiver is detected.

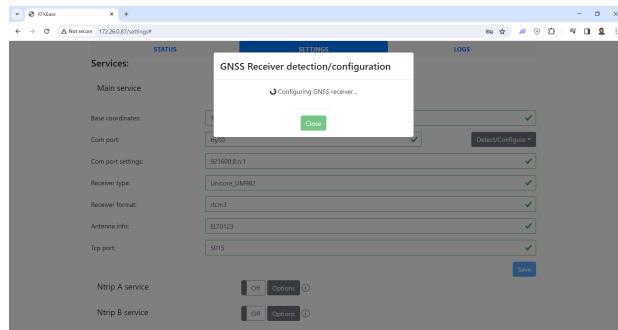


Then you can click the **Apply** button to save the detected receiver's settings (port, speed, receiver name, and protocol type). These four settings will be used later during the receiver configuration.

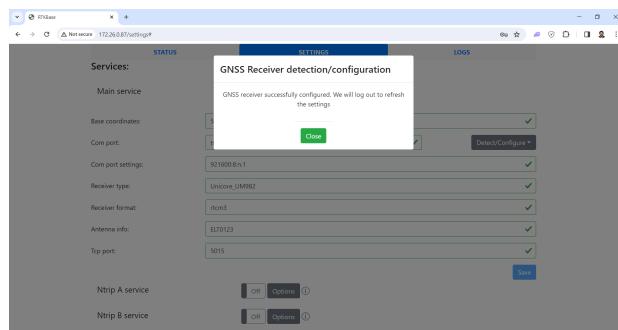
Septentrio receivers can operate using either the **rtcm3** protocol (by default) or the **sbf** protocol. To select the **sbf** protocol, change the protocol after detection and then proceed with the configuration.

Configuration

To configure the receiver, do as described in the “[Detection](#)” section, but click the “**Configure**” button.



After configuration is complete, click the “**Close**” button.



During configuration, the receiver speed is reset to **115200**, and all services are disabled.

If the receiver was not at **115200** speed and the configuration ended with an error, the receiver speed will not match the speed specified in the settings. In this situation, you need to perform detection as described in the “[Detection](#)” section. In general, detection is a universal way to fix various issues.

Checking the Receiver Firmware Version

After configuring the receiver, the firmware version is displayed at the bottom of the “Settings” page. For **Unicore UM980**, the required version is **R4.10Build10231** and above, for **Unicore UM982** – **R4.10Build10186** and above, for **Bynav M2-0 — V7.81_19D751_T** and above, and for **Septentrio mosaic-X5** – **4.14.4** and above. If the version is older, update the firmware as described in the sections “[Updating Receiver Firmware](#)”, “[Unicore UM980](#)”, “[Bynav M20](#)” and “[Septentrio Mosaic X5](#)”.

Gnss receiver:	Unicore_UM980 R4.10Build10231
Board:	Raspberry Pi 4 Model B Rev 1.5
Os:	Debian 12 (Bookworm)
CPU Temp:	54,5 C° - (highest record: 56,0C°)
Uptime:	39mn 30s
Storage:	26.71GB available of 30.83GB - (8.7 % used)
Settings:	Backup Restore Reset
Diagnostic:	View
Power:	Reboot Shutdown

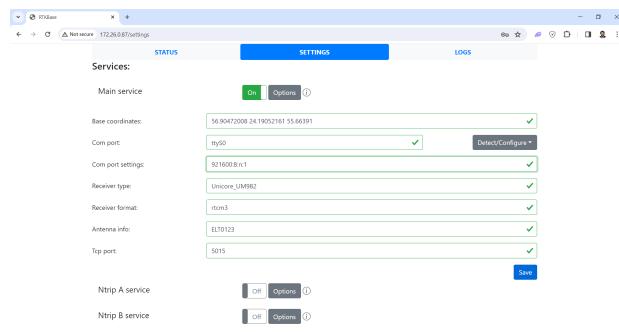
ELT_RTKBase v1.5.0 RTKBase v2.5.0 gnss.store gnss.design

Changing the Speed

To reduce the delay time between measurements and data transmission, it can be helpful to increase the speed to **921600**. However, equipment from some manufacturers may work unstably at this speed. If you want to change the speed, simply adjust it in the settings and click the **Save** button. During saving, the receiver is reconfigured to the required speed. However, although you can enter any speed, only the speeds **115200:8:n:1**, **230400:8:n:1**, **460800:8:n:1**, **921600:8:n:1** are allowed. All other speeds are not allowed.

Manually changing other parameters (except for speed, coordinates, and antenna name) is strictly not recommended.

When the **Save** button is clicked, all services are stopped. If the main service was running at the time of clicking **Save**, it will restart, but the other services will remain stopped.



Configuring the Septentrio Receiver

Septentrio Mosaic Website

Find the button to open the **mosaic** receiver's website on the **Settings** page and click it.

Gnss receiver: Septentrio_mosaic-X5 - 4.14.4 **Mosaic Web server**

Board: Raspberry Pi 4 Model B Rev 1.5

Os: Debian 12 (Bookworm)

CPU Temp: 58,4 C° - (highest record: 60,4C°)

Uptime: 5h 18mn 22s

Storage: 26.5GB available of 30.83GB - (9.4 % used)

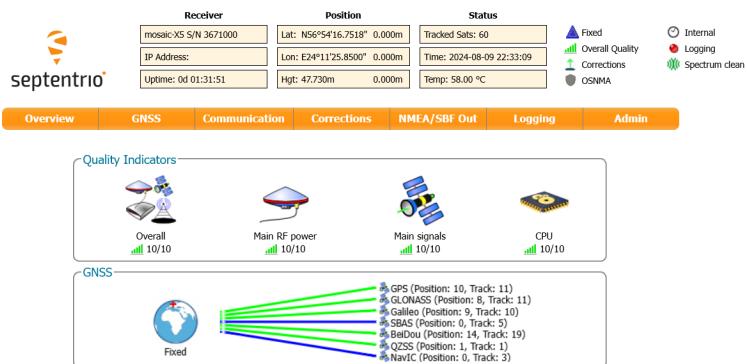
Settings: **Backup** **Restore** **Reset**

Diagnostic: **View**

Power: **Reboot** **Shutdown**

ELT_RTKBase v1.5.5 RTKBase v2.6.0 gnss.store gnss.design

On the website that opens, you can configure the receiver.



RxTools

You can use **RxTools** utilities (such as **RxControl**) to configure the **Mosaic X5** receiver. To do this, connect via **TCP/IP**, using rtkbase.local or the **Raspberry Pi**'s **IP** address as the address, and port **28784** as the port number.

Internet Access

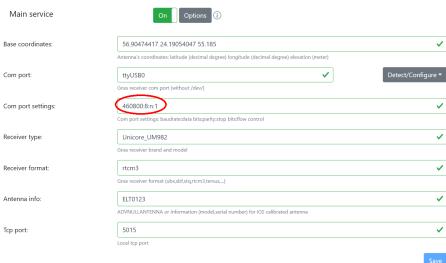
The **Mosaic X5** receiver is connected to the **Raspberry Pi** via **USB**. This means the receiver has the address **192.168.3.1**, and the **Raspberry Pi** performs **NAT** functions for it. The **Mosaic X5** receiver has nearly full internet access with a few exceptions:

- For incoming connections (**IPR** or the receiver's built-in **NTRIP** caster), only ports **3000-3009** (both **TCP** and **UDP**) are available.
- **FTP** access is not functional. Since the **Mosaic X5** does not have its own **SD** card, **FTP** is unnecessary.
- The **Mosaic X5** acts as the time server (**NTP** and **PTP** protocols), not the **Raspberry Pi**.
- Access to the **Mosaic X5**'s web interface is through port **9090**, while ports **80** and **443** are routed to the **Raspberry Pi**.
- **DNS** servers **8.8.8.8** and **1.1.1.1** are used for the **Mosaic X5**.
- The “**Outgoing Internet Access Over USB**” setting **must not** be disabled.
- The “**Ethernet Interface Mode**” setting **must not** be enabled.
- The “**TCP/IP Settings**” must be set to **DHCP**.

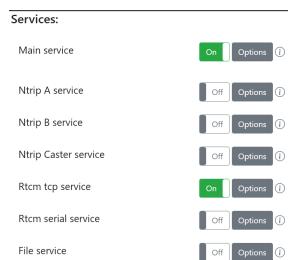
Updating Receiver Firmware

Unicore UM980

Set the receiver speed to **460800**, as described in the “[Changing the Speed](#)” section.



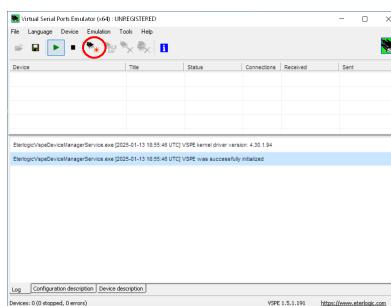
Enable the “**Rtcm tcp service**” and temporarily disable all other services except for “**Main service**” and “**Rtcm tcp service**” while updating the firmware.



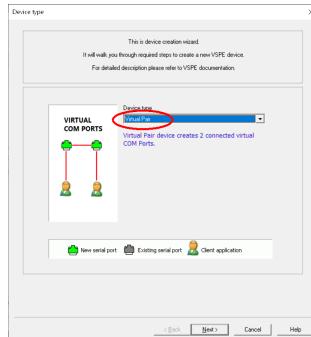
You will now need a **Windows** program that converts **TCP/IP** to a **COM port**. Several such programs are available; we’ll describe **Virtual Serial Ports Emulator (VSPE)** as it is the most versatile. Download and install **VSPE** from the “[Eterlogic Software](#)” website.

It is recommended to install the “**Virtual Serial Ports Emulator for 32-bit Windows operating systems**” version because it does not require a license and can be used for free. However, if you have 64-bit **Windows**, you can use **VSPE** with the built-in **Evaluating** license. Details are available via the [provided link](#).

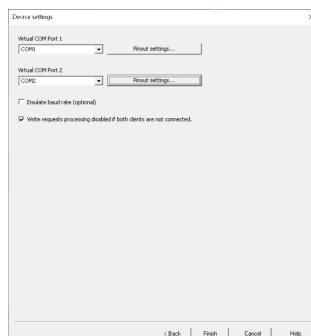
After installation, launch **VSPE**. Click the “**Create new device...**” button.



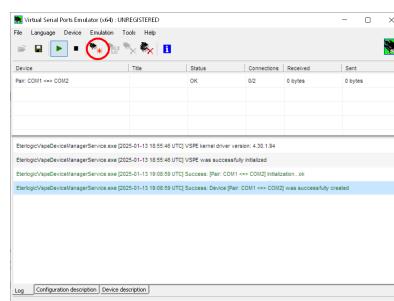
Select “Virtual pair” and click **Next**.



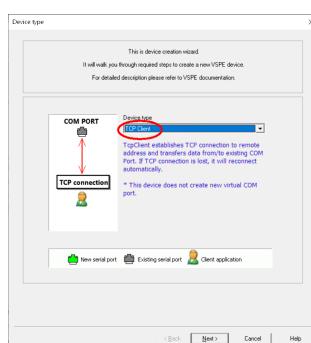
On the next screen, you can change the **COM** port numbers or keep the defaults selected by **VSPE**. Then click the **Finish** button.



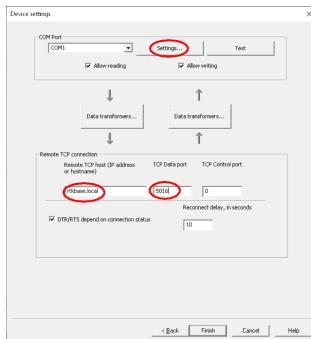
Now you'll see that a **COM** port pair has been created. Click the “Create new device...” button again.



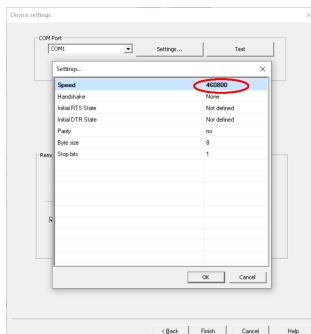
Select “TCP Client” and click **Next**.



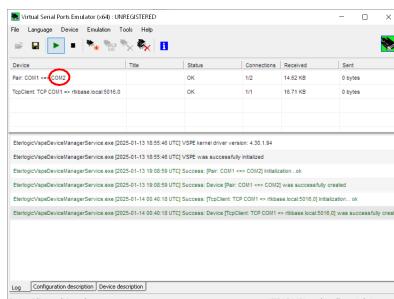
Set the **IP** address (usually “**rtkbase.local**”) and port (typically **5016**). Click the “**Settings...**” button.



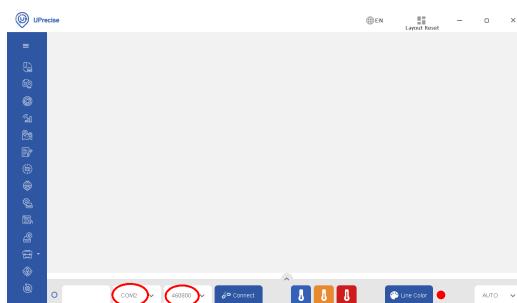
Change the speed to **460800**, then click **OK**, and finally click **Finish**.



You should now see a result similar to this:



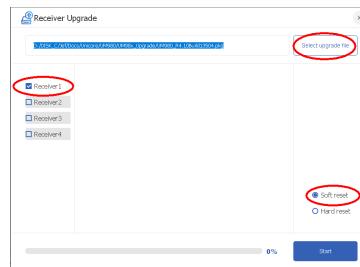
Download and launch **UPrecise** from the [website](#). At the bottom, enter **COM2** (the second port of the created pair) and the speed **460800**, then click the “**Connect**” button.



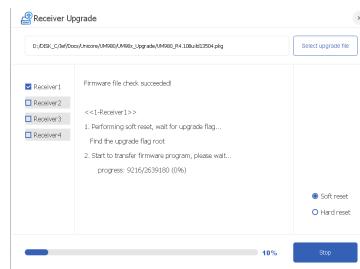
On the left panel, click the “**Receiver Upgrade**” button.



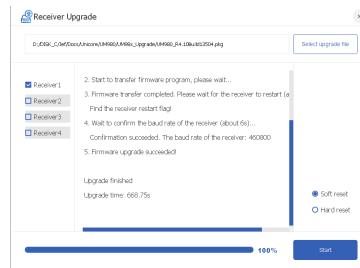
After clicking the button, the firmware update settings window will appear. Check the box next to “**Receiver 1**”. Select “**Soft Reset**”. Click “**Select upgrade file**” and choose the new firmware file.



Once the new firmware file is selected, click the **Start** button. The firmware update process will begin.



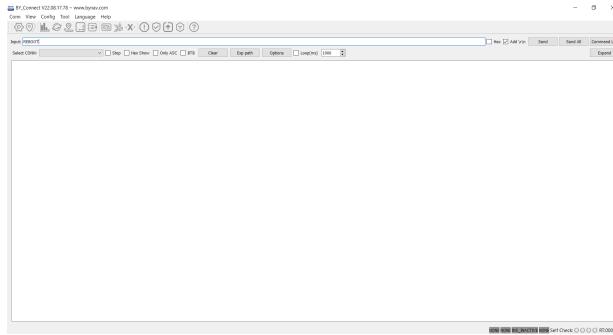
After the update is complete, you will see a message like this:



Close both **UPrecise** and **VSPE**. Then perform “Detection” and “Configuration” as described in the corresponding sections.

Bynav M20

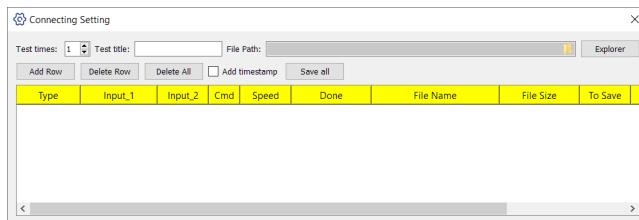
Download, unzip, and run **BY_connect** from the [website](#).



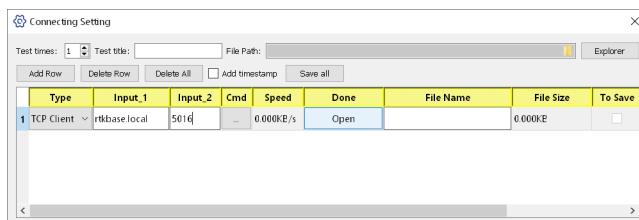
In the **Conn** menu, select **Set**.



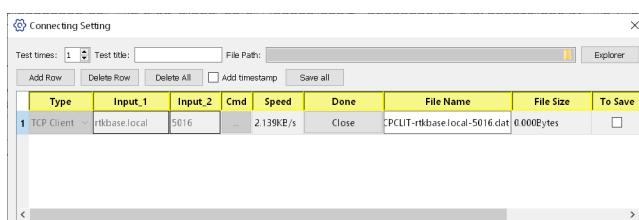
The “Connecting Setting” window opens.



Click “Add Row” and fill in the fields as shown in the screenshot.



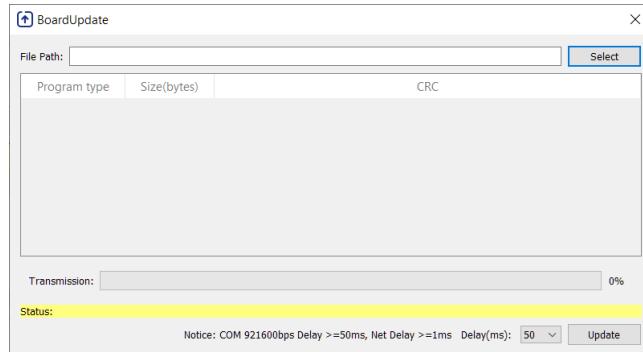
Click **Open**.



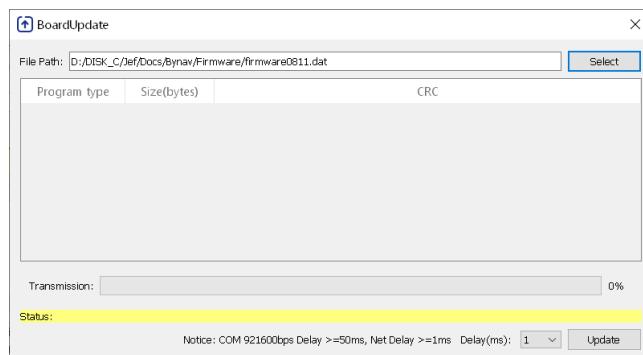
In the **Tool** menu, select “Firmware update”.



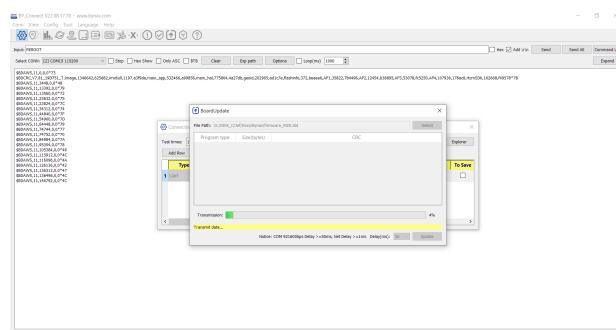
The “**BoardUpdate**” window opens. Click **Select** and choose the firmware update file.



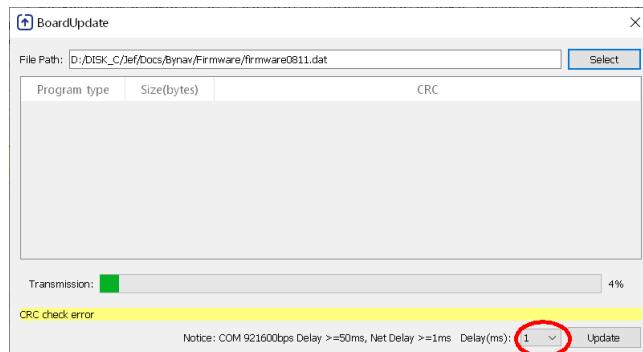
After selecting the new firmware file, click the **Update** button in the lower right corner of the window. It's best to set the delay to **50**.



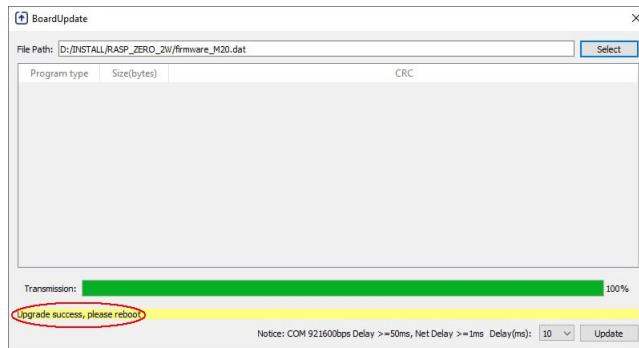
The firmware update process begins.



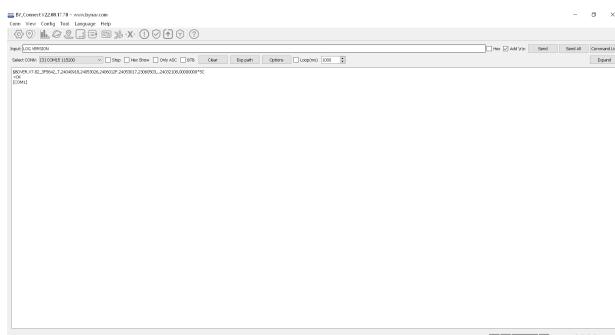
If you receive a "**CRC Check Error**" message, increase the delay (e.g., by 50) and click **Update** again.



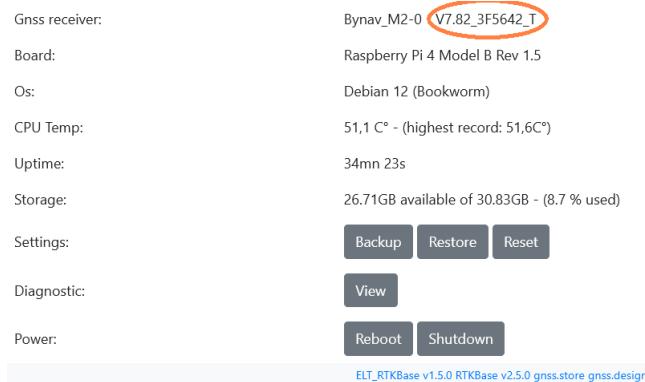
Wait for the firmware update to complete. On success, the message “**Upgrade success, please reboot**” appears, and on failure, “**Upgrade failure**” appears.



After the firmware update is complete, you need to issue the “**REBOOT**” command, followed by the “**LOG VERSION**” command. If any field (except the last one) in the response to this command shows only zeros, you need to repeat the firmware update.

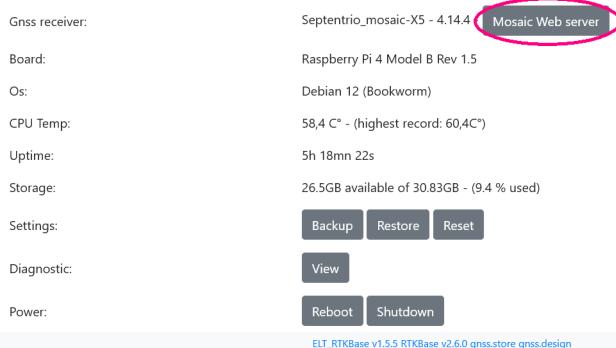


Then configure the receiver as described in the “[Configuration](#)” section and check the receiver firmware version at the bottom of the settings page.

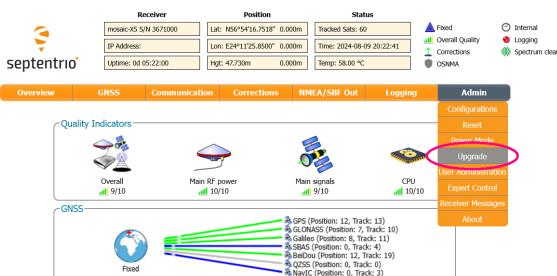


Septentrio Mosaic X5

Find the button to open the **mosaic** receiver's website on the **Settings** page and click it.



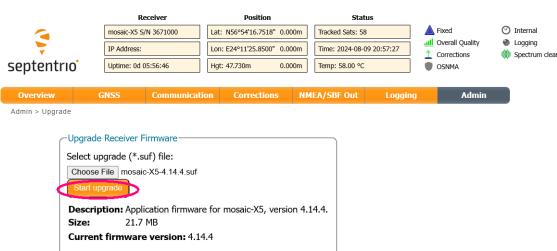
On the receiver's website that opens, go to the **Admin** menu and click the **Upgrade** option.



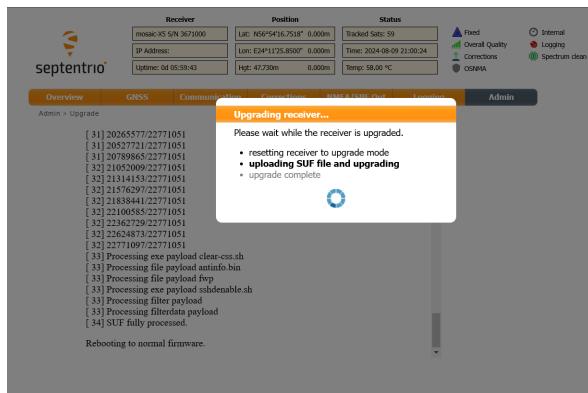
Click “Choose file” and select the firmware update file.



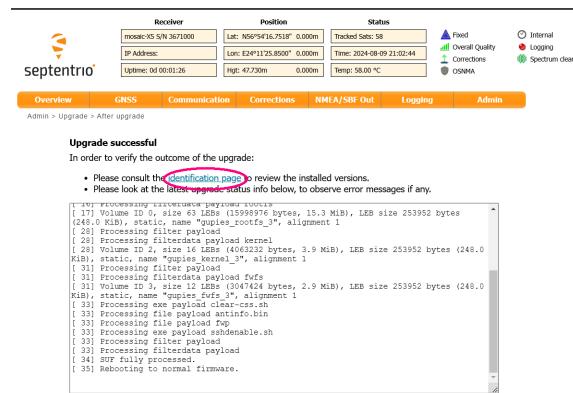
Then click the “Start Upgrade” button.



The firmware update process begins.



The firmware is updated. Click the “**identification page**” link to check the version.



Verify that the version number is correct.



Now proceed with the configuration as described in the “Configuration” section.

Determining Coordinates

Determining coordinates is necessary to find the exact coordinates of the antenna. Start with a rough determination of coordinates using the built-in **PPP**, then refine the coordinates using one of the more accurate methods.

Before determining coordinates, be sure to read the section on [accuracy and stability](#) on our blog.

It is very important to remember about frames and epochs. **Ublox** has a [good tutorial](#) on this topic, and a [brief explanation](#) can also be found on **Onocoy**. The **PPP** and **HAS** methods give results in the **ITRF** frame associated with the Earth's center, while the **RTK** methods sometimes use the **ETRF** frame associated with continents. The difference between frames in Europe is currently about 80 centimeters, so it is recommended to use a [frame calculator](#) for conversion.

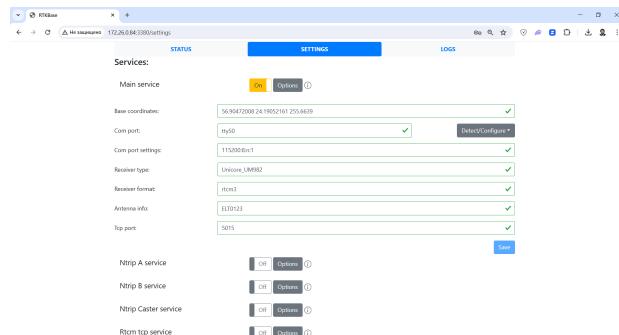
The determination time should be no less than a full day, ideally **23** hours and **56** minutes (**86160** seconds). For high accuracy, it is better to use several daily **RTK** measurements and perform adjustment. The most accurate way is to hire a surveyor or use a paid service.

The main condition is that the antenna should not move relative to the ground. High bending masts are not suitable.

When specifying coordinates, there are two main options. If coordinates “**0.00 0.00 0.00**” are specified, the receiver determines its coordinates by averaging the autonomous solution within a minute. If other values are specified, the receiver tries to establish them.

If the coordinates are incorrectly specified (more than 50 meters from the value determined by the receiver), the **Unicore** receiver will not work. In this situation, only the **Beidou** and **QZSS** satellites will be visible on the **Status** page. To avoid this, when specifying incorrect coordinates in the settings, the receiver uses the averaged value of the autonomous solution. The indicator next to “**Main service**” will be orange, not green.

As for the indicator, **green** means “everything is fine”, **yellow** means “the service is running with errors”, and **red** means “the service is not running”. There is also a **blue** color, which indicates that the service is currently in the process of starting up.



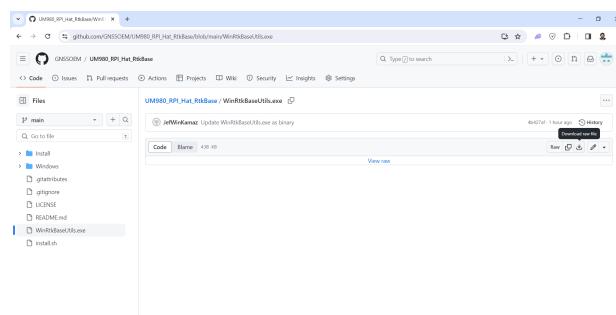
Determining Coordinates using the PPP Method

To determine coordinates using the built-in **PPP**, go to the **Status** page after a day and copy the coordinates as described “[Checking Satellite Reception](#)”. Note that each time the base coordinates or other main service settings are changed, the **PPP** refinement process starts from scratch.

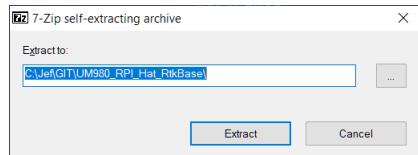
WinRtkBaseUtils Package

Download and unpack

Insert the **SD** card sent to you into your computer's card reader and download the self-extracting archive **WinRtkBaseUtils.exe** to your hard drive. You can also download this archive from **GitHub** using the [provided link](#).



Run the file to unpack it. During the run, you can choose the folder for unpacking and click the **Extract** button.



Sometimes the antivirus may give a warning, and you need to explain to it that this file is safe. For example, **Microsoft Defender** may display the following message. In this case, click “**More Info**”.

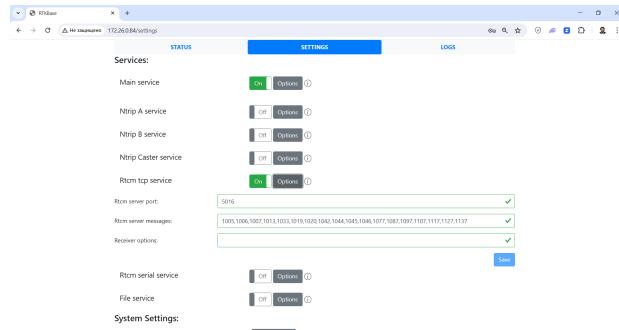


Next, click “**Run anyway**”.



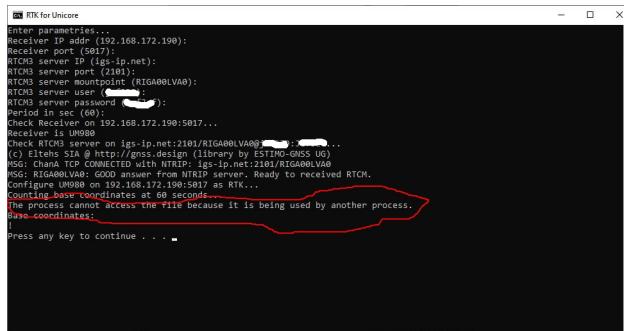
Important Requirements

To determine coordinates using the **WinRtkBaseUtils** package, you must enable the “**Rtcm tcp service**” by clicking the “**On/Off**” button to the right of “**Rtcm tcp service**”, and after determining the coordinates, disable it again. Enabling this service allows access to change the receiver settings from outside the **Raspberry PI**, and in the worst case, even outside your local network. The list of messages for this service is obsolete and does not affect anything.

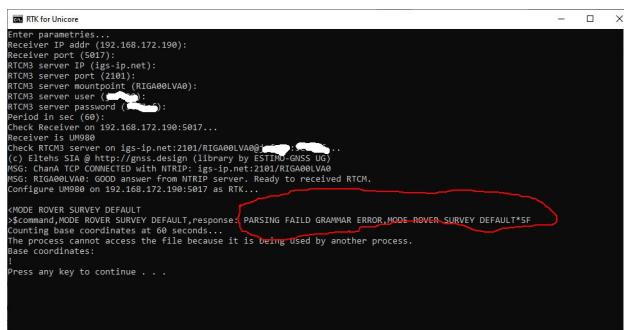


Moreover, if there were failures during the execution of **RTK.bat** or **HAS.bat**, you must reconfigure the receiver as described in the “Configuration” section. The **WinRtkBaseUtils** package reconfigures the receiver, and in case of a failure, it must be reconfigured back.

It is not possible to run multiple **RTK.bat** or multiple **HAS.bat** from the same directory simultaneously, even with different **Raspberry pi** and receivers. This is due to the impossibility of simultaneous use of the same temporary file. Trying to do this will result in a message like the one shown in the picture.



If the receiver firmware version is outdated, there may be messages like the one in the picture. In this case, check the receiver firmware version as indicated in the “Checking the Receiver Firmware Version” section.



After changing coordinates by clicking the **Save** button, all services are stopped. If the “**Main service**” was running at the time of clicking **Save**, it will restart, but the other services will remain stopped.

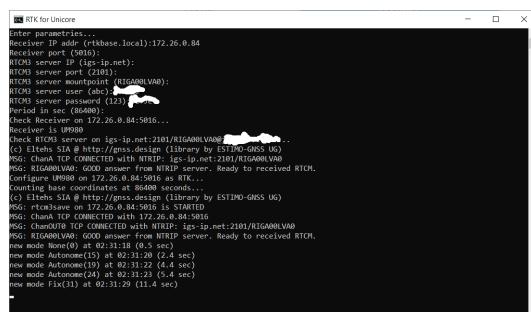
Determining Coordinates via RTK

RTK stability on **Unicore** receivers is about 4 mm **CEP50** horizontally and 8 mm **CEP50** vertically. Accuracy is approximately 1mm per kilometer of distance between the receiver and the base. For increased accuracy, network corrections with virtual bases should be used.

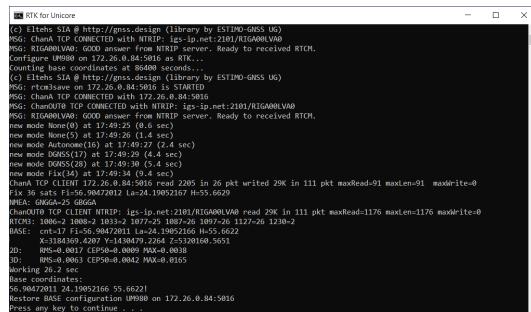
To determine coordinates using **RTK**, run the **RTK.bat** file. In the opened window, enter the receiver address and port. If you use **Raspberry pi** on the local network, do not change them. Then enter the address, port, mount point, login, and password for the **NTRIP** server, as well as the measurement time. The entered parameters are saved in the **Ini.cmd** file.



Communication with the receiver and server is checked, then the receiver is configured, and then **RTK** starts.

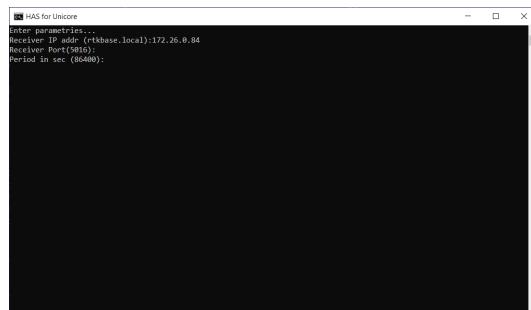


In the end, the coordinates are copied to the clipboard and displayed on the screen, and the receiver is configured back to base mode. For early termination, press the **Q** button. After completion, press any key to close the window.



Determining Coordinates via HAS (Only Unicore)

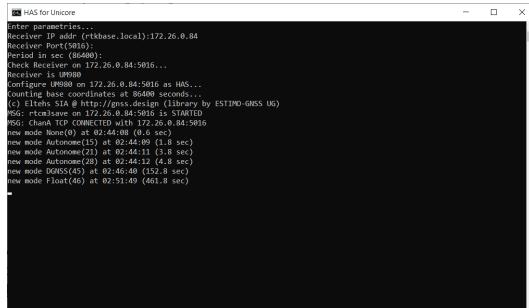
Determining coordinates using the **HAS** method is available only for **Unicore** receivers. To do this, run the **HAS.bat** file. In the opened window, enter the receiver address and port. If you use **Raspberry pi** on the local network, do not change them. Then enter the measurement time. The entered parameters are saved in the **Ini.cmd** file.



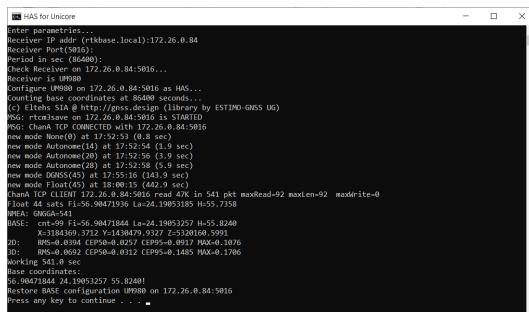
Communication with the receiver is checked, then the receiver is configured.



HAS resolution starts in 2-10 minutes.



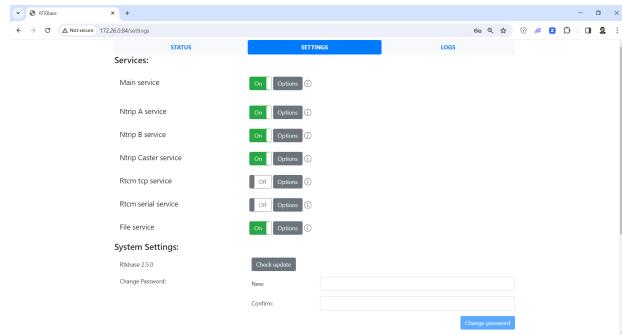
In the end, the coordinates are copied to the clipboard and displayed on the screen, and the receiver is configured back to base mode. For early termination, press the **Q** button. After completion, press any key to close the window.



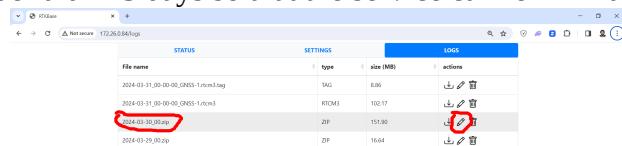
Determining Coordinates via External Services

Another method is to use an external **RINEX** post-processing service operating in your region. For example, for France, **IGN** services (instructions for it [here](#)) and **Orpheon** are suitable, and for the rest of the world, **NRCAN**. Such services are usually paid.

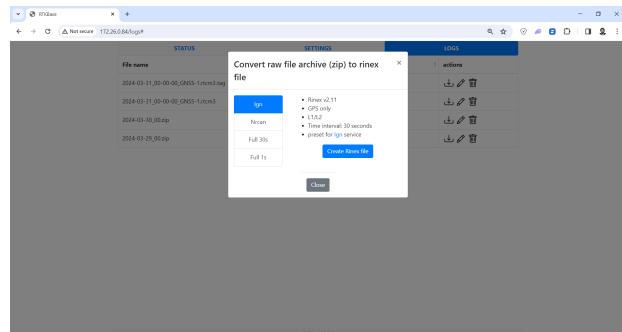
First, enable the “**File Service**” and record the measurements. You need at least one full day according to Greenwich. The fact that recording is in progress is visible on the **Logs** page by the increasing size of the **rtcm3** file. For this, only one file should be recorded per day. Turning off the device or stopping the file or main service will result in the daily archive being unsuitable for conversion to **RINEX**.



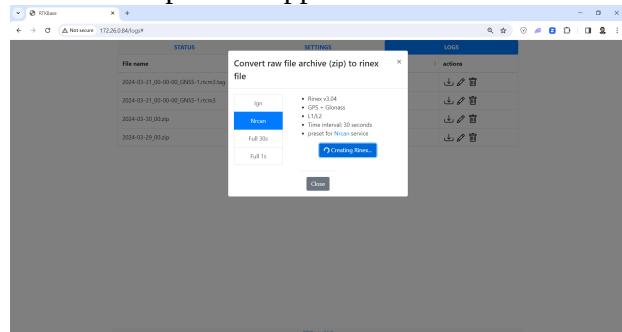
After recording, go to the **Logs** page. Click on the pencil icon next to the full-day **ZIP** archive file. Ideally, use an archive older than 15 days so that the service can form final satellite orbits.



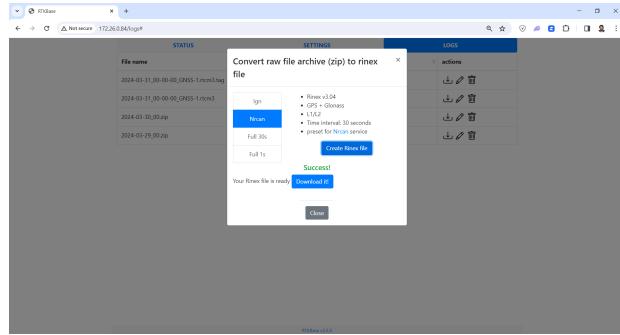
A window like this will open. For **NRCAN**, select “**Nrcan**”, for **IGN** - “**Ign**”, and click the “**Create RINEX file**” button.



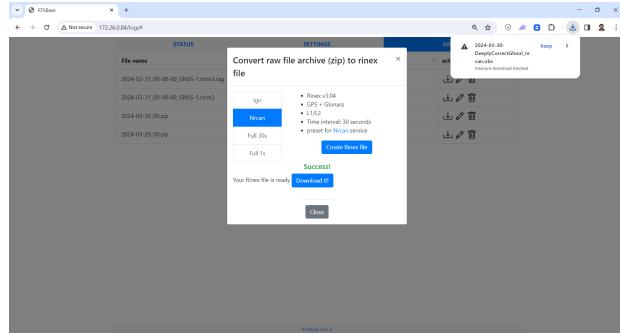
A message indicating the file creation process appears. Wait a few minutes.



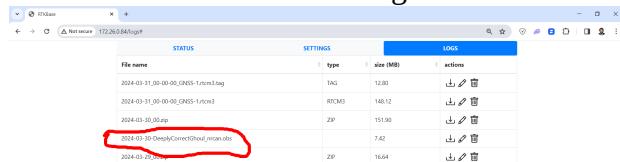
The **RINEX** file is created. Click d “**Download it!**” to download it.



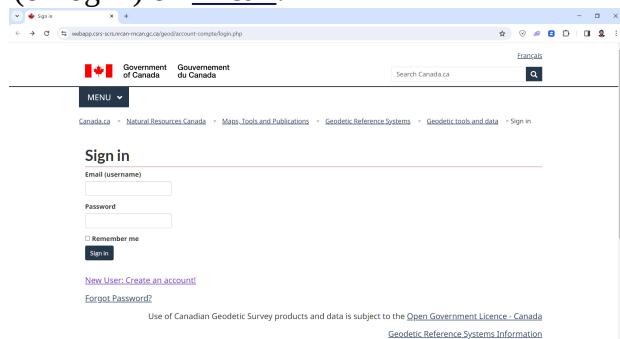
During the download, a message about unsafe downloading may appear. Click “keep”. The downloaded file size is 6-8 megabytes.



After downloading, the created file can be seen in the log list for re-downloading.



Next, you need to register (or log in) on **Nrcan**.



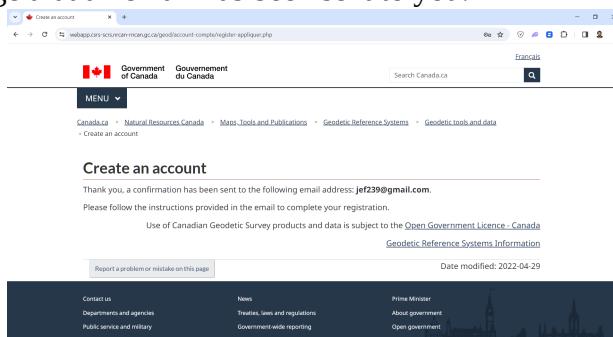
Click “New User: Create an account!” and fill in the details. After completing the form, click “Submit”.

The screenshot shows a web browser window titled "Create an account". The URL is <http://webapps.surveyscanada.gc.ca/good/account/compte/register/applica.php>. The form fields include:

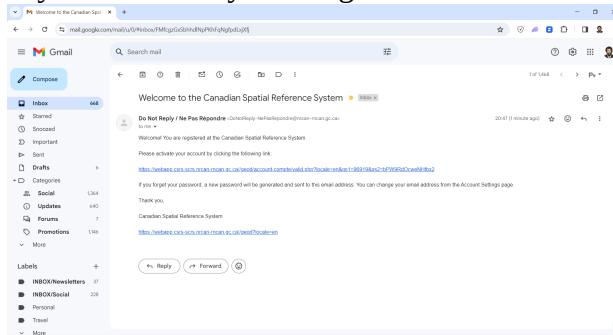
- Email*:
- Password* [between 5 and 32 characters]:
- Confirm password:
- Organization Type*:
- Country or Territory*:
- Province (Canada only)*:

Below the form, a note states: "This information is used by the Canadian Geodetic Survey to administer the website and fulfill visitor requests." A "Submit" button is at the bottom.

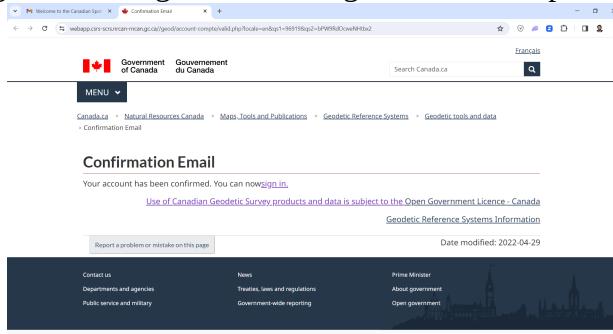
You will receive a message that an email has been sent to you.



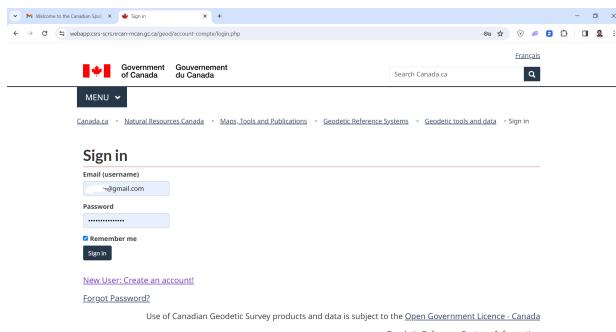
Open the email and activate your account by clicking on the link.



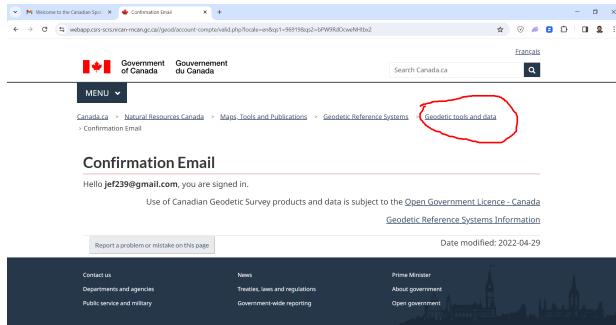
You will receive a message confirming successful registration and a prompt to log in.



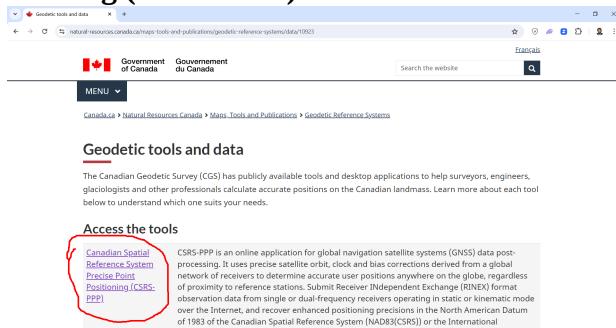
Click “Sign in” and log in.



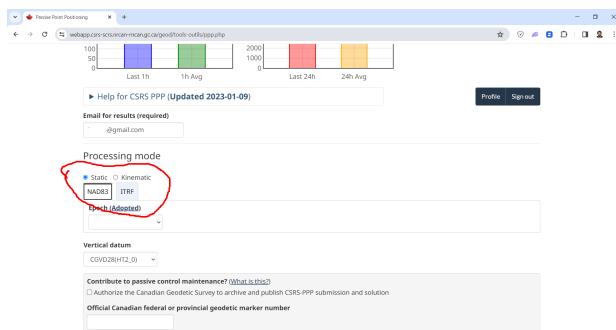
You will be greeted with a message congratulating you on successfully logging in. Click on “Geodetic tools and data”.



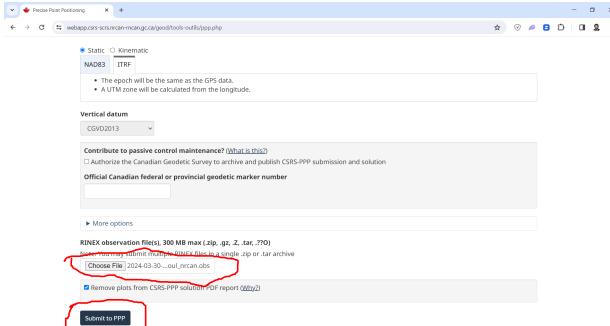
You will land on the “Geodetic tools and data” page. Click on “Canadian Spatial Reference System Precise Point Positioning (CSRS-PPP)”.



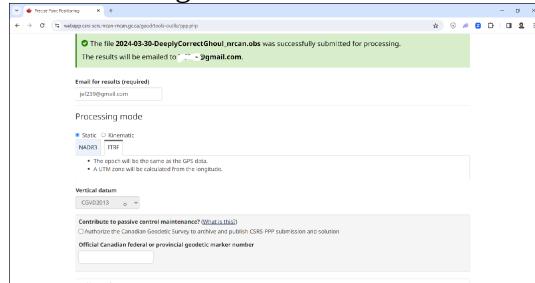
You will be taken to the PPP calculation page. Select **ITRF** (not **NAD83**) and **Static** (not **Kinematic**).



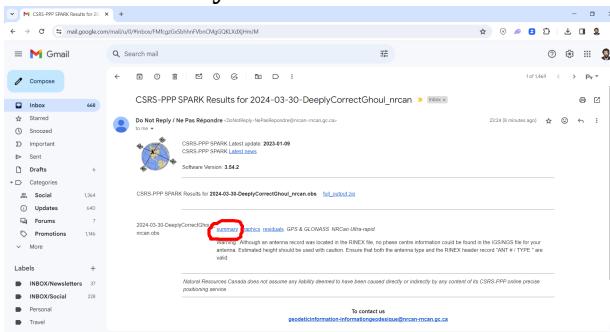
Scroll down the page. Click “**Choose File**” to select the RINEX file, and then click “**Submit to PPP**”.



After processing, you will receive a message that the result has been sent to your email.



Open the email and click on the “**summary**” link.



Follow the link to view the coordinates in the **ITRF2020** frame.



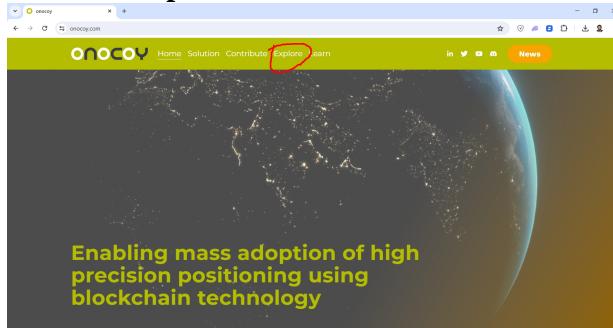
Another interesting section in the report is “**Orbits and Clocks Used**”. In our example, it shows “Ultra-rapid”, but if we had waited 15 days, we would have received the much more accurate “Final”.

NTRIP Configuration for Onocoy

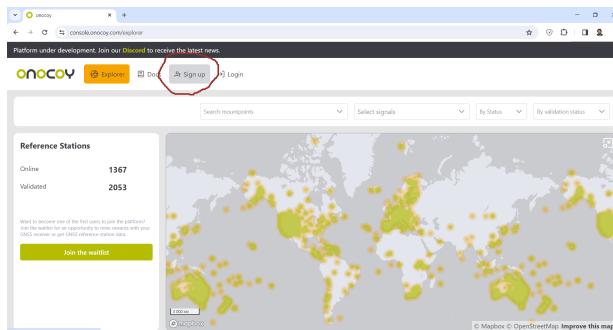
<https://www.onocoy.com> is a service that allows you to earn money using base stations. Documentation can be read at <https://docs.onocoy.com>, and we will provide a brief description for **RtkBase**. Additionally, the Onocoy project's "White paper can be read at the [link](#). Technical support and project news can be obtained on [Discord](#).

Registration

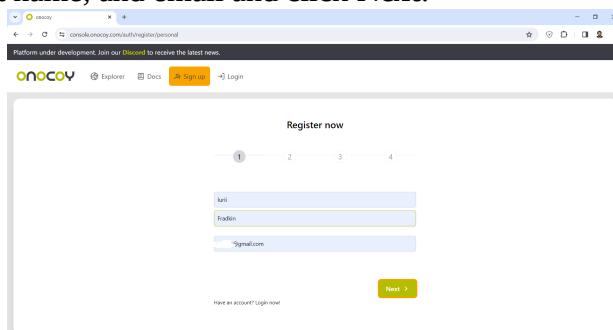
Go to <https://onocoy.com> and click **Explore**.



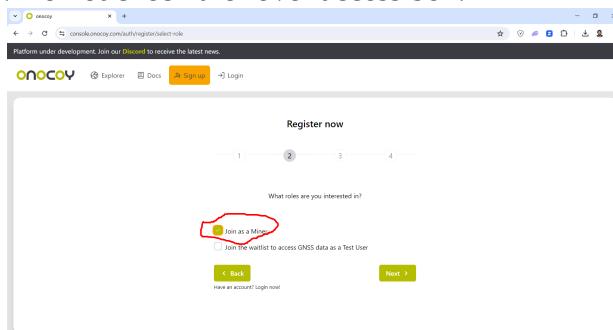
Click "Sign Up".



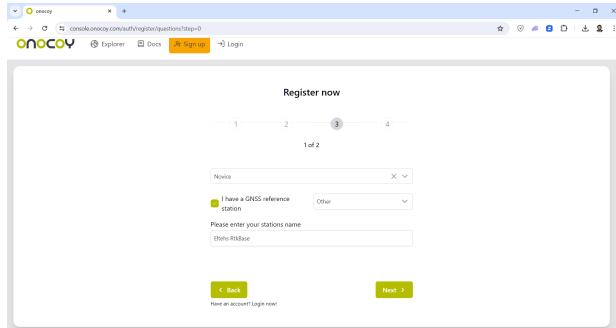
Enter your first name, last name, and email and click **Next**.



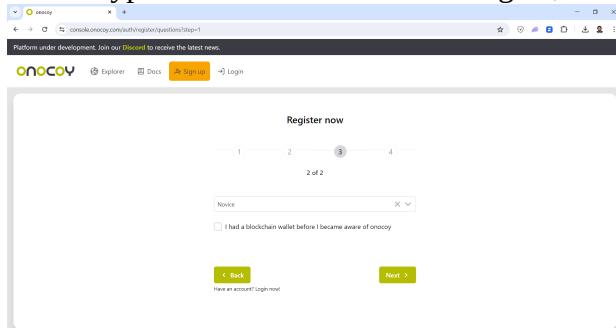
Check "Join as a Miner". Do not check the rover access box.



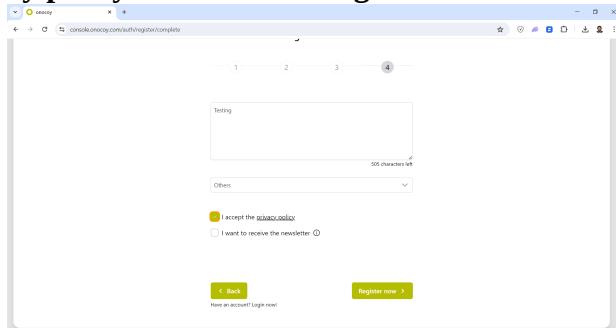
Set your **GNSS** knowledge level to “**Novice**”, mark that you have a **GNSS** station, and set the station type to “**Eltehs RtkBase**”. All these answers are only for collecting statistics, so they do not affect anything.



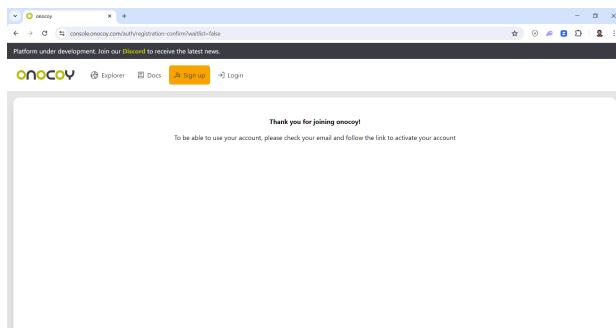
Set your knowledge level about cryptocurrencies to “**Novice**”. Again, this does not affect anything.



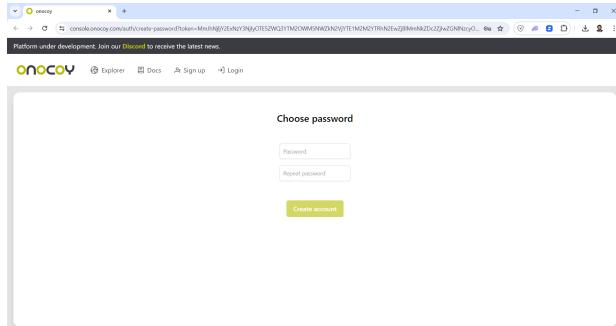
The last question is about your motivation, i.e., money, fame, love for humanity... Just make sure to check “**I accept the privacy policy**”. Then click “**Register now**”.



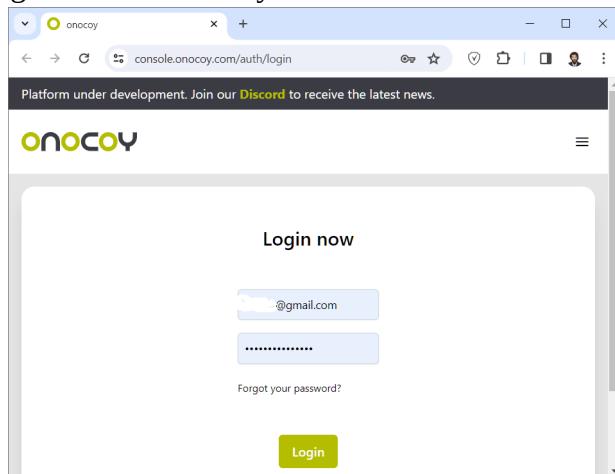
You will be asked to wait for an email.



Wait for the email with a big blue **JOIN** button. Click it and go to the password setting page. Sometimes you may receive another email indicating you are on the waiting list before this one. Enter your password and create an account.

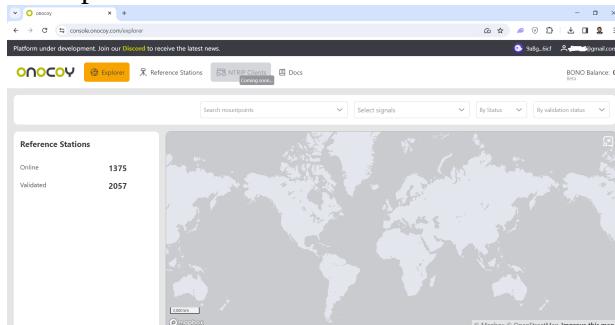


You will be taken to the login window where you need to click “**LOGIN**”.

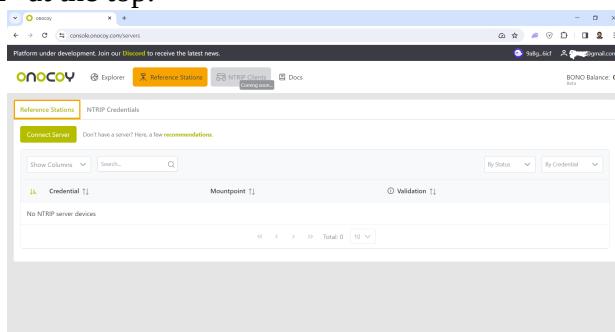


Getting Credentials

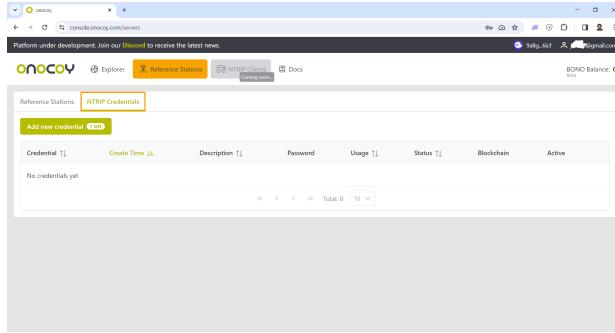
Log in with your username and password.



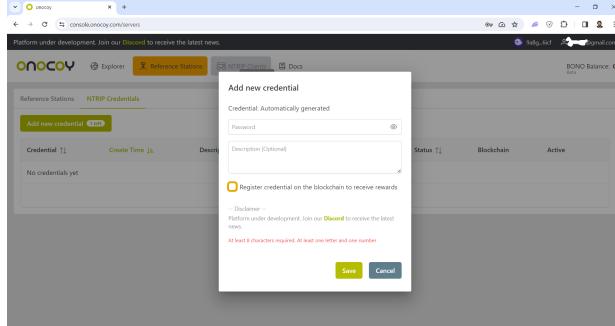
Click “**Reference Station**” at the top.



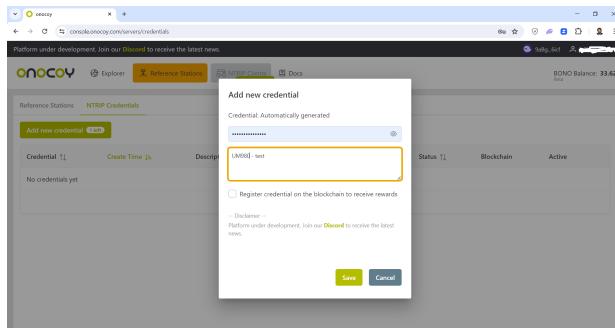
Click “NTRIP Credential”.



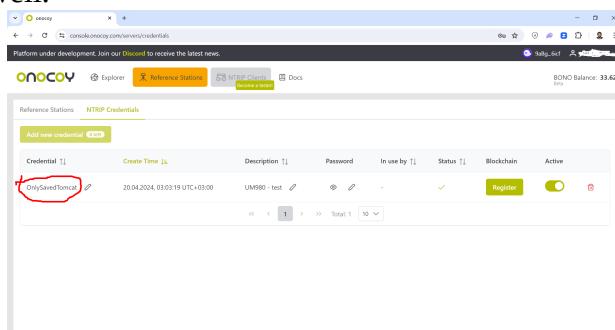
Click “Add New Credential”.



Enter a password, description, and click **Save**. Remember the password as it will be needed for the **RtkBase** settings.



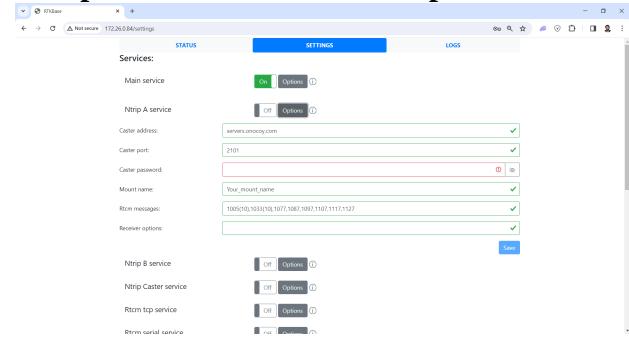
After successfully creating it, you will receive a mount point name, referred to as **Credential**. Remember this name as well.



NTRIP Server Setup

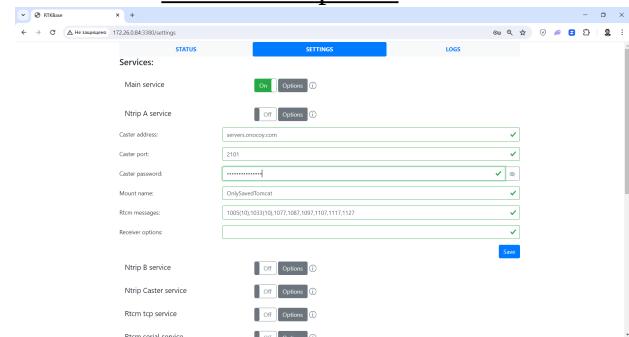
NTRIP Server is a mechanism for transmitting data from the base station receiver to a large **NTRIP Caster**, which then distributes (and sells) these data to clients.

Go to **RtkBase** and click the **Options** button next to “Ntrip A service”.

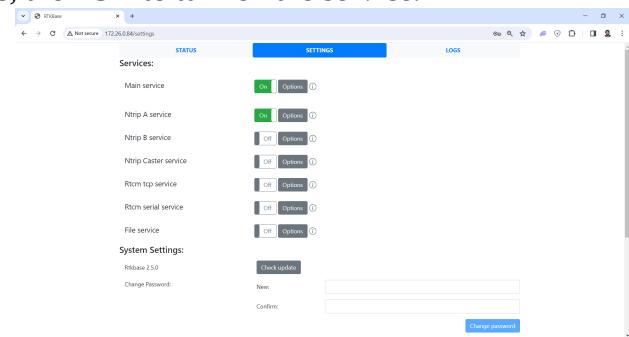


Enter the data from **Onocoy**. In the “Caster password” field, enter the password you set for the **Credential**. In the “Mount name” field, enter the name from the **Credential**. **Important!** Due to **Onocoy**'s specifics for the **NTRIP v1** protocol, the “Mount name” field should contain the **Credential** name, not the **mountpoint** name.

The “Receiver Options” field is intended for **Ublox** receivers, and information about the “Rtcn messages” field can be found in the “RTCM3 Proposals” section.

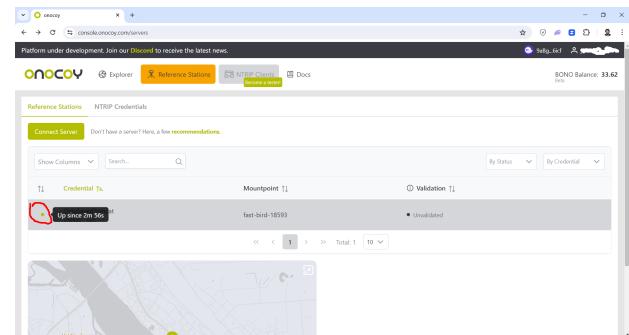


Click **Save**, then **Options**, then **Off** to turn on the service.

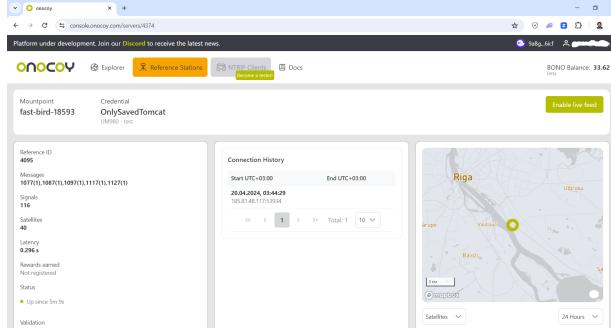


Connection Check

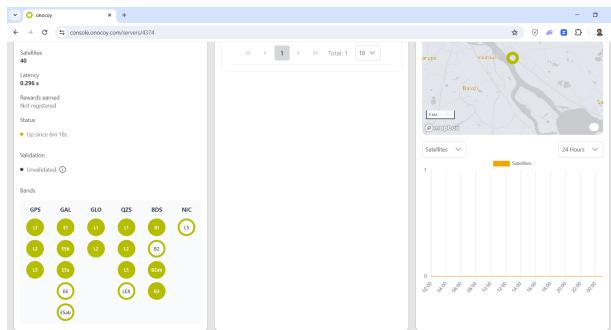
Return to **Onocoy**, click “**Reference Stations**”, and after a couple of minutes, see that your server is running, and the light on the left is green. Click anywhere on the gray stripe (e.g., the server name).



You will be taken to a window with server data. The “**Enable live feed**” button is on the top right, which will be discussed later.



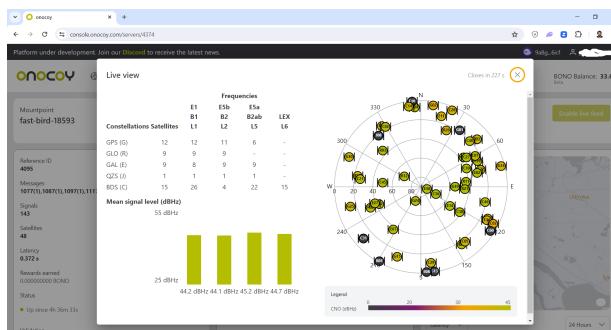
Scroll down and see the received and unreceived signals.



The green signals are received, and the white signals are not. On the right, there is a graph of the number of satellites and signals. If you see signals like in the screenshot or better, everything is fine. If you see only **Beidou** signals with a **Unicore** receiver, it means the base station coordinates are entered incorrectly. How to enter them correctly is described in the “[Determining Coordinates](#)” section.

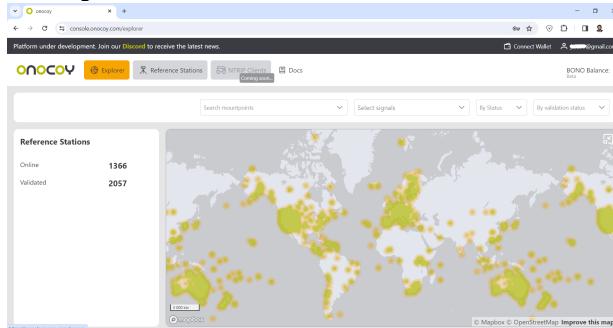
If you have two receivers connected to one antenna, you will not be able to double the benefits on **Onocoy**; in this case, only one receiver will connect.

If you click the “**Enable live feed**” button in the top right corner, you will get a display like this showing the satellite positions in the sky and the signal levels by frequency.

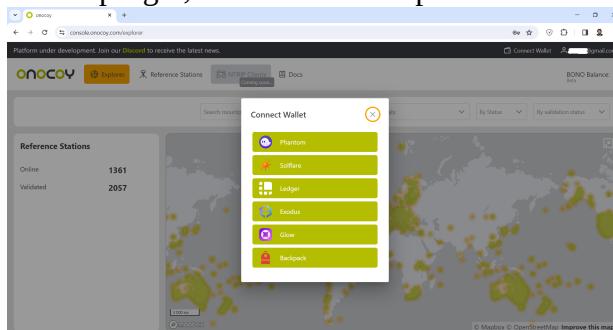


Creating a Wallet

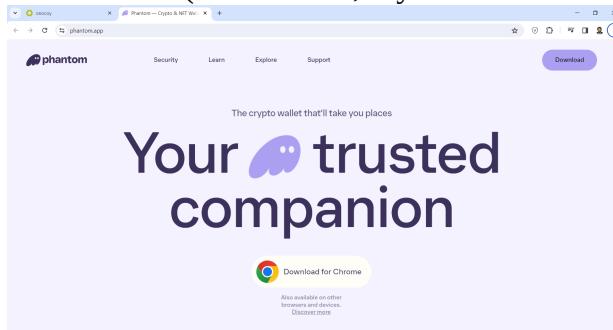
Log in with your username and password.



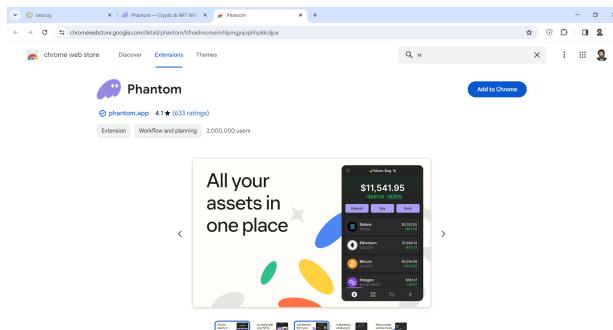
Click “Connect Wallet” at the top right, then select the top wallet — **Phantom**.



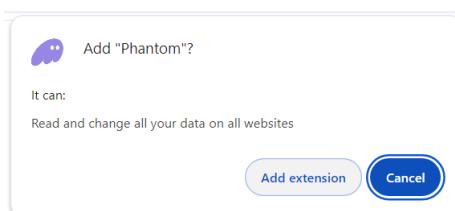
There is a [video](#) on setting up and configuring **Phantom** for **Onocoy**. It is slightly outdated. On this screen, click “Download for Chrome” (or otherwise, if you have a different browser).



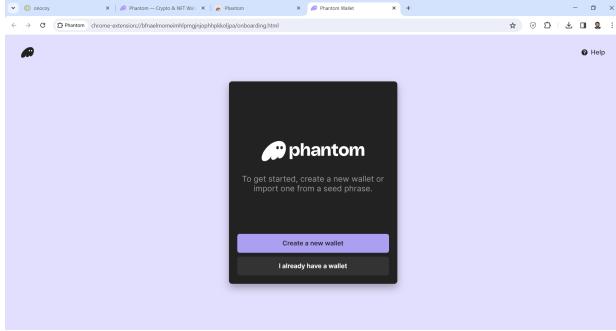
After clicking the button, go to the **Chrome web store** and click “Add to Chrome” to install the extension.



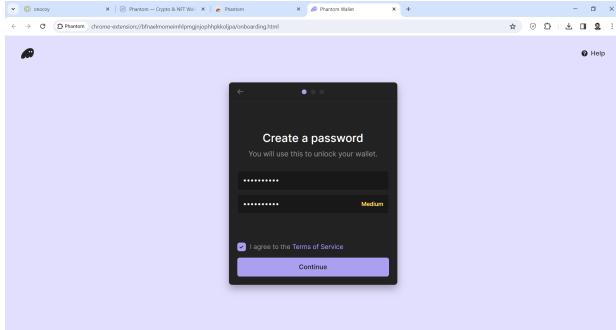
Click “Add Extension”.



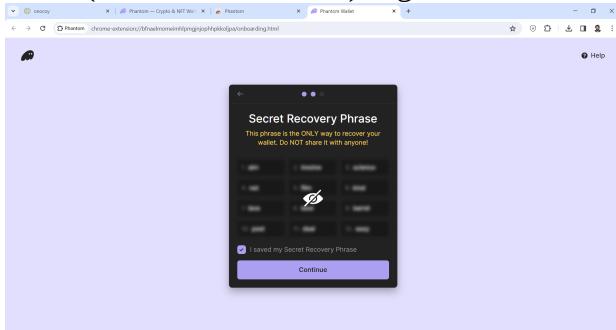
The wallet window opens, where you click “Create a new wallet”.



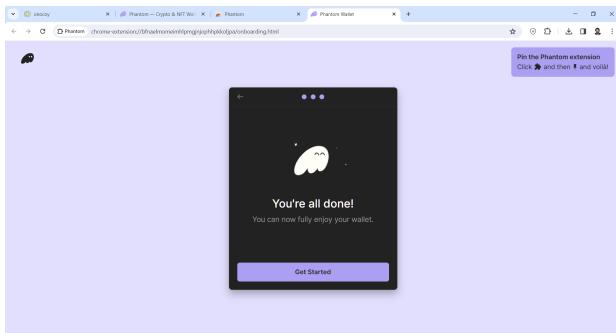
Create and enter a password twice, check the box, and click **Continue**.



Write down the 12 secret words (or take a screenshot). Again, check the box and click **Continue**.

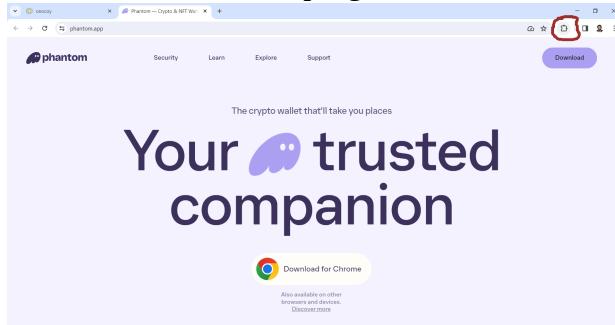


Finally, click “Get Started”.

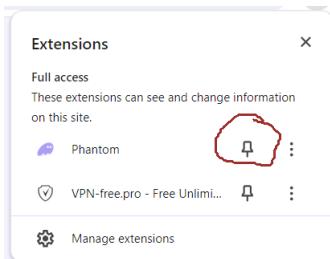


Enabling the Plugin

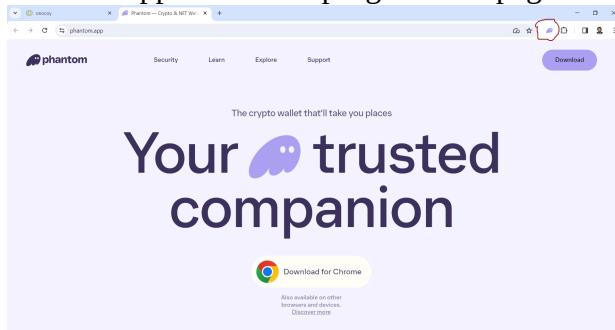
On any page, click the **Extension** button at the top right.



In the dropdown menu, click the button next to **Phantom**.

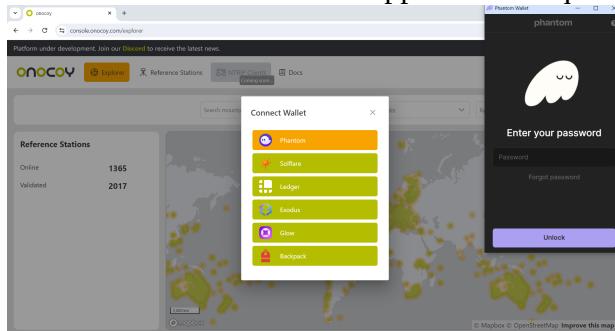


As a result, the **Phantom** icon will appear at the top right of the page.

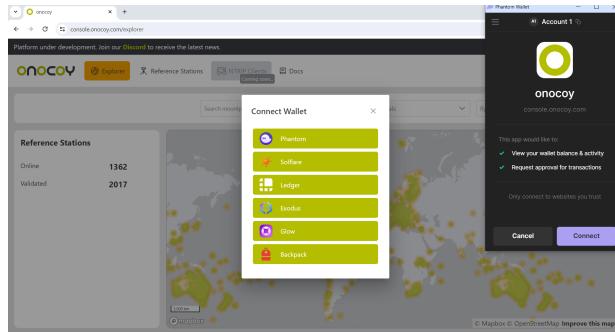


Connecting the Wallet

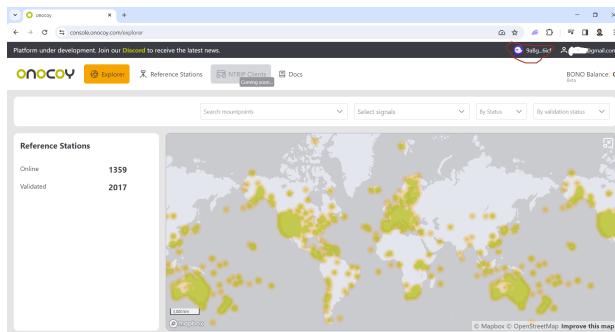
Return to the **Onocoy** page. As described earlier, click “**Connect Wallet**” at the top right, then select the top wallet — **Phantom**. The wallet window appears and requests the password.



Enter the password.

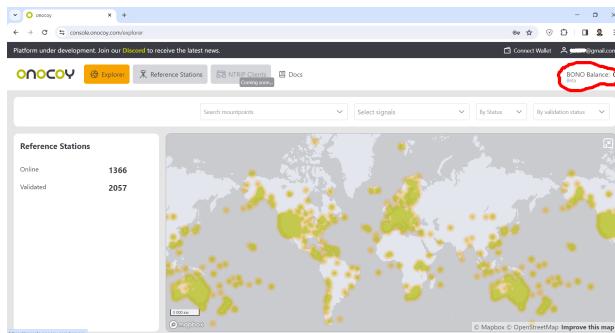


Click **Connect**. The wallet is connected.

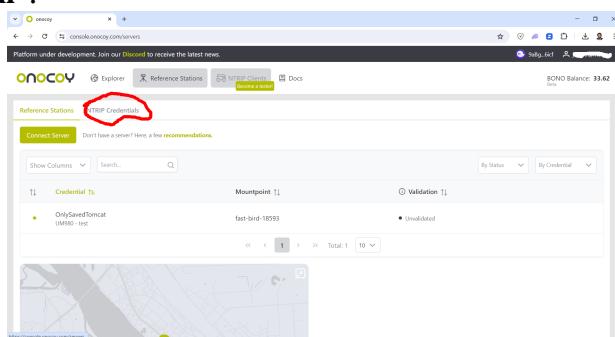


Registering the Wallet

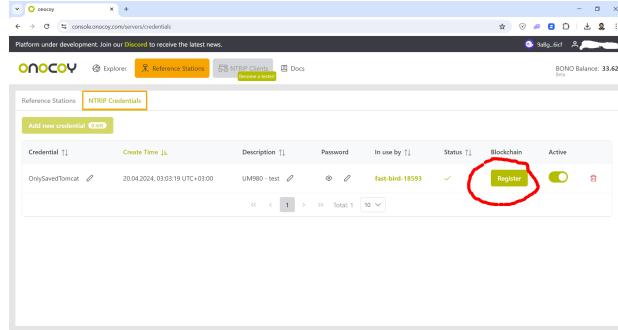
Log in with your username and password. Registering the wallet makes sense only with a positive balance, i.e., after validating your station and starting to earn cryptocurrency. If you decide to register, click “**Reference Station**”.



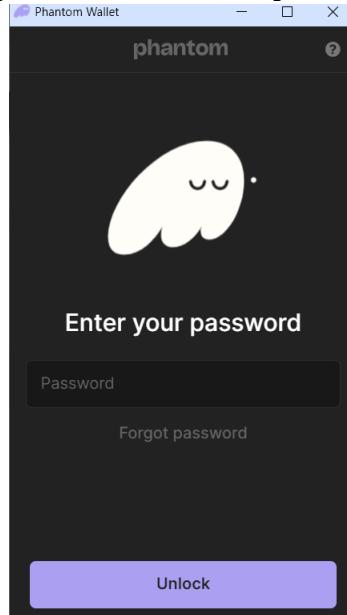
Click “**NTRIP Credential**”.



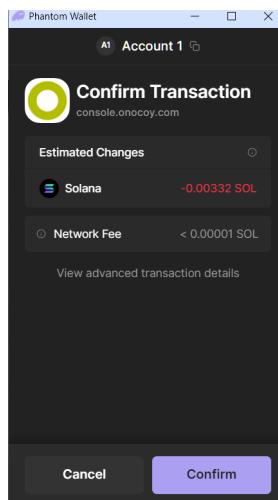
Click Register.



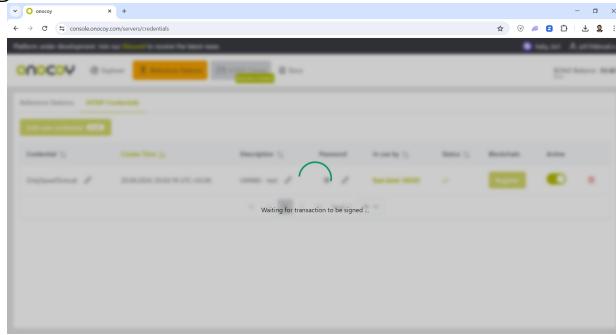
The wallet window pops up, where you need to enter the password and click **Unlock**.



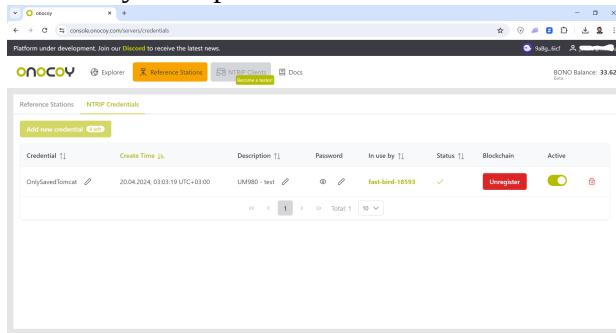
Click Confirm.



The transaction is pending.



After successful registration, the screen looks like this. If the registration was unsuccessful, wait a day or two. This means that the blockchain refuses to make a free transaction, and you have not yet accumulated enough cryptocurrency for a paid one.



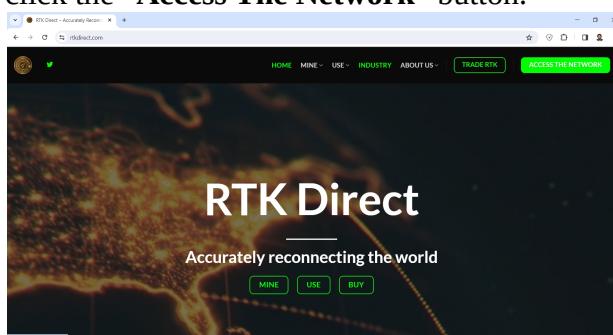
NTRIP Configuration for RtkDirect

<https://rtkdirct.com/> is another service that allows you to earn money using base stations. A brief connection guide is available at <https://rtkdirct.com/buy-a-hotspot/>, and we will provide a brief description for **RtkBase**.

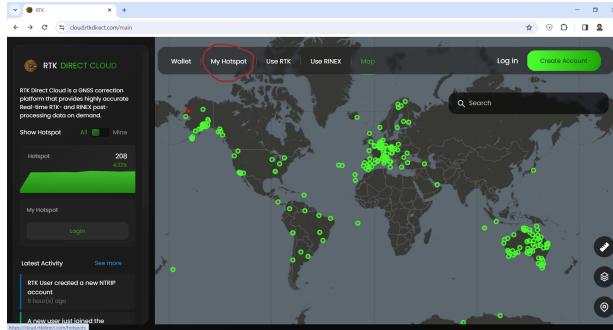
Before connecting to **RtkDirect**, set the precise coordinates of your base as described in "[Determining Coordinates](#)".

Registration

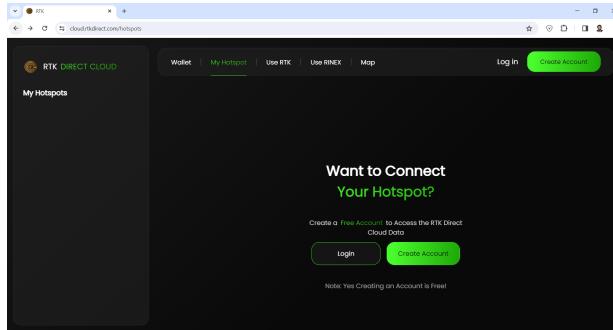
On <https://rtkdirct.com/>, click the “Access The Network” button.



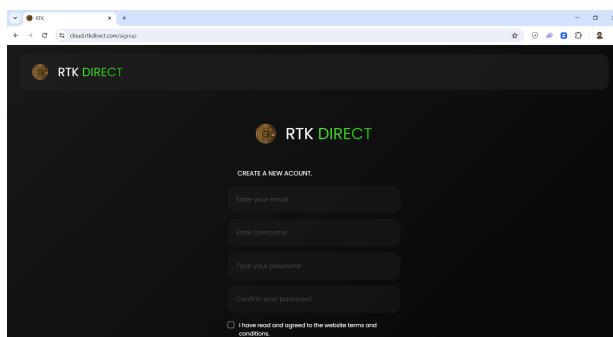
Click “My Hotspot”.



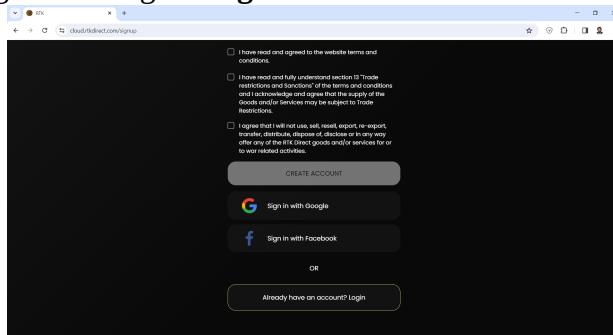
Click “Create Account”.



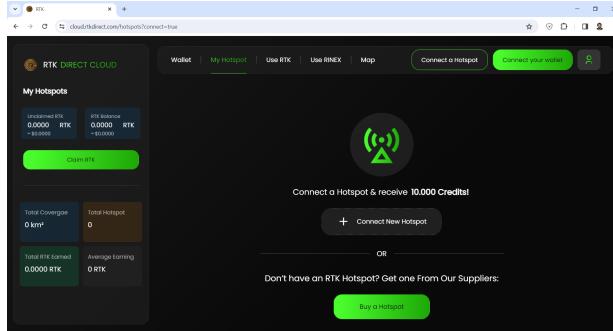
Scroll down.



The simplest way is to register through **Google**.

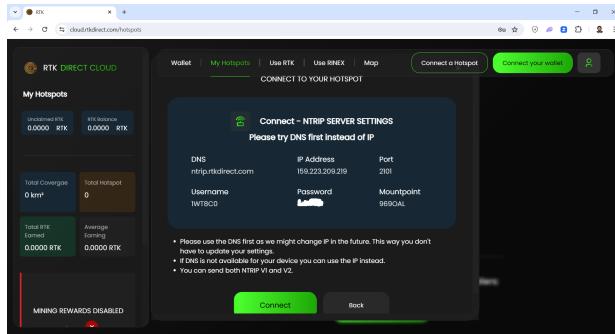


After registration, you can proceed to connect the station. To do this, click “**Connect New Hotspot**”.



Getting Credentials

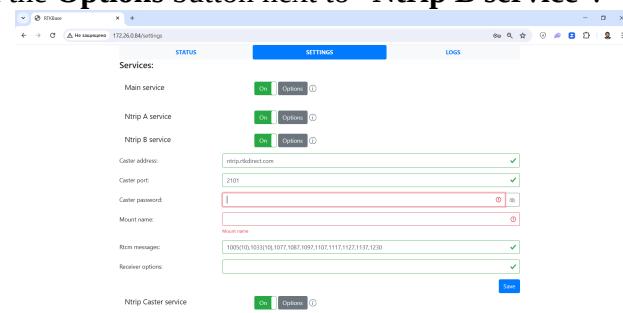
After clicking “**Connect New Hotspot**”, you will receive a login, password, and mount point for entry. The login is used only in the **NTRIP v2** protocol, so we do not need it. Record the mount point and password.



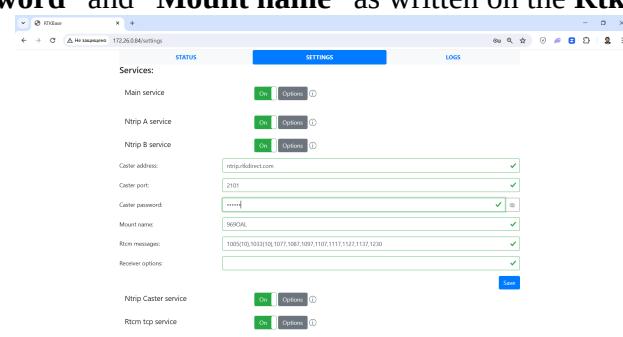
NTRIP Server Setup

NTRIP Server is a mechanism for transmitting data from the base station receiver to a large **NTRIP Caster**, which then distributes (and sells) these data to clients.

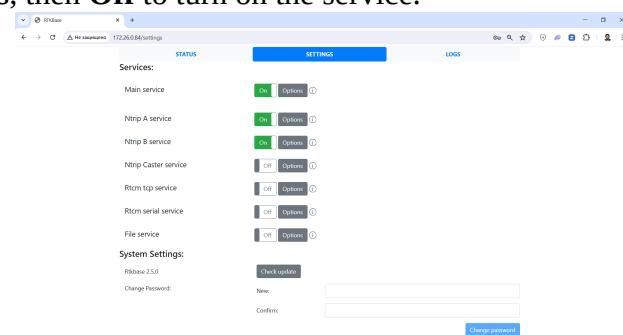
Go to **RtkBase** and click the **Options** button next to “**Ntrip B service**”.



- Enter the “**Caster password**” and “**Mount name**” as written on the **RtkDirect** website

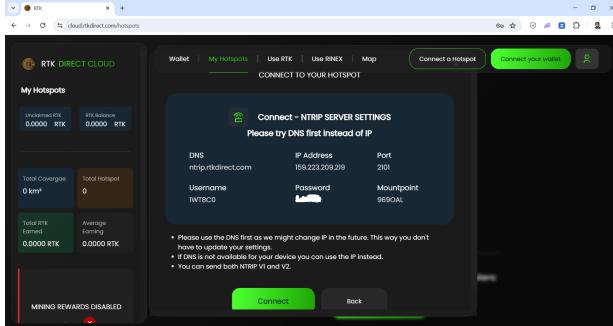


Click **Save**, then **Options**, then **Off** to turn on the service.

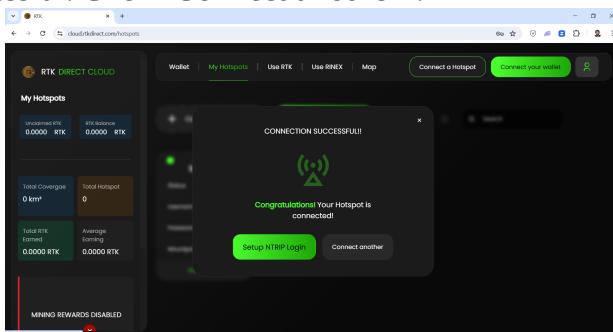


Connection

Now we are ready. Click **Connect** and wait for the connection.

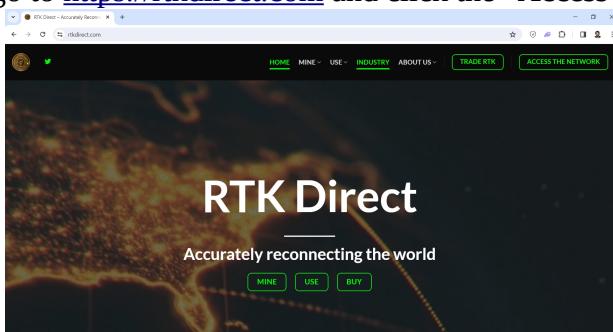


The connection was successful. Click “**Connect another**”.

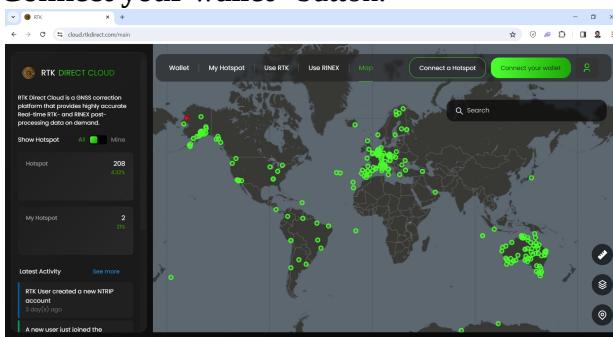


Choosing a Wallet

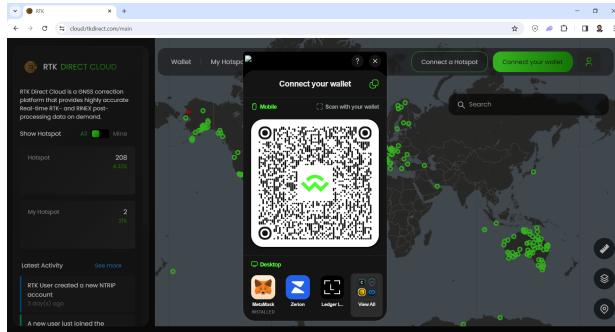
Start from scratch. First, go to <https://rtkdirct.com> and click the “**Access The Network**” button.



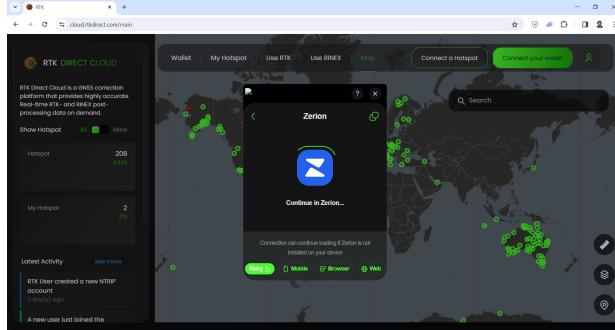
Click the green enticing “**Connect your wallet**” button.



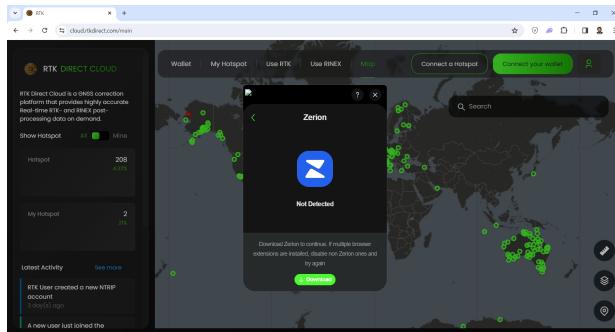
Select the **Zerion** wallet and click on it.



It tries to connect, but we do not have a wallet. Therefore, click the **Browser** button.

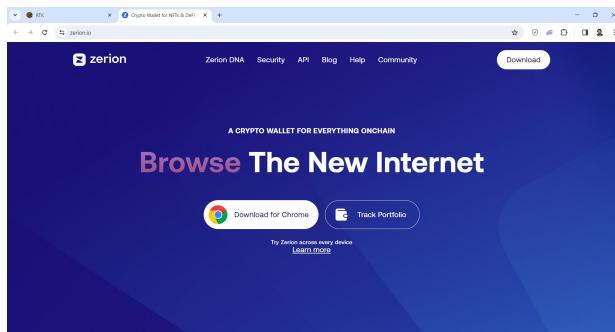


Click **Download**.

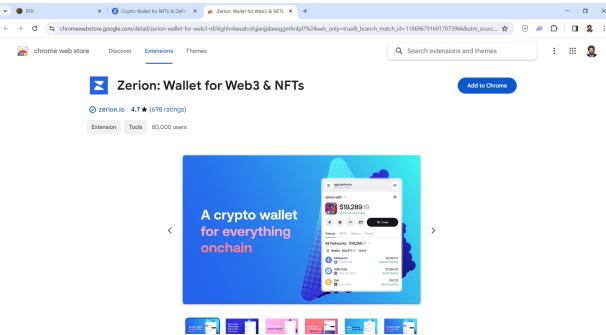


Installing the Wallet

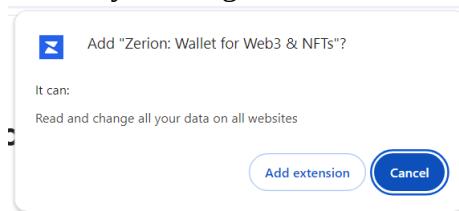
After performing the previous section, go to the **Zerion** wallet installation and click “**Download for Chrome**”.



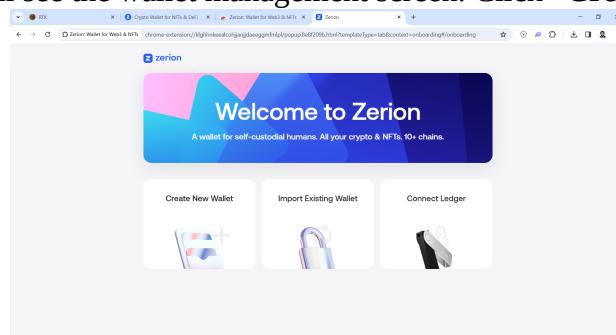
Click “Add to Chrome”.



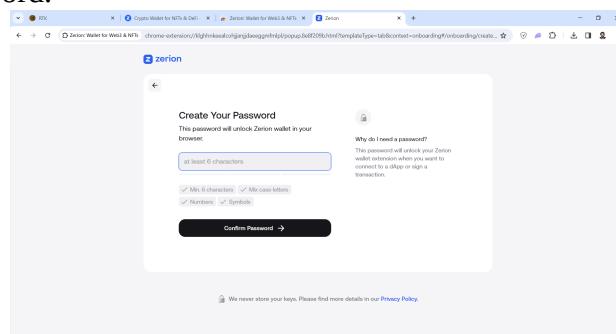
Allow the installation of the extension by clicking “Add Extension”.



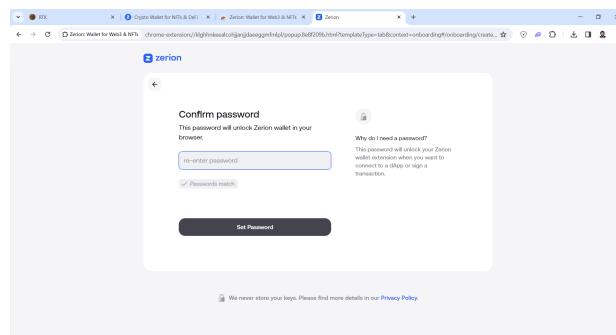
After installation, you will see the wallet management screen. Click “Create New Wallet”.



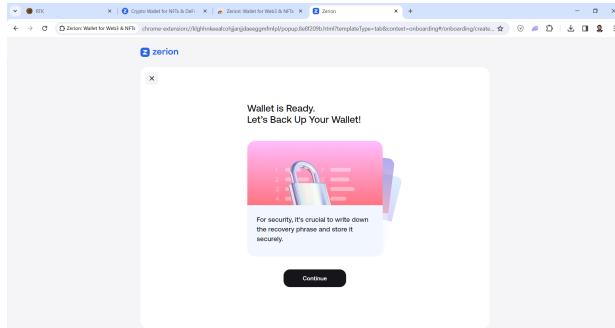
Create and enter a password.



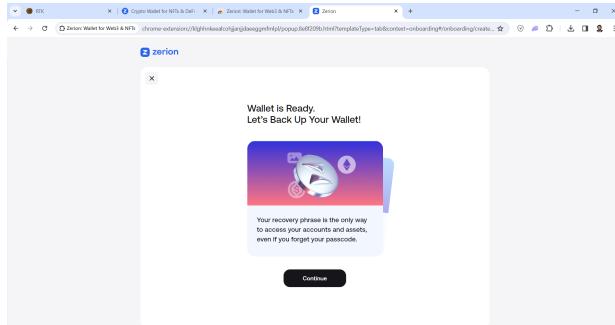
Repeat the password.



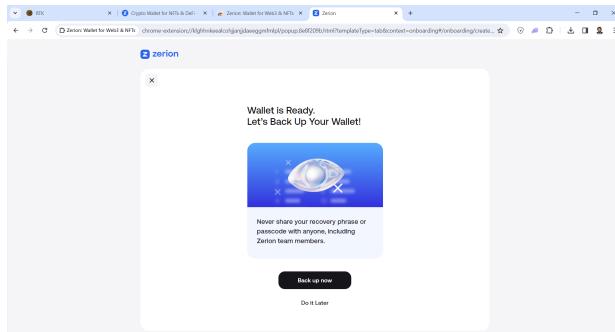
The wallet is created. Click **Continue**.



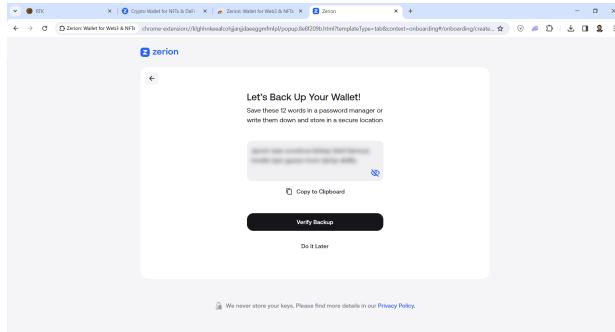
Click **Continue** again.



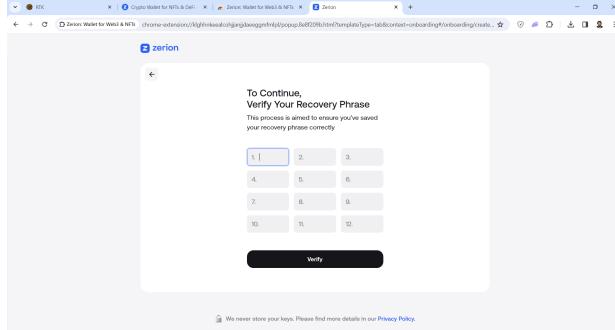
Click “**Back up now**”.



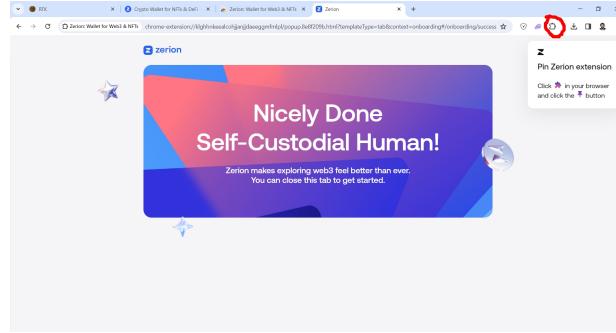
Get a list of 12 words that must be saved. Click “**Copy to clipboard**” and save it to **Notepad**. Click “**Verify Backup**”.



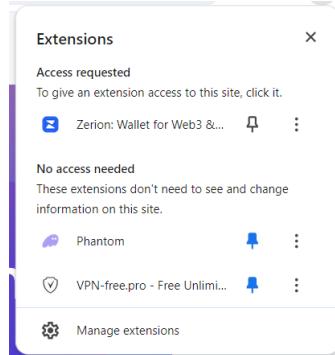
Perform verification by entering all 12 words and clicking **Verify**.



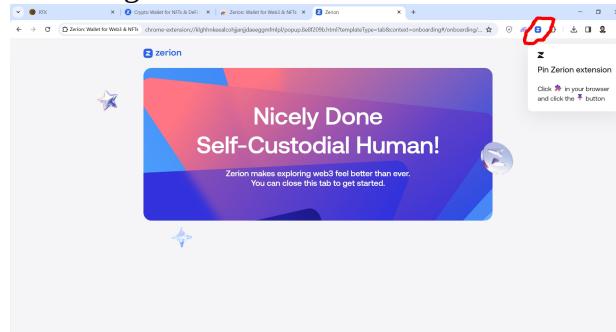
Verification is successful. Click the extension management icon at the top right.



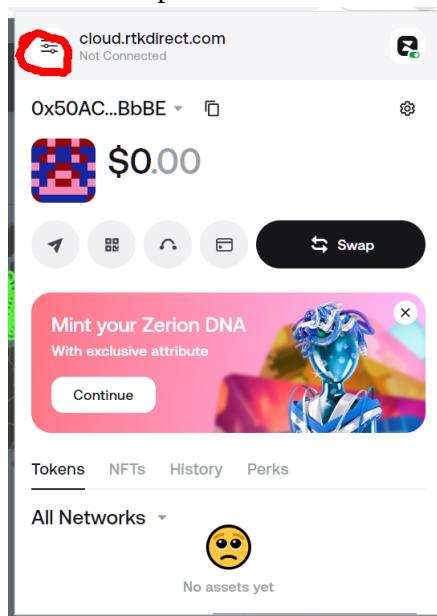
In the extension management window, click the button next to **Zerion**.



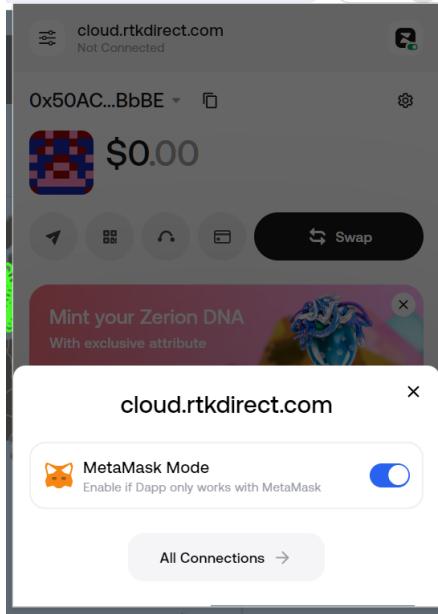
You will see the **Zerion** icon among the extensions.



Click on it to see the settings button in the top left corner.

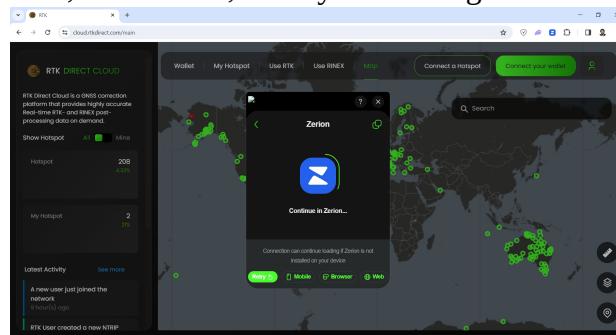


Click the settings button and disable the **MetalMask** mode.

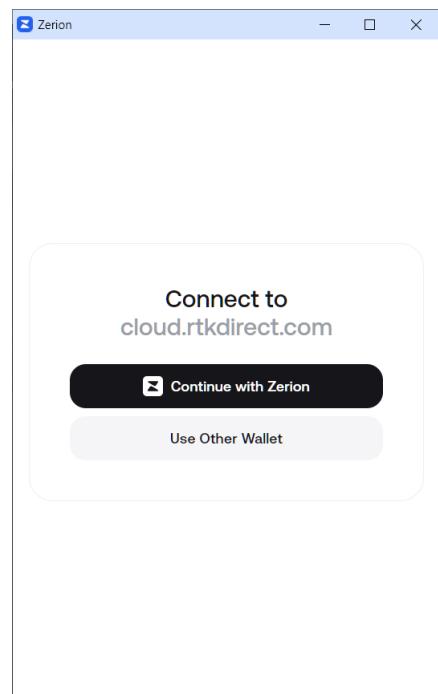


Connecting the Wallet

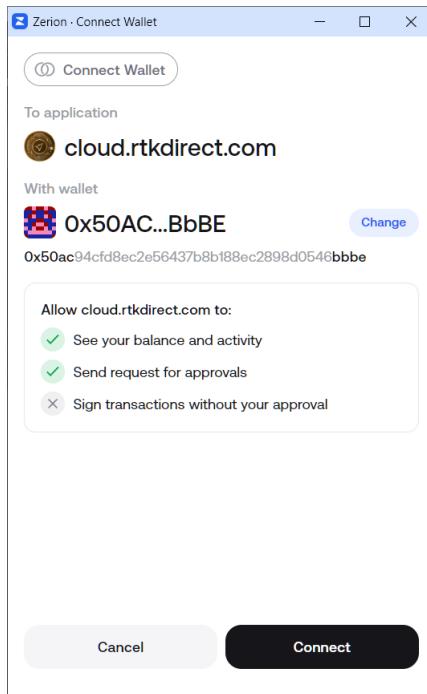
Close the wallet and extra tabs, return back, and try connecting with **Zerion** again.



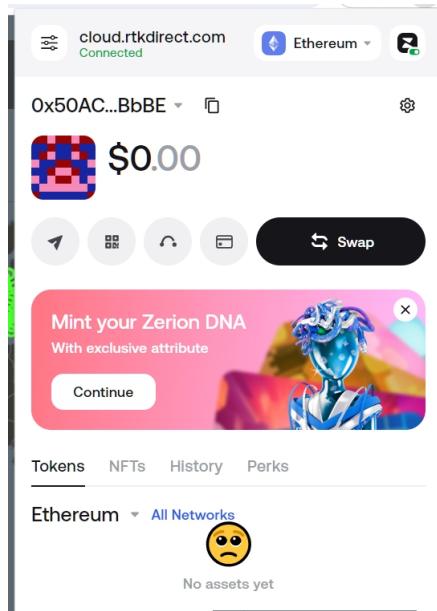
The window pops up, click “**Continue with Zerion**”.



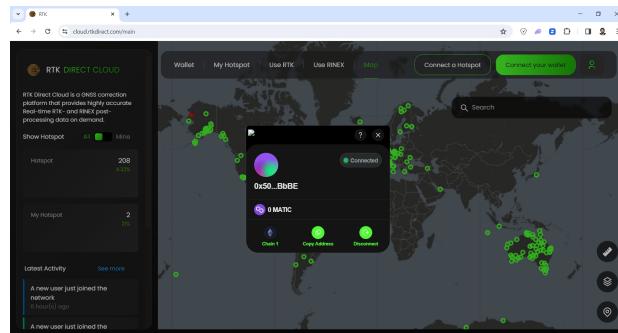
In the next window, click **Connect**.



Check the drop-down wallet window by clicking the extension icon at the top right — the connection is visible.



Click "**Connect your wallet**" — the connection is visible.

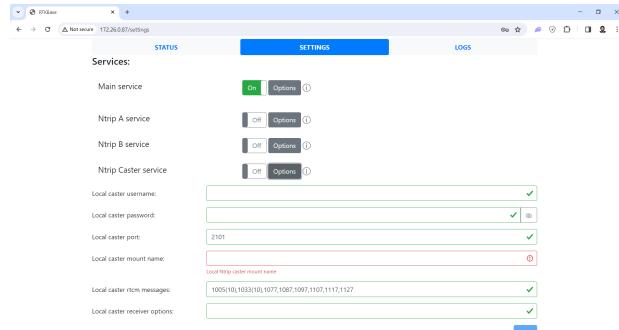


Other

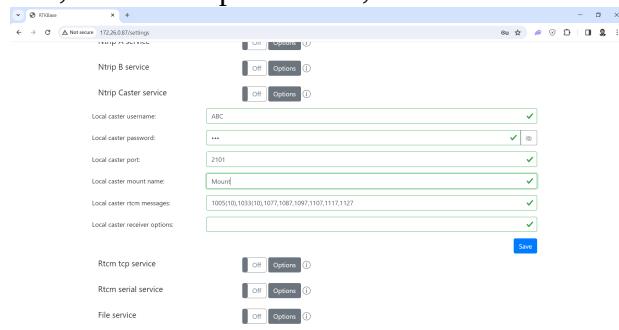
NTRIP Caster Setup

NTRIP Caster is a mechanism for distributing data from the base receiver. Typically, **NTRIP Server** transmits data from the receiver to the **NTRIP Caster**, and the **NTRIP Caster** distributes data from various receivers to several rovers. **RtkBase** has a simple **NTRIP Caster** that allows you to avoid additional (external) **NTRIP Caster**.

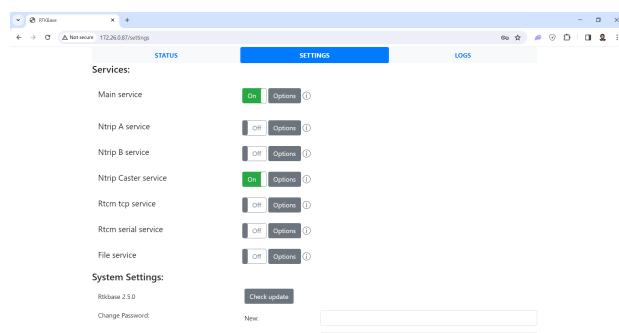
To make **RtkBase** work as an **NTRIP Caster**, go to the **Settings** page and click the **Options** button next to “**Ntrip Caster Service**”.



Enter the username, password, and mount point name, then click **Save**.



After that, close the settings with the **Options** button and turn on the **NTRIP caster** by clicking the **Off** button.



RTCM3 Proposals

In the settings of all services, except for **Main** and **File**, there is a list of transmitted **RTCM3** proposals. After the proposal number, you can specify the period (time in seconds between proposal transmissions) in parentheses. This is especially relevant for the caster.

The **Unicore** receiver transmits the following proposals:

1. Base coordinates: 1005 and 1006
2. Antenna name: 1007 and 1033
3. Ephemerides: 1019 (GPS), 1020 (Glonass), 1042 (Beidou), 1044 (QZSS), 1045 (Galileo FNAV), 1046 (Galileo INAV)
4. Measurements **MSM7**: 1077 (GPS), 1087 (Glonass), 1097 (Galileo), 1107 (SBAS), 1117 (QZSS), 1127 (Beidou), 1137 (IRNSS)

The **Bynav** receiver transmits the following proposals:

1. Base coordinates: 1005 and 1006
2. Antenna name: 1033
3. Ephemerides: 1019 (GPS), 1020 (Glonass), 1042 (Beidou), 1044 (QZSS), 1046 (Galileo INAV), 1048 (IRNSS)
4. Measurements **MSM7**: 1077 (GPS), 1087 (Glonass), 1097 (Galileo), 1107 (SBAS), 1117 (QZSS), 1127 (Beidou), 1137 (IRNSS)
5. Measurement offset information: 1230 (Glonass)

The **Septentrio** receiver transmits the following proposals:

1. Base coordinates: 1005 and 1006
2. Antenna name: 1007 and 1033
3. System Parameters: 1013
4. Ephemerides: 1019 (GPS), 1020 (Glonass), 1042 (Beidou), 1044 (QZSS), 1045 (Galileo FNAV), 1046 (Galileo INAV)
5. Measurements **MSM7**: 1077 (GPS), 1087 (Glonass), 1097 (Galileo), 1107 (SBAS), 1117 (QZSS), 1127 (Beidou), 1137 (IRNSS)
6. Measurement offset information: 1230 (Glonass)

TCP Client Setup

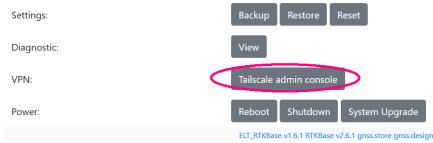
If you write **TCP** in the mount point and password fields in the **NTRIP** service settings (either **A** or **B**), it will connect as a **TCP** client instead of an **NTRIP** client.

Thus, our equipment can act as both a **TCP** Server (see “[Important Requirements](#)”) and a **TCP** client.

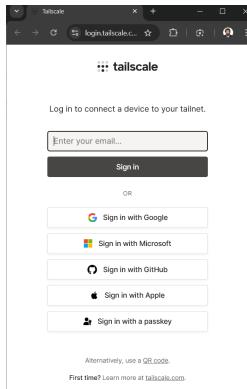
Built-in VPN from Tailscale

Imagine you went on vacation, but you urgently need to fix something in your base settings. For such cases, we have equipped the base with a built-in **VPN** from [Tailscale](#). With this **VPN**, you can access the connected devices as if they were all on the same local network. Tailscale is free for up to [100 devices](#) and has apps for [all operating systems](#), including iPhone and Android smartphones. For more information, visit [tailscale.com](#).

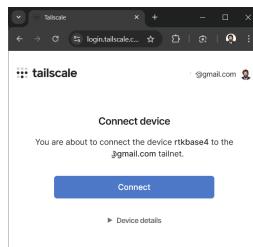
Open the **Settings** page. At the bottom, you will see the “**Tailscale admin console**” button.



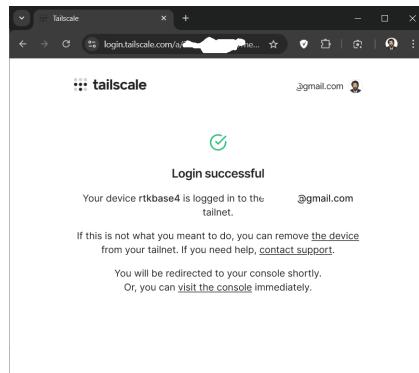
Click it, and you will be taken to the **Tailscale** login screen.



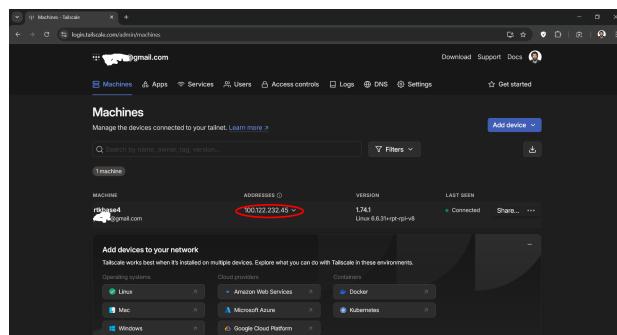
Register with **Tailscale**. You will see a screen with a large “**Connect**” button.



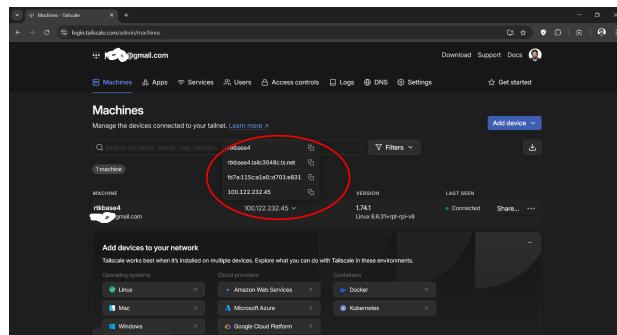
Click it, and you will see messages confirming a successful login.



After a few seconds, you will be directed to the Tailscale admin console.



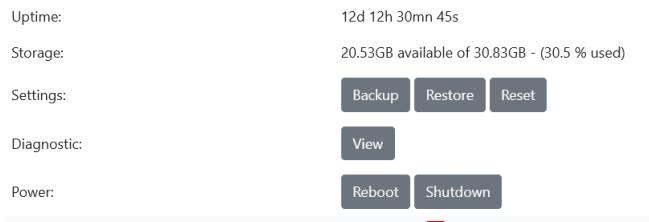
Now, you need to download the client, install it on your laptop or smartphone, and register your device with **Tailscale** in the same way. After that, you will be able to open the web interface of the device in several ways. To view all the device's addresses, click the arrow to the right of its IP address.



Software Update

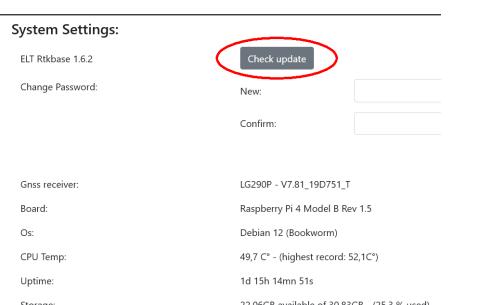
Like any other company, we continuously release new versions. We add functionality, fix bugs, and generally do everything to make life easier and more convenient for our users. There are three methods to install updates: “[Updating Over the Internet](#)”, “[Updating from a File](#)” and “[Updating via SD Card](#)”. Additionally, it is recommended to periodically perform a “[Linux Update](#)”.

To determine the current version number, look at the bottom of any page.

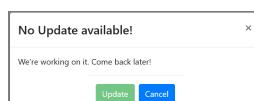


Updating Over the Internet

To check for updates, click the “**Check update**” button.



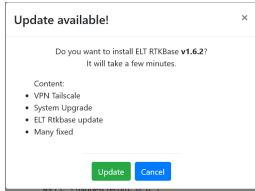
If there are no updates, a window will appear:



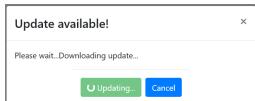
In case of an error, you will see a message like this:



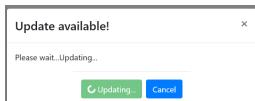
If an update is available, the window will look like this:



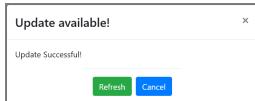
To update, click the “**Update**” button. A message will appear indicating that the update is being downloaded from the website.



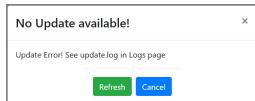
Then, you will see a message about the ongoing update:



Once the update is complete, you will see a message confirming its completion. Next, click the “**Refresh**” button to reload the page.



In case of an error, there will be a different message, after which you should also click the “**Refresh**” button to reload the page.



In this case, go to the **Logs** page, download the update log, and send it to rtkbase@eltehs.com.

STATUS	SETTINGS	LOGS	
File name	type	size (MB)	actions
2024-09-28_03-43-08_UPDATE.log		0.02	(refresh) (log) (trash)

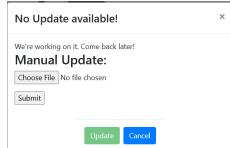
If you have multiple **ELT_RTKBase** units on different **Raspberry Pi** devices, make sure that only one site from one **ELT_RTKBase** is open before starting the update. Verify this by going to the **Status** page to ensure you are not prompted for a password. If you skip this step, it may appear that the update is never completing. In this case, simply refresh the page after 10 minutes. This applies only when using multiple **ELT_RTKBase** units.

Updating from a File

In some situations, you may need to update from a file. For example, a file provided by technical support, a file downloaded from the debug branch on **GitHub**, or if you want to reinstall the current version. A version with an earlier number cannot be installed this way, but a version with the same number can be.

To do this, go to <http://rtkbase.local/settings?update=manual> or navigate to the **Settings** page and add “[update=manual](#)” to the end of the **URL**.

After clicking the “**Check Update**” button, the following form will appear:



Click “**Choose file**”, select the file, and then click the “**Submit**” button. After this, the file will upload, and the update process will begin, as described in the “[Software Update](#)” section.

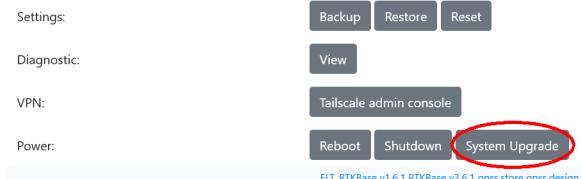
Updating via SD Card

Update the **Raspberry Pi** firmware by inserting the **SD** card into a card reader and copying the **install.sh** file to the root directory of the first (the only one visible, if you have **Windows**) partition of the card. The update occurs at startup and takes 5-10 minutes. This update will **not work** if you installed the system using the **install.sh** file instead of an SD card image (or purchased a pre-configured system from gnss.store). Internet is **required** for the update.

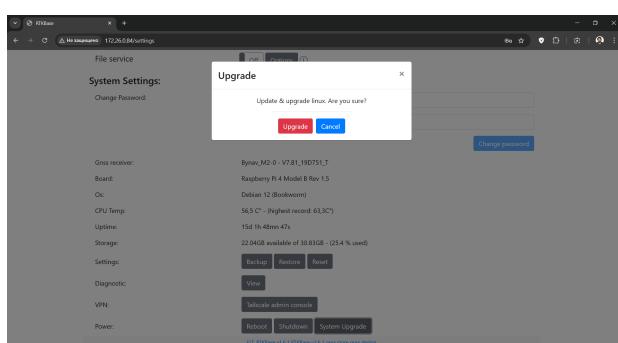
Linux Update

All operating systems occasionally encounter bugs, and these bugs are fixed by updating the system. **Linux** differs in that not only the operating system gets updated, but all installed programs as well. Sometimes, a bug is so critical that it gets covered in the press. In such cases, updating is absolutely necessary. In other situations, you can update once a month or every six months. The update process takes about 3-10 minutes if done monthly or up to an hour if done every six months.

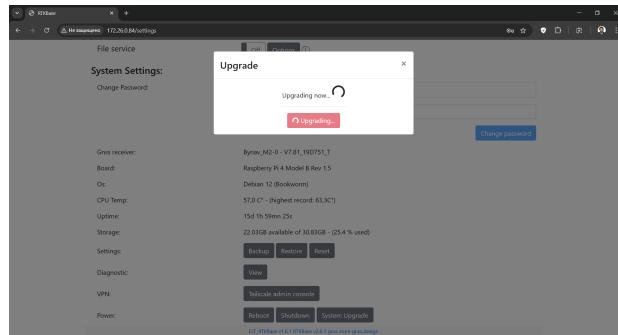
To update, click the “**System Upgrade**” button on the **Settings** page.



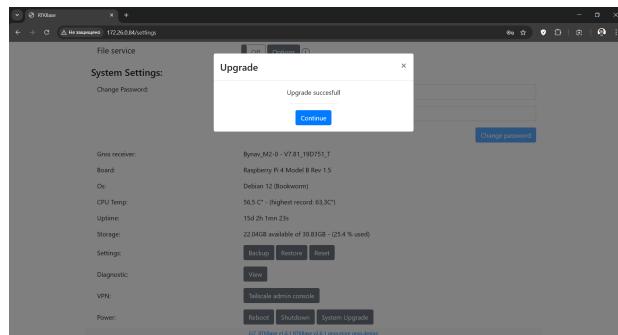
A confirmation window will appear. Click the red **Upgrade** button.



After that, the Linux update process will begin.



Once it's complete, you will see a blue **Continue** button. Click it. This concludes the **Linux** update process. Of course, it is recommended to reboot by pressing the **Reboot** button after the update.



Diagnostics

To diagnose issues, click the “**View**” button.



A diagnostics page will open:

STATUS	SETTINGS	LOGS
active	antrite_top.service : Active	
active	dr2dr_nntp_as.service : Active	
active	dr2dr_nttp_b.service : Active	
inactive	dr2dr_local_nttp_caster.service : Inactive	
inactive	dr2dr_ntcm_svt.service : Active	
inactive	dr2dr_ntcm_svt.service : Inactive	
inactive	dr2dr_file.service : Inactive	
active	ridbase_archive.timer : Active	
inactive	ridbase_archive.service : Inactive	
inactive	ridbase_rawmosaicservice : Inactive	
active	ridbase_greend_web_proxy.service : Active	
active	ridbase_web.service : Active	
active	ridbase_check_internet.service : Active	
inactive	RidbaseSystemConfigure.service : Inactive	

The diagnostics content is intended for advanced users.

Temperature Check

In the web interface on the **Settings** page, you can view both the current temperature and the maximum temperature since the **Raspberry Pi** was powered on.



Troubleshooting

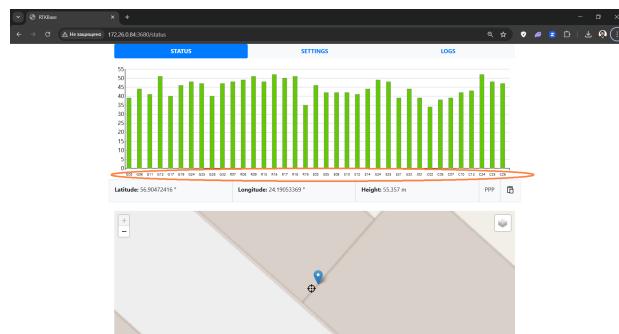
Detecting Issues on the Status Page

To check for issues, go to the **Status** page.

First, look at the names of the received satellites. You should see satellites labeled **G (GPS)**, **R (Glonass)**, **E (Galileo)**, **C (Beidou)**. Additionally, you may see satellites labeled **J (QZSS)**, **I (IRNSS)**, **S (SBAS)**. If you have a **Unicore** receiver and see only **C (Beidou)** satellites, the problem lies in incorrect coordinates (more than 50 meters off from the true coordinates) in the main service settings. In other cases, it is likely due to incorrect receiver settings.

Next, check the number of received satellites. Typically, 40-50 satellites are received, which is more than the 36 visible on the screen. If there are fewer satellites, consider the length and quality of the antenna cable and the correctness of the antenna installation.

Then, look at the signal strength of the received satellites. If most are above 35, and some are above 50, it indicates good reception quality. If not, there may be issues with the length and quality of the antenna cable and its proper connection to the connectors.



Now, let's look at the middle section. If, despite having a good satellite signal, the coordinates remain zero for more than 15 seconds, the issue lies in the receiver settings. In this case, configure the receiver as described in the "[Configuration](#)" section.

Finally, the bottom section with the map. The blue marker represents the current **PPP** solution, while the target represents the coordinates set in the base settings. About an hour after the solution begins, the blue marker should almost stop moving. If the blue marker continues to move significantly after an hour, it indicates multipath reception. This means the antenna is receiving not only direct signals from the satellites but also reflected ones. To correct this, it is recommended to use a **groundplane**, as described in [our blog](#).

No Connection with Onocoy

For **Onocoy**, in the **NTRIP Server** settings, the "**Mount name**" field should contain the **Credential** name, not the **mountpoint** name.

Onocoy initially assigns a temporary **mountpoint** name and later changes it to one that includes the country and city of your station. If you relocate the base station to another city, the **mountpoint** name will change again.

Therefore, identification is done by the **Credential**, not the **mountpoint** name.

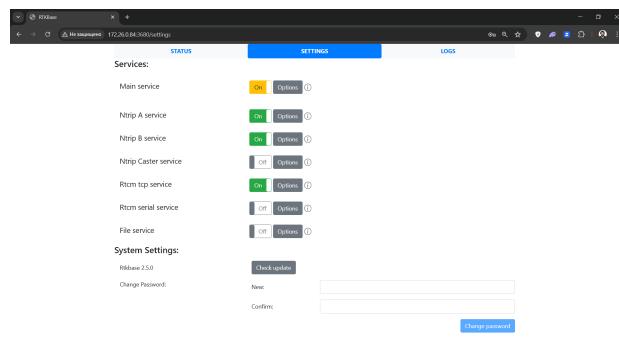
Receiver Problem Resolution

To check the connection with the receiver, perform detection as described in the “[Detection](#)” section. If the receiver is not detected the first time, it makes sense to repeat the operation. If the receiver is not detected twice in a row, it means the program has no connection with the **GNSS** receiver, the receiver is not operational, or it is not powered.

The only method to resolve receiver issues is configuration, as described in the “[Configuration](#)” section. If the configuration fails, perform detection (since configuration resets the receiver speed) and repeat the configuration.

Service Statuses

The service status can be blue, green, yellow, or red. Blue means “the service is in the process of starting up”, green means “everything is fine”, yellow means “the service is running with errors”, and red means “the service is not running”.



The main reason for a yellow status is parameter errors. For “**main service**”, there are several common reasons for a yellow status:

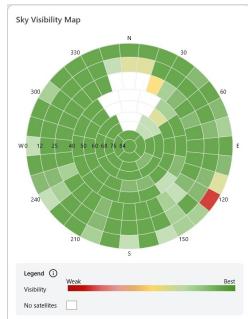
- A speed other than the allowed **115200:8:n:1, 230400:8:n:1, 460800:8:n:1, 921600:8:n:1**.
- Coordinates more than 50 meters off from the true coordinates (only for **Unicore** receivers).
- Very rarely: receiver errors when changing speed or setting coordinates.

A yellow status for **NTRIP** servers indicates a lack of connection with the **NTRIP** caster. In this case, the reason is displayed to the right of the status icon.

If you find an error in the settings, correct it and save the settings. The status should correct itself within a minute. If it is due to rare receiver errors, wait 5 minutes; they usually resolve on their own.

Northern Gap

Users often ask about the “gap in the north”. This refers to an image like this:



The orbital inclination of **GPS** and **Beidou** satellites is 55 degrees, **Galileo** is 56 degrees, and **GLONASS** is 64.8 degrees. This means that if you are at a latitude greater than the orbital inclination, you will never see these satellites on the northern side of the sky in the northern hemisphere and on the southern side in the southern hemisphere. To check satellite visibility, you can use the [GNSS Mission Planning](#) website.

What about satellites at the far north? From this side, you can receive satellites that fly in a geosynchronous “[Tundra](#)” orbit (also known as **IGSO**). This includes some **QZSS**, **IRNSS**, and **Beidou** satellites. Good animations of this orbit can be found on [Wikipedia](#). The apogee of such an orbit is more than three Earth diameters, so at distant points in the orbit, satellites are visible not only on the side of the Earth they face but also on the northern side of the opposite part of Earth, though at a very low angle.

Antenna Relocation

If you plan to relocate the antenna and are using a **Unicore UM980** or **UM982** receiver, you must set the coordinates to “**0.00 0.00 0.00**” before moving it. If you skip this step, nothing will work until you reconfigure the receiver as described in the “[Configuration](#)” section. The reason is that if the coordinates calculated by the receiver differ from the entered coordinates by more than 50 meters, the receiver stops functioning and generates significant error messages.

Customize web service port

The **RTKBase** web server runs on port **80** by default. If you want to use other applications (e.g. Wingbits) in parallel with **RTKBase** that already use port **80**, you can adjust this as follows:

Open **settings.conf**:

```
sudo nano /usr/local/rtkbase/rtkbase/settings.conf
```

Change the **web_port=80** parameter at the beginning of the file. For example, to **8080**, save the file and restart the web service with:

```
sudo systemctl restart rtkbase_web.service
```

The web server can then be reached under the new port.

Bug reports

Send bug reports to info@gnss.store. Try to describe both the error manifestation and the history leading up to it as detailed as possible.