RTRef System

Provide network RTK Services in a few simple steps

What is RTRef ?

RTRef is a software system to provide GNSS network corrections for accurate positioning. The system includes a web-based interface for easy configuration of the system, for authorizing end-users, and for monitoring its performance. A network RTK service can be configured in a few short minutes. The system was first introduced at the GNSS+ ION 2013 conference in Nashville and the paper is available at https://www.ion.org/gnss/pdf.cfm?fid=2310 .

Who may be interested?

Companies that want to provide network corrections, network operators, government agencies and GNSS receiver manufacturers all may find that RTRef is an attractive new and easy way to offer network RTK services.

What about reference stations?

The customer must have access to real-time reference station data. These data can be from private networks or from publicly available data streams. In principle all dual frequency GPS or GPS & Glonass reference station receivers can be supported – for new data types new decoders may have to be added. Station spacing should be < 150 km.

How much does it cost?

There are two options. (1) The software is installed in the cloud or at the customer and maintained for free and GPS Solutions receives a percentage of end-user charges. (2) Customer purchases the software (price depends on how many reference stations are run) and GPSS installs it remotely on customer computers. A yearly maintenance fee applies in this case. The advantage of (1) is that there are no upfront costs – it is possible to provide a service without software purchase or much training. Another advantage - since the cost is a percentage of end user fees, the cost adapts to differing rates in different parts of the world.

Can the service be tested for free?

Yes – please contact GPSS and we will send you a URL, user name and password to set up your test network on GPSS computers or on cloud computers.

How does it work?

The following pages provide a brief introduction how a user can configure a service. In addition a 3-part video tutorial is available at:

part1: https://www.youtube.com/watch?v=ojVMioYLaqs
part2: https://www.youtube.com/watch?v=re01H33nKrk
part3: https://www.youtube.com/watch?v=m7IA1lisywA

RTRef User Guide – Quick Overview

Setting up a network RTK service in a few simple steps

Step 1 – Go to web site
- Contact GPSS (barronj@gps-solutions.com) to obtain URL / User ID / Password
- Log on to system

Step 2 – Enter reference station information
- Station Name:
- Station coordinate X / Y / Z [meters]:
- Antenna Offset: North East Height [meters]:
- Antenna Type / Dome:
- Data Source: Host / Port:
- Data connection (TCP or Ntrip):
- Data Format:

Step 3 - Define your network(s)
- Name your network(s)
- Select which stations are part of which network (graphic selection)
- Define the area for which this network shall provide corrections (draw on map)

Step 4 – Define Mount Points
Here you define mount points that end users can connect to and get corrections from. Mount points can be defined for the following:
- Network RTK or DGNSS (DGPS) corrections
- Single station correction (for traditional baseline RTK)

Step 5 – Enter end-customer information
- Enter customer's information and level of authorization:
  - Which mount point can customer access and corresponding password
  - For what period can customer access the mount point(s)
  - How many simultaneous connection are allowed for this customer

Step 6 – Set up alarms and notifications
Configure what conditions should trigger notifications of anomalous behavior and who should receive emails or text messages.

Ready to start the service …..
Now you can start your networks and authorized customers can receive corrections. You can monitor the processing of your networks and you can monitor end user activities. All information that you entered has been stored in a database. All information about customer activities is logged to a database and can be extracted for troubleshooting, invoicing, and end-user support.
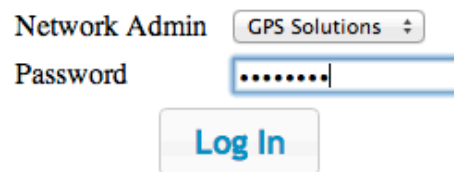
RTRef User Guide – Step 1

Go to RTRef Web Site

Contact GPS Solutions and tell us what you want to do: test service, how many stations, etc. We will set up a user area for you and email you the required information to log onto the system. This process has not (yet) been automated because tests will be run on computers at our office in Boulder and we need to avoid overloading the system.

Figure 1 Example log on to RTRef Manager for user GPS Solutions

If the test network is far from Boulder it may be required to set up a processing computer in the cloud closer to the reference network to reduce latency.

We recommend use of the "Google Chrome" browser.

RTRef User Guide – Step 2

Enter reference station information

In this step the required information to start streaming and processing data from the reference network has to be entered. We recommend that the user collects the relevant information for all station in the reference network. To avoid coordinate errors it is also recommended that X / Y / Z coordinates are cut and pasted.

Figure 2 Example page for entering information for station AZU1

To enter a new station click ADD at the left bottom of the window. Then enter that station name and the associated information. Also enter the sampling rate (if you want to process at a lower rate than the data is streamed), and if quarter cycle slips should be applied (needed for some receivers).

Select the correct antenna model and dome type from a menu – if your antenna is not offered please inform GPS Solutions so that we can add your antenna type.

Enter Cartesian X Y Z coordinates in meters (geodetic coordinates will be computed) and the antenna reference point (ARP) offset relative to those coordinates.

Select the data connection type (TCP or Ntrip) / Host computer / Port number and data format. In case of Ntrip you will also be asked for a mount point, authentication type, user ID, and password.

RTRef User Guide – Step 3

Define your network(s)

Once the required station information has been entered the station will appear on the map. Under the "Networks" tab multiple stations can be selected to define one or more networks.
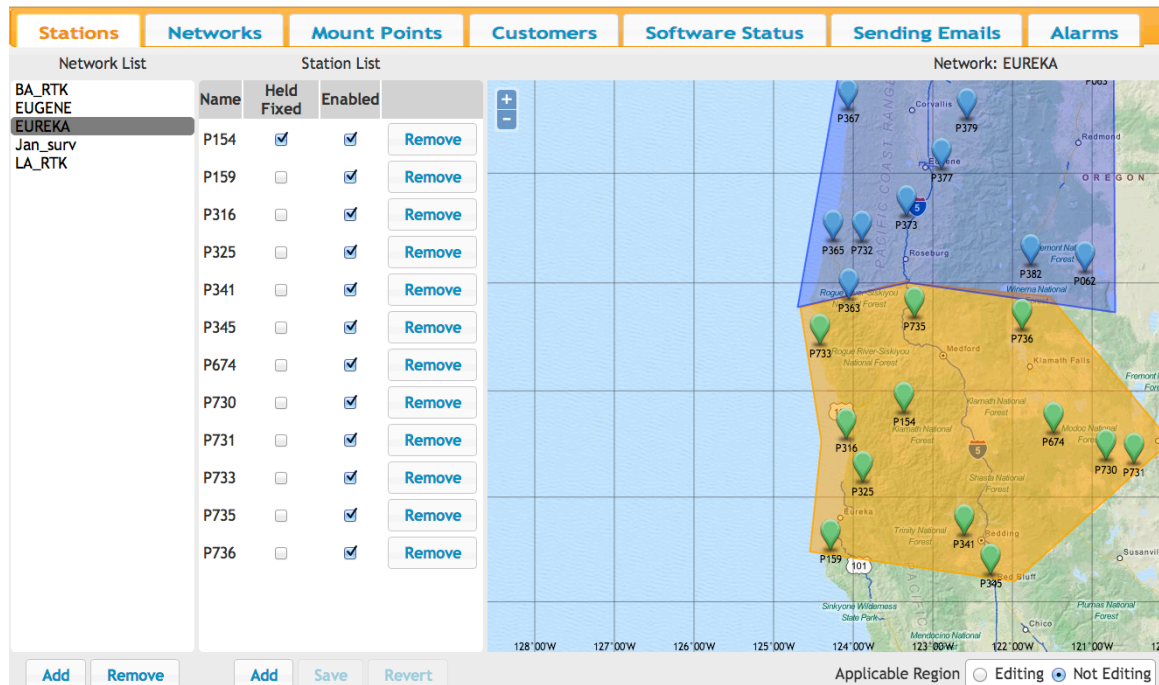

Figure 3 Example window for defining the network "Eureka" on the US West coast.

Start by clicking ADD at the left bottom of the window and entering the network name. To select stations belonging to this network double click on stations in the map. Stations coordinates can be held fixed (recommended only if station is known at the mm-level and stable). At least one station should be held fixed (as shown in the example above – all other stations will be estimated relative to that station in the GNSS ITRF reference from. It is recommended that the fixed station is providing a highly reliable data stream. Unreliable or troublesome stations can be disabled (by unchecking the "Enabled" box or the can be removed from the network.
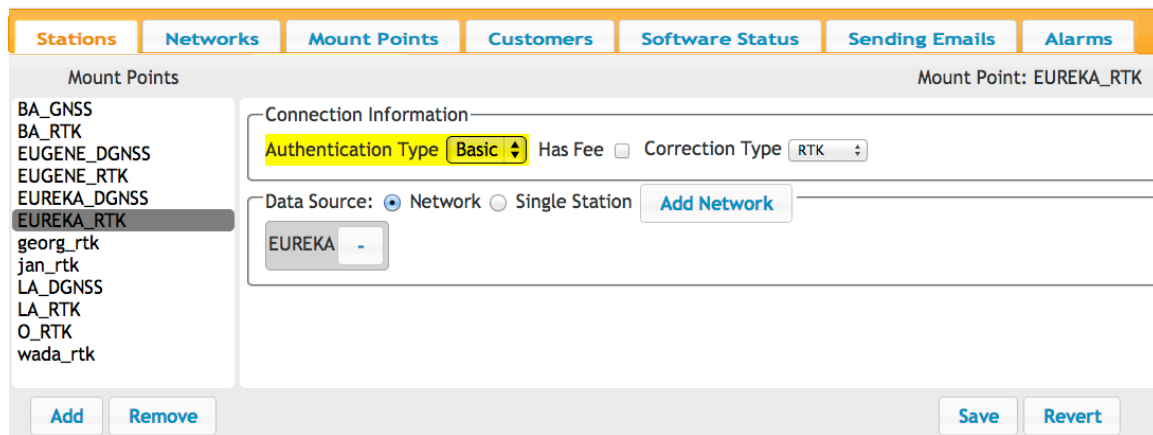
Once the network has been selected one can optionally draw a box for the "Applicable region". To do this, enable "Editing" of the applicable region and use the mouse to draw a polygon. When satisfied with the region, return to "Not Editing". The Applicable region has two benefits: (a) A user too far from the network will not get corrections and (b) large networks can be subdivided into sub-networks to reduce computing time. End users will automatically receive corrections from the appropriate network based on their locations.

RTRef User Guide – Step 4

Define Mount Points

 Users of the RTRef corrections will be given access to different mount points from where to receive corrections. These mount points can be defined when selecting the "Mount Points" tab.

RTRef Manager: GPS Solutions

Figure 4 Example window for defining Mount Points.

To define a new Mount Point start by clicking ADD at the bottom left corner. Name your mount points. For example a mount point to provide RTK corrections in the EUREKA network could be named "EUREKA_RTK".

Once a mount point has been named, one has to assign the desired attributes to it. Most importantly select the network (or multiple networks) that are used to generate the available corrections. The select they type of corrections (RTK or DGNSS). It is possible to generate these corrections based on a network solution (select "Network" as Data Source, or from the nearest single station with the selection of "Single Station".

Finally select if access to this mount point will require authentication and if a Fee shall be charged or not. For a government provided public service it may be desirable to require authentication (user must have a password) but the mount point will be listed as "no Fee".

RTNet User Guide – Step 5

Enter end-user (customer) information

The network operator / service provider can add customers that are authorized to use the corrections. To do this, go to the "Customers" tab.
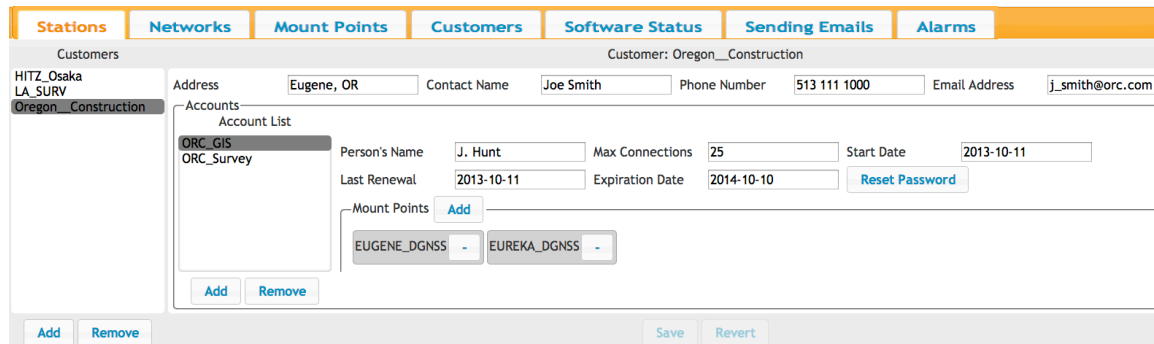
RTRef Manager: GPS Solutions

Figure 5 Example panel to add end-users and customers

Go the "Customers" tab to add users in the field that can use the corrections from the RTRef system. Go to the lower left corner and click "Add" to add a new customer. Enter the customer name. Then add general customer information.

The Accounts section defines details of the level of customer authorization. One customer can have multiple accounts. In the example above the customer "Oregon_Construction" has two accounts: 1 OCS_GSI which allows the user up to 25 simultaneous connections to the (previously defined) mount points EUGENE_DGNSS and EUREKA_DGNSS. The period of authorized use is for one year and the password has been set.

RTRef User Guide – Step 6

Notifications and Alarm

To receive notifications of anomalous behavior of the network processing the network operator can configure what triggers messages, the contents of these messages and who should receive these messages.

Figure 6 This panel configures the recipients of messages.

Figure 7 This panel configures the anomalies and corresponding messages of which the operator (and customers) shall be informed.

RTNet User Guide: Operations

Starting the Network Runs

After the networks have been defined (Step 3) the network processing can be started. Mount points and customers can always be added and changed at a later time.
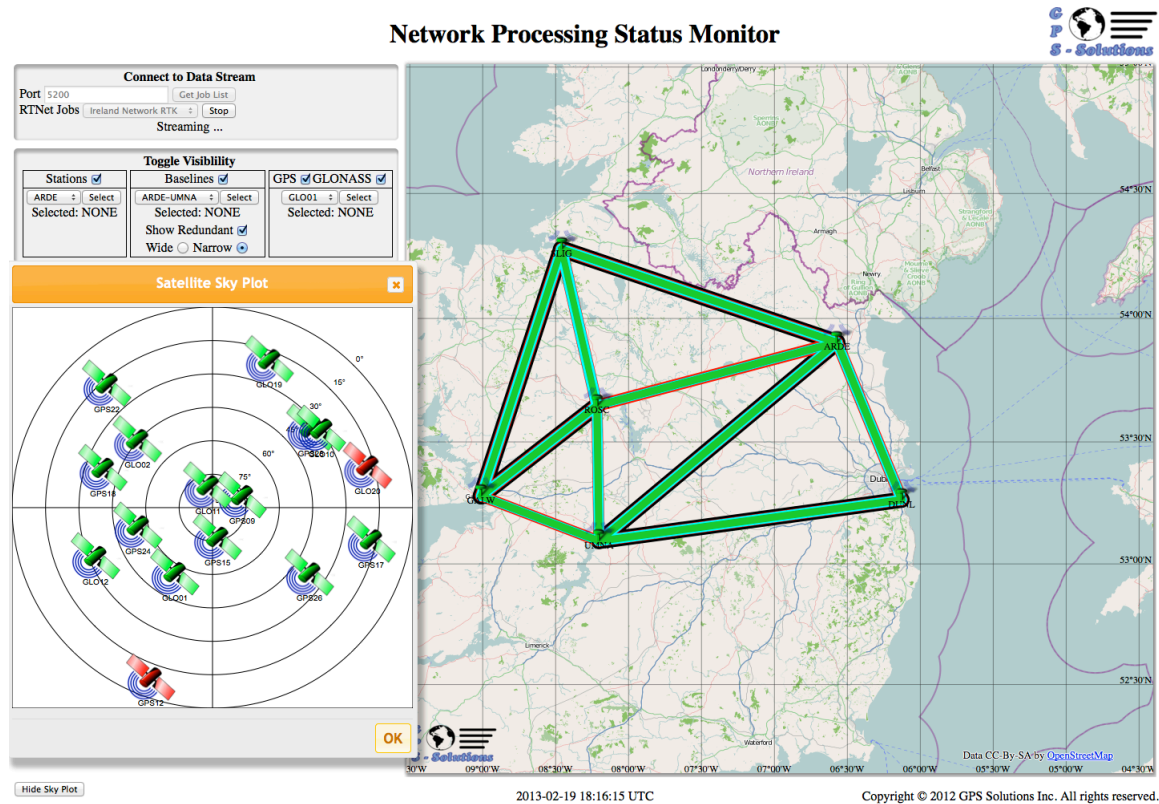

Figure 8 Example panel for starting and stopping

For starting network runs and for monitoring the status of network runs and customer activity select "Software Status". Under "Network Processing" select the network that you want to start (or stop). When a network is started the station will be added to the "Streaming Stations" and the network run will start. You can check the "Streaming Stations" pull-down menu to see which stations are streaming data at present. Assuming that "Network Status Streaming" is "Running" you can check the status of your run under "See Status" (explained below). If the Ntrip Caster is running to communicate with end-user clients you can monitor that activity by inspecting General logs or Client Logs in the bottom panel.

RTRef User Guide: Monitoring Runs

Keeping an eye on network processing

To check on the status of the network run click "See Status" under the "Software Status" tab.

Figure 9 Example software status monitoring page.

The software status monitoring displays baselines that presently processed and they ambiguity resolution status. It also shows satellite sky maps and station data latency statistics. Two tutorials about the use of this status monitoring tool can be found at:
http://www.youtube.com/watch?v=8R5nbujetH4
http://www.youtube.com/watch?v=pdBOp87cdzU