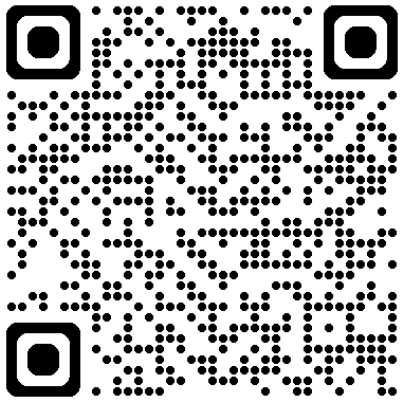

# APRS, EMERGENCY COMMUNICATIONS AND NET CENTRAL

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v1.20

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# OVERVIEW

APRS and EmComm

What is missing?

Filling the gap

Moving forward

# APRS AND EMERGENCY COMMUNICATIONS

**APRS is a key technology for providing EmComm uses:**

- Sending small tactical emergency messages
- Tracking location of resources
- Providing situational awareness of weather and natural environment
- Enabling information sharing in low-cost, open format
- Modeling real-life objects for status and location reporting

# CURRENT DEFICIENCIES

**APRS has not been exploited to its full capabilities**

- Lacks focus-built tools for enabling emergency communications
- **Many rely upon internet-based solutions that may not be available in emergency situations such as remote or internet-free areas.**

Example: ARES teams and others create “nets” that do not go beyond sending a “check-in” message, creating dependencies on tools like APRS-IS, ANSRVR and web sites such as APRS.FI.

# WHAT IS NEEDED?

**To fully exploit APRS in EmComm settings, a new tool must:**

- Enable the management of “nets”
  - Who is participating, from where and how
  - Share information and messages easily within the net
- Support operations and situational awareness in challenging environments primarily with ***internet being optional***
- Identify and report on local infrastructure supporting the radio landscape
- Identify and report on natural world (weather, physical items)

# NET CENTRAL – CREATED FOR SUCH A NEED

**Net Central allows you to:**

- Create a “net” accessible via APRS over its own callsign
  - Example: NEAPRS-1
- Monitor participation through operator check-in/check-out
- Send group messages between net participants
- Ask questions and receive answers from net participants
- Gain situational awareness of net participants

- Simplified commands for radio text input along with web-based application make nets easy!

# NET CENTRAL – CREATED FOR SUCH A NEED

**Additionally, Net Central enhances situational awareness:**

- Identify and report on radio infrastructure
  - iGates, Repeaters, Winlink and Digipeaters
- Gather information from local weather stations
- Visualize participants and infrastructure locations on maps

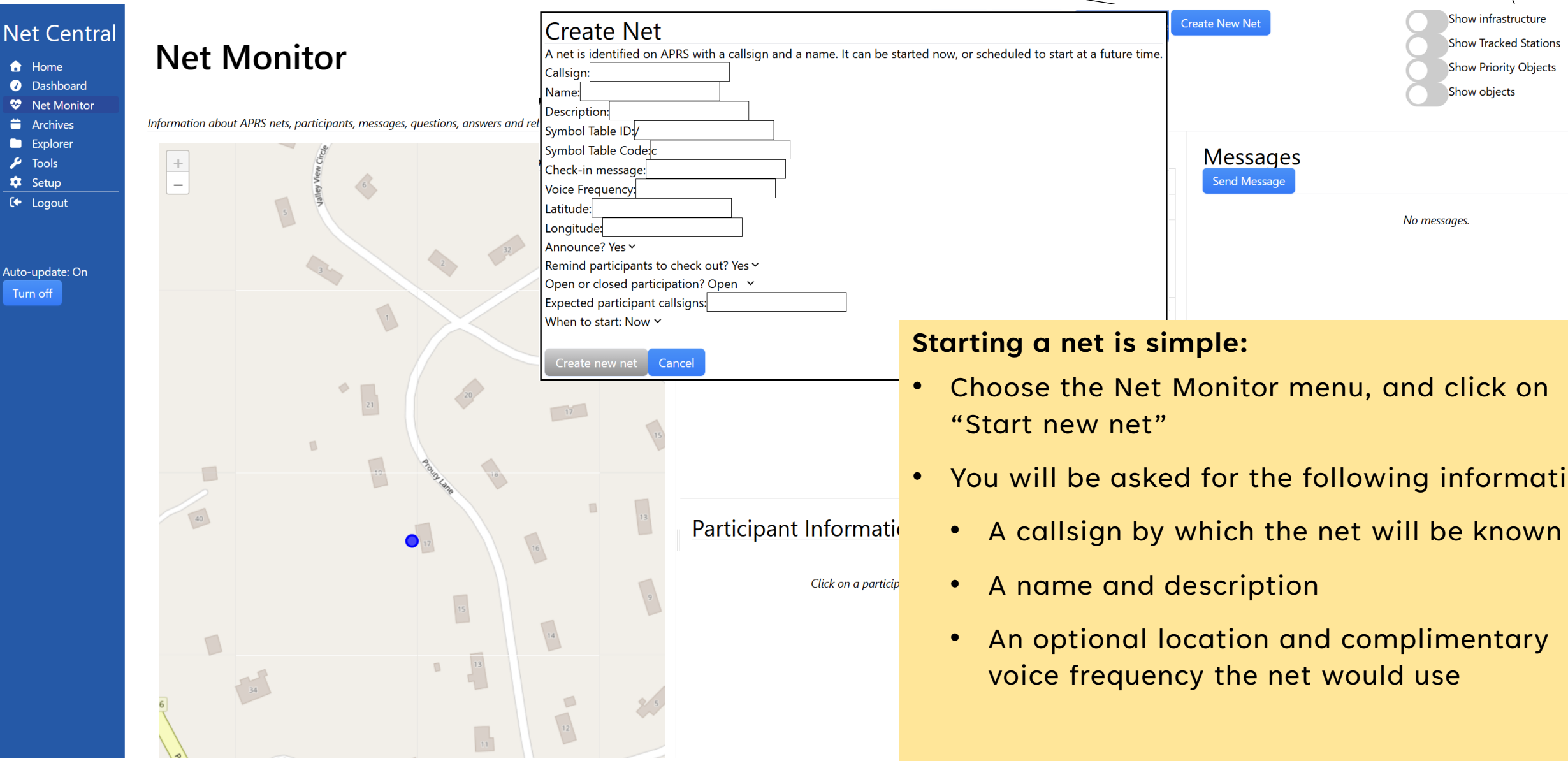
- Net Central will listen to available traffic to identify these resources and maximize the usefulness of the information it has heard.

# NET CENTRAL – CREATED FOR SUCH A NEED

**Net Central enables APRS-augmented reality:**

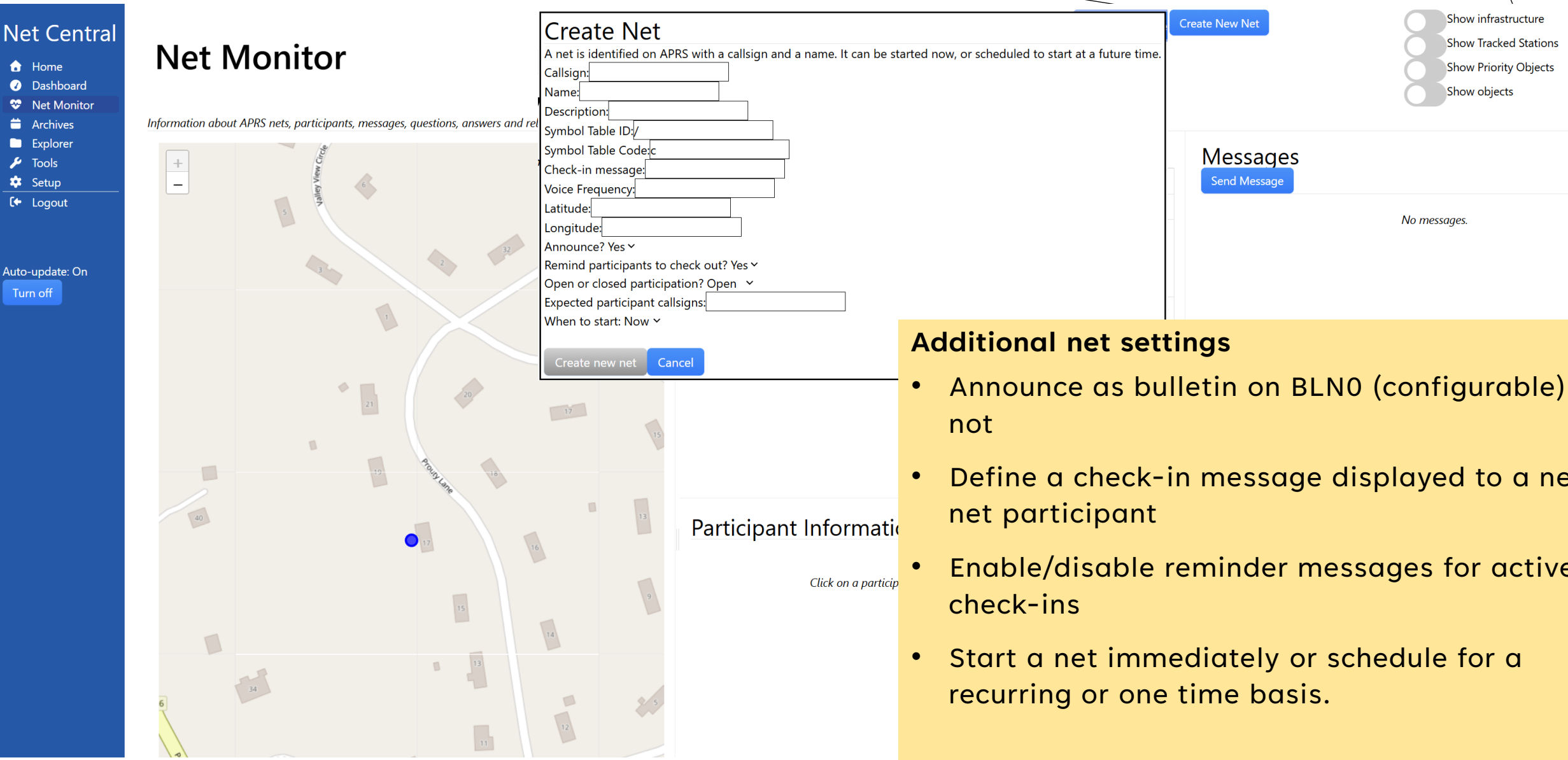
- Create objects representing real-world infrastructure and provide user-defined reports to enrich situational awareness.
- Model hospitals and medical treatment facilities, and report on their capabilities and capacity
- Identify incident locations and provide details

# USING NET CENTRAL



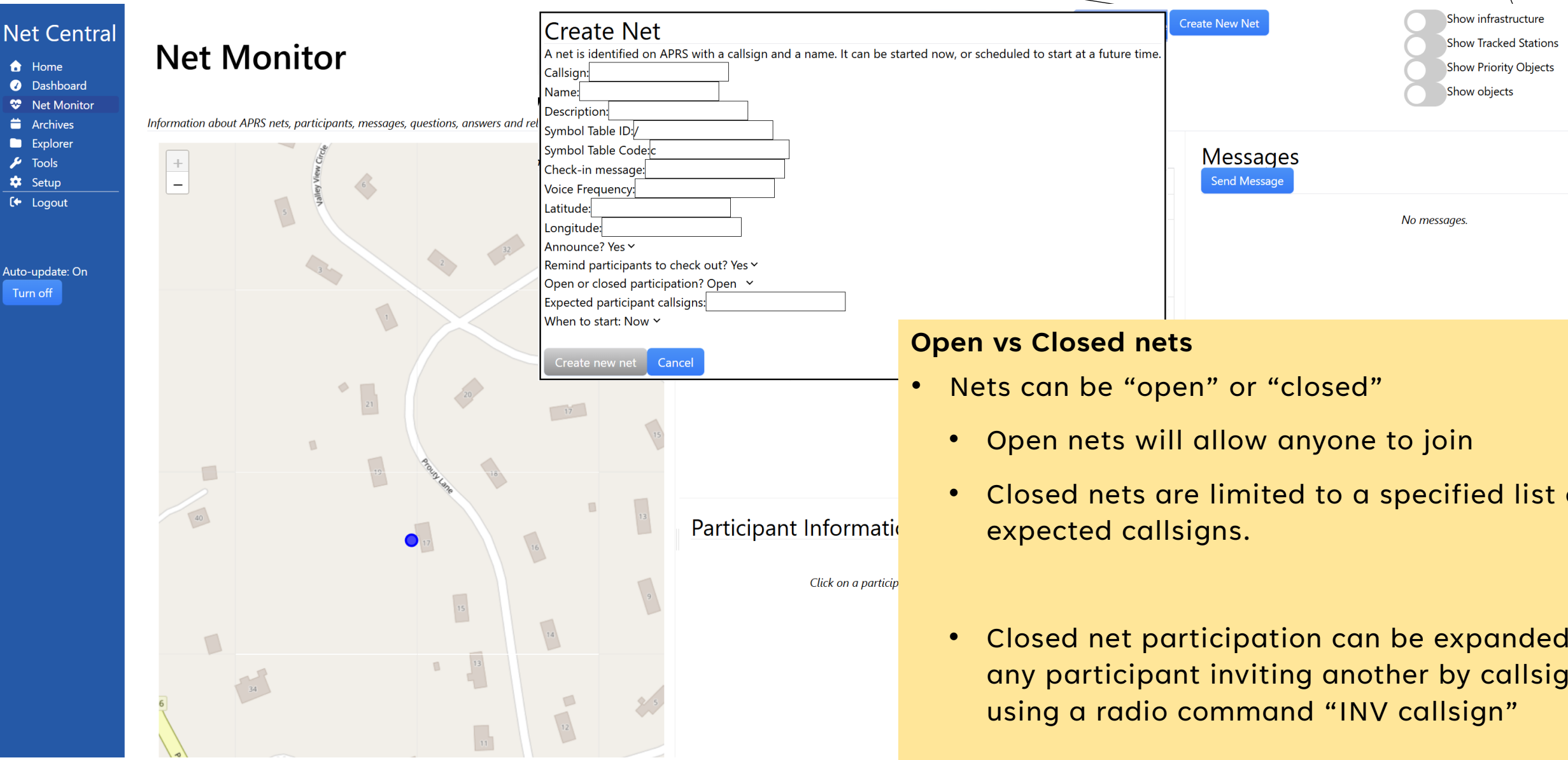

**Starting a net is simple:**

- Choose the Net Monitor menu, and click on “Start new net”
- You will be asked for the following information:
  - A callsign by which the net will be known
  - A name and description
  - An optional location and complimentary voice frequency the net would use



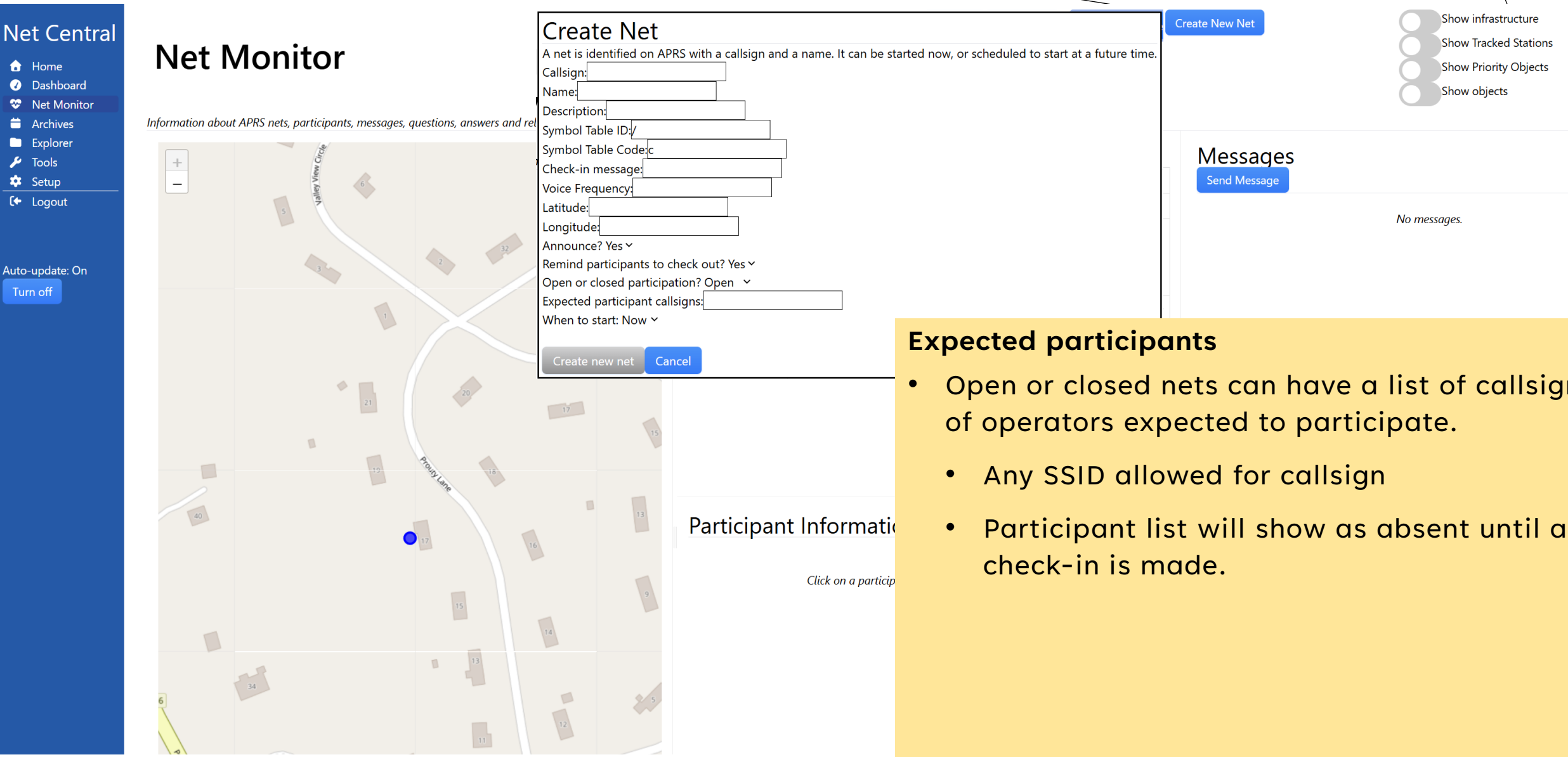

## Additional net settings

- Announce as bulletin on BLN0 (configurable) or not
- Define a check-in message displayed to a new net participant
- Enable/disable reminder messages for active check-ins
- Start a net immediately or schedule for a recurring or one time basis.




## Open vs Closed nets

- Nets can be “open” or “closed”
  - Open nets will allow anyone to join
  - Closed nets are limited to a specified list of expected callsigns.
  - Closed net participation can be expanded by any participant inviting another by callsign using a radio command “INV callsign”




## Expected participants

- Open or closed nets can have a list of callsigns of operators expected to participate.
  - Any SSID allowed for callsign
  - Participant list will show as absent until a check-in is made.

# SIMPLE MESSAGE-BASED COMMANDS

**Once a net is started, any APRS messaging client or radio can send messages to the net callsign to act within the net.**

**CI** - Check in to net
**CO** - Check out of net

# SIMPLE MESSAGE-BASED COMMANDS

**Additional commands:**

**S status** - report your status
**T callsign** - set tactical callsign for net
**F frequency** - report the voice frequency that you are monitoring
**X n** - report your transmit power n in watts
**E (BATTERY, COMMERCIAL, GENERATOR, NONE, SOLAR)** - report your electrical power type
**B (BATTERY, COMMERCIAL, GENERATOR, NONE, SOLAR)** - report your backup electrical power type
**Y (APPLIANCE, BASE, HANDHELD, INTERNET, MOBILE, OTHER)** - report your radio style

**CI, CO, T, F, X, E, B, and Y** can all be combined in a single message (ex: CI X 50 E COMM B SO)

# SIMPLE MESSAGE-BASED COMMANDS

**Additional commands:**

**I** - Send net info (name, voice frequency, description)

**L** - list net participants, their callsigns, status, location, and voice frequency monitored
**P callsign** - ping callsign to test connectivity
**O callsign** - get known operational status of a station by its callsign
**INV callsign**[,...] - invite one or more callsigns to a net

**NCI** - toggle notification of all check-ins and check-outs (default OFF)

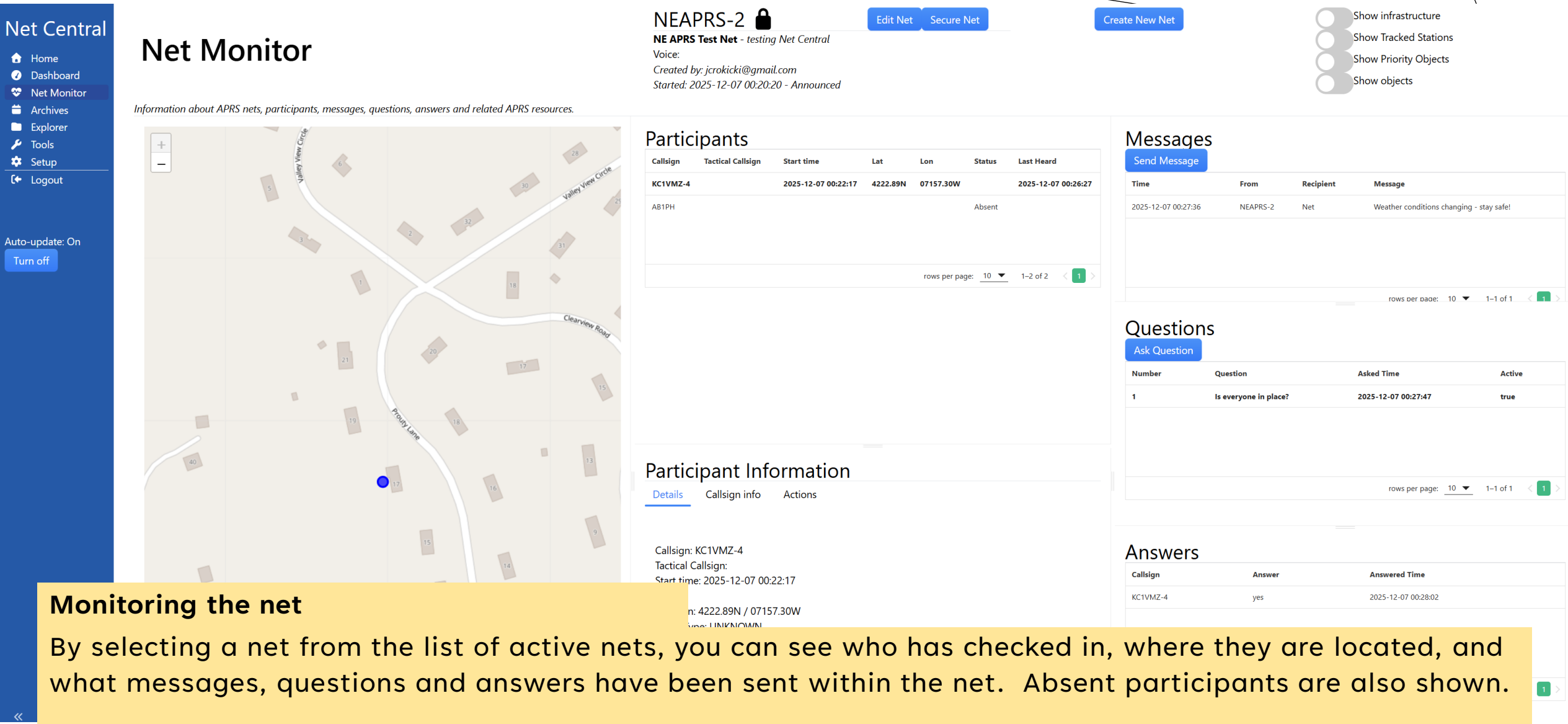
# SIMPLE MESSAGE-BASED COMMANDS

**Additional commands:**

**M** - send message to all participants in net
**MC** - send message to only net control
**R n** - replay last n messages sent to the net (n is a number)

**Q** - send a question to all participants in net
**A n** - answer question n sent to the net
**QL** -send a list of unanswered questions
**QR** -Report on question n and its answer

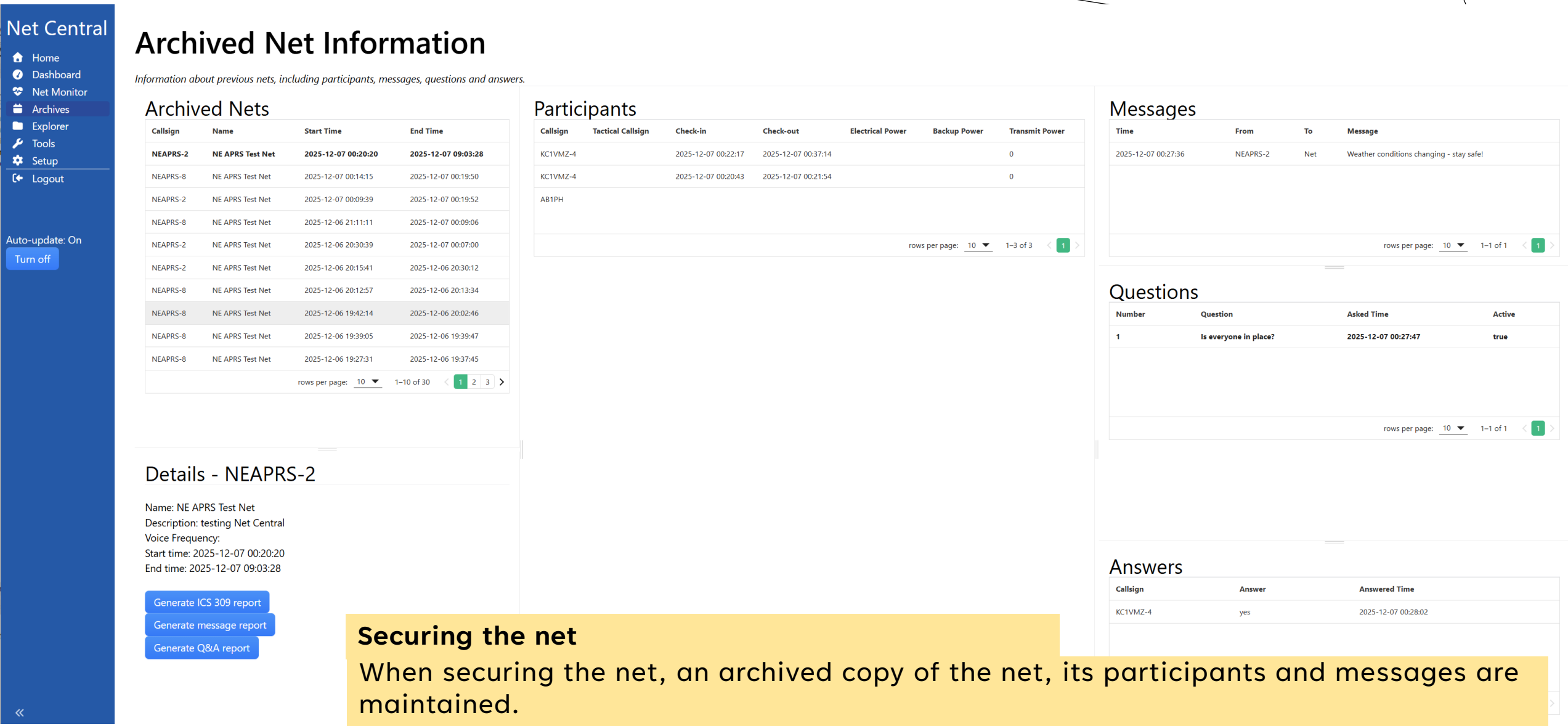
**H** - display help message of all commands




## Monitoring the net

By selecting a net from the list of active nets, you can see who has checked in, where they are located, and what messages, questions and answers have been sent within the net. Absent participants are also shown.

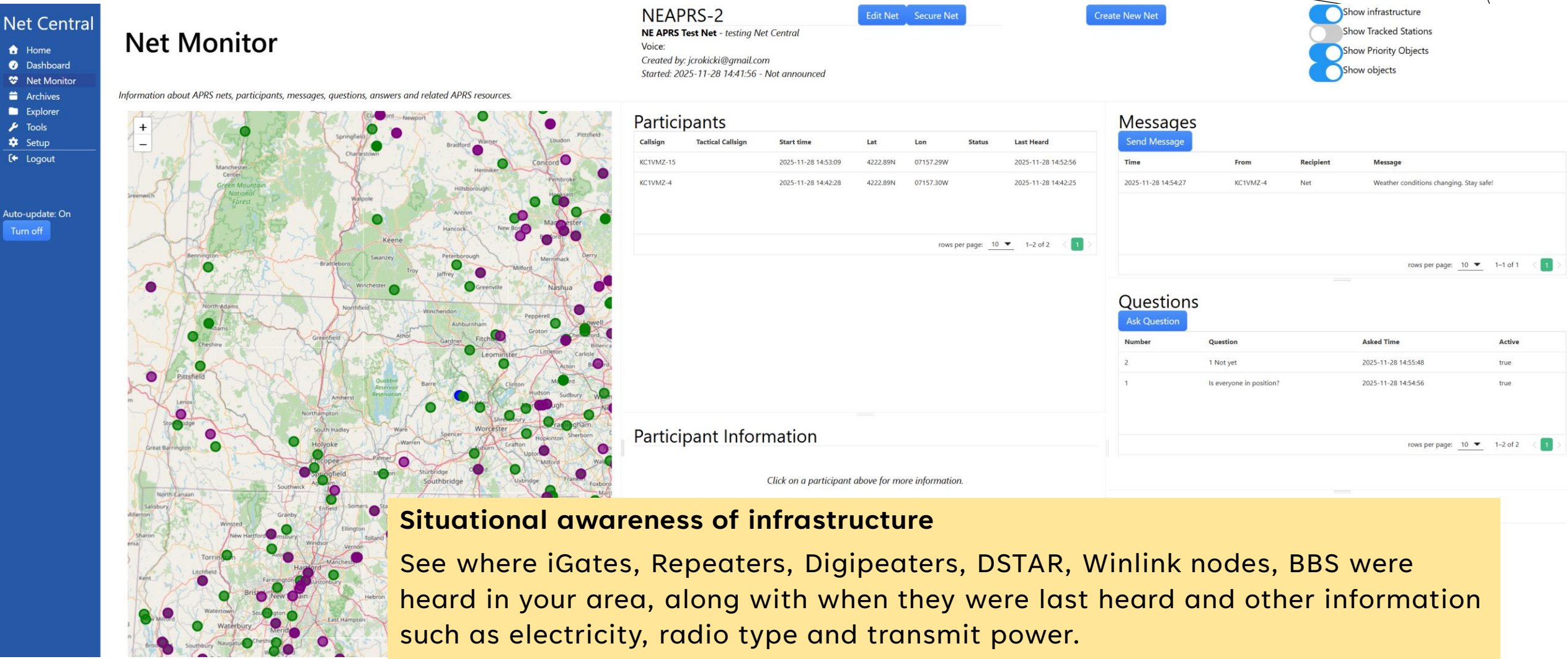
Messages can be sent via radio to the net callsign, or from this web console, to all net participants.




**Securing the net**

When securing the net, an archived copy of the net, its participants and messages are maintained.

Absent participants are also reported and included in the ICS 309 report.

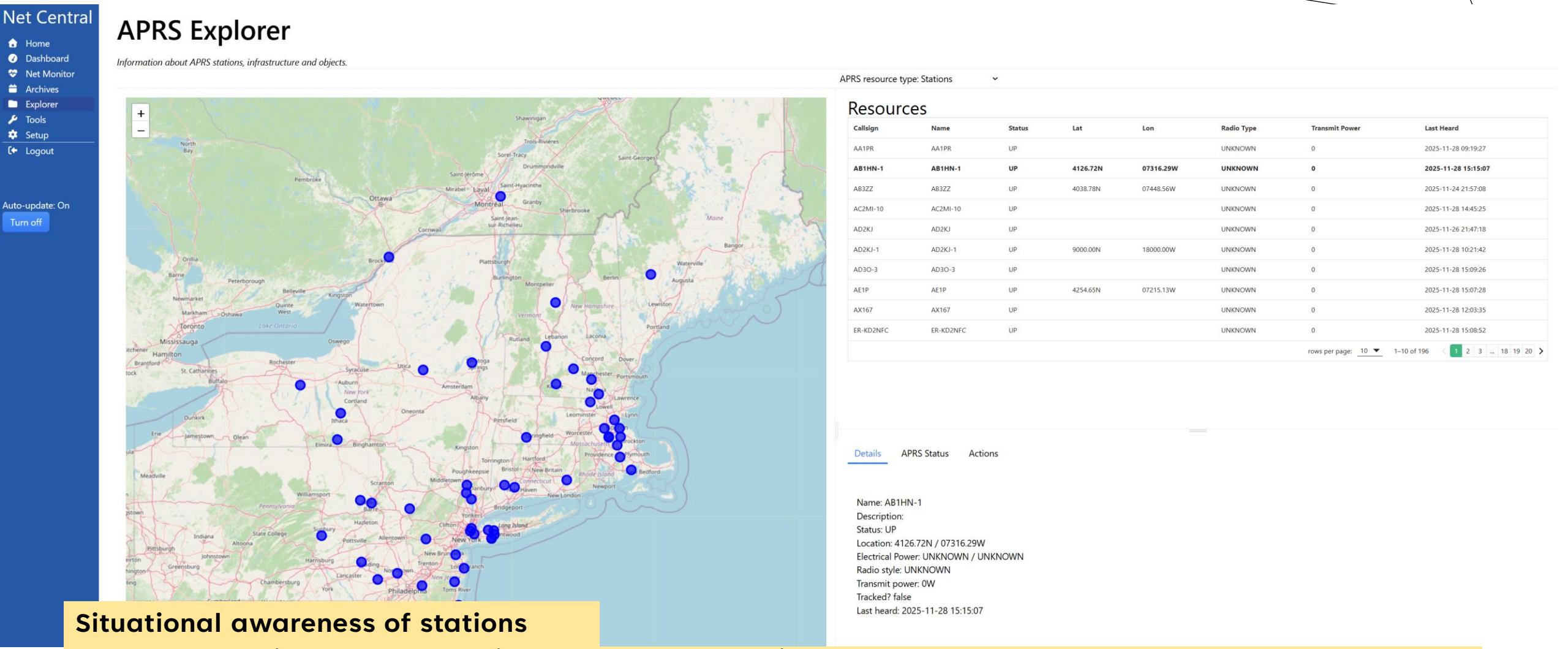



**Situational awareness of infrastructure**

See where iGates, Repeaters, Digipeaters, DSTAR, Winlink nodes, BBS were heard in your area, along with when they were last heard and other information such as electricity, radio type and transmit power.

Filter and track a subset rather than everything heard.

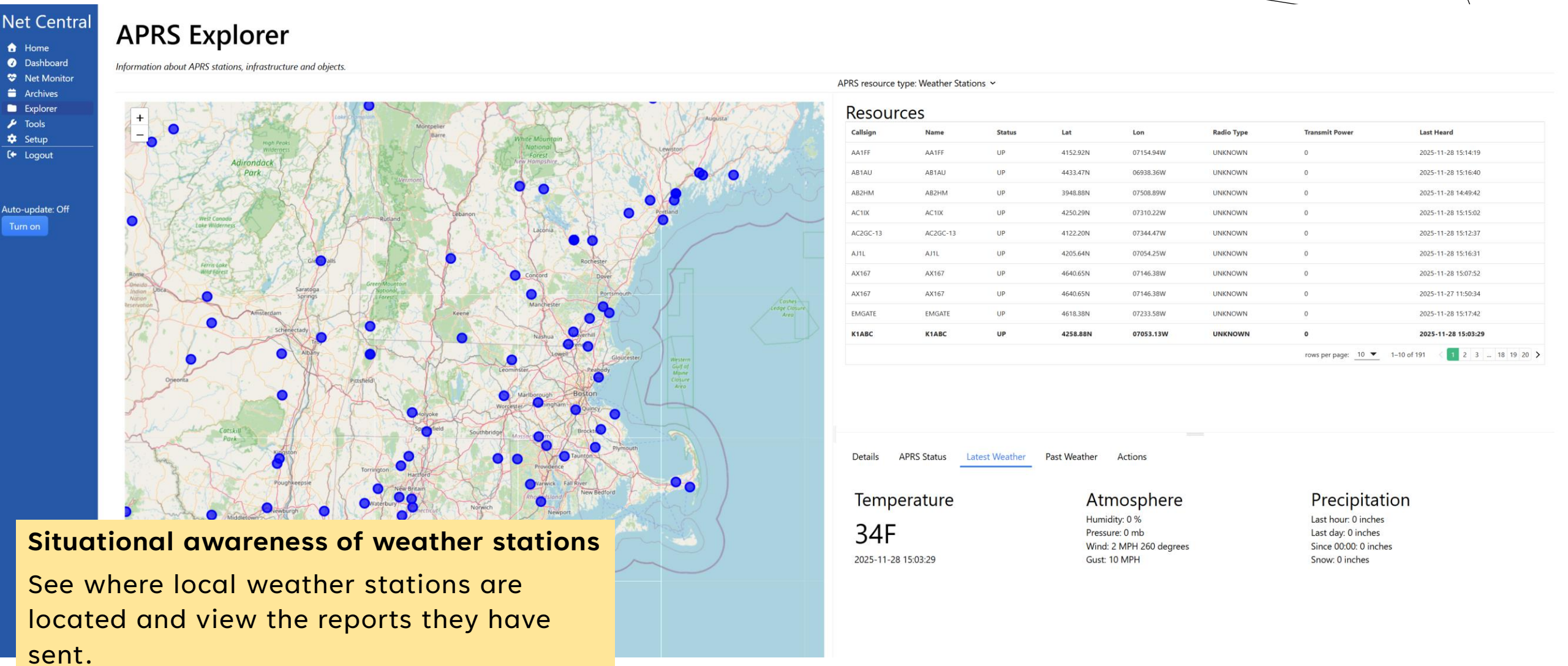
Blue=participants, Yellow-Priority, Green-Infra, Purple-Objects




**Situational awareness of stations**

See where stations were heard in your area, along with when they were last heard and other information such as electricity, radio type and transmit power.

Filter and track a subset rather than everything heard.




**Situational awareness of weather stations**

See where local weather stations are located and view the reports they have sent.

Net Central

- Home
- Dashboard
- Net Monitor
- Archives
- Explorer
- Tools
- Setup
- Logout

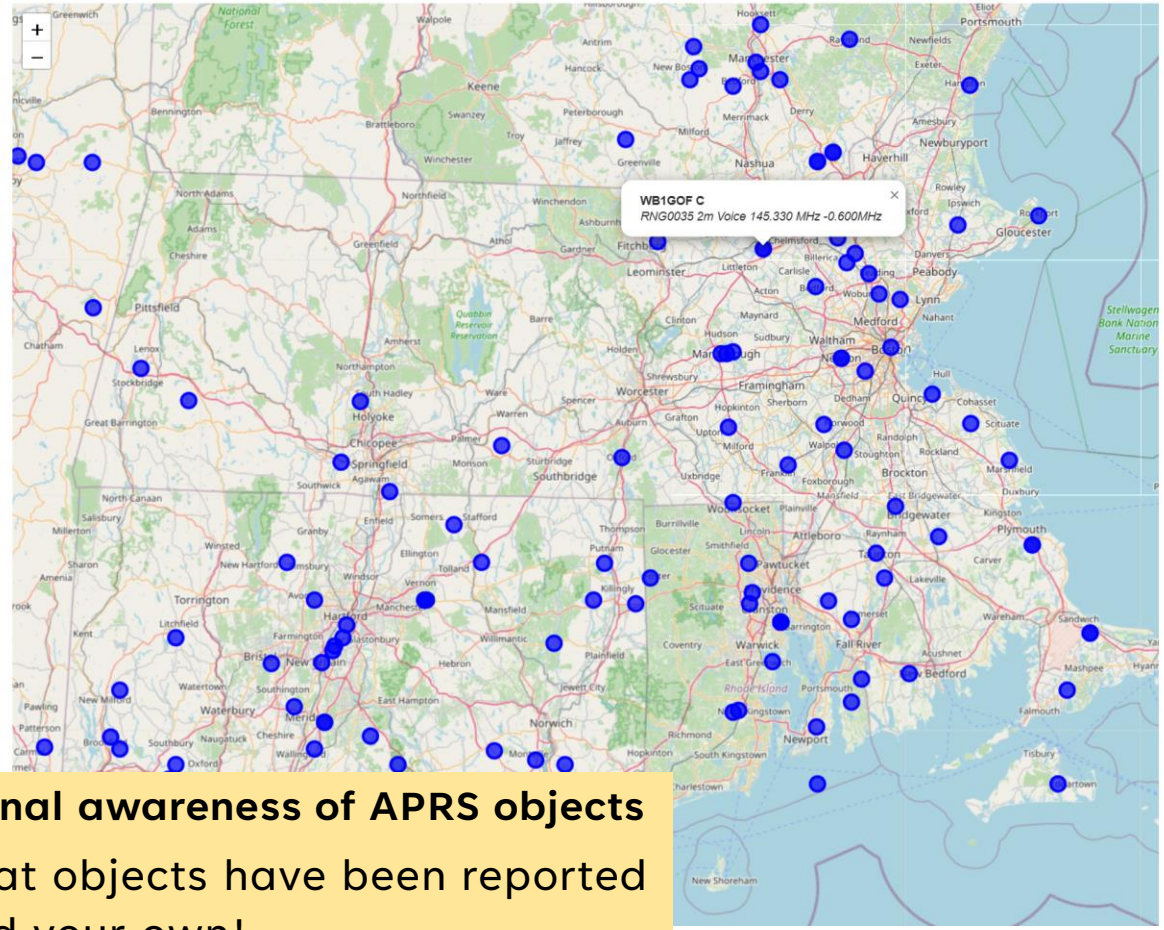
Auto-update: Off

Turn on

# APRS Explorer

*Information about APRS stations, infrastructure and objects.*

APRS resource type: Objects




## Resources

| Callsign | Name | Status | Lat | Lon | Radio Type | Transmit Power | Last Heard |
|---|---|---|---|---|---|---|---|
| WA2EPI B | WA2EPI B | Alive | 4052.97N | 7434.15W | | | 2025-11-28 10:51:35 |
| WA2GUG-10 | WA2GUG-10 | Alive | 4221. N | 7402. W | | | 2025-11-28 16:11:16 |
| WA2NAN-1 | WA2NAN-1 | Alive | 4414.43N | 7505.67W | | | 2025-11-28 13:56:58 |
| WA2RES-14 | WA2RES-14 | Alive | 3945.62N | 7415.64W | | | 2025-11-28 16:23:08 |
| WA2RES-15 | WA2RES-15 | Alive | 3954.30N | 7414.06W | | | 2025-11-28 16:26:07 |
| WA3SWJ B | WA3SWJ B | Alive | 4143.47N | 7005.50W | | | 2025-11-28 16:15:32 |
| WA3WLH-10 | WA3WLH-10 | Alive | 4023. N | 7532. W | | | 2025-11-28 16:11:19 |
| WB1GOF B | WB1GOF B | Alive | 4234.61N | 7126.55W | | | 2025-11-28 16:27:53 |
| **WB1GOF C** | **WB1GOF C** | **Alive** | **4234.61N** | **7126.55W** | | | **2025-11-28 16:27:53** |
| WB2LJK/P | WB2LJK/P | Alive | 4049.36N | 7525.34W | | | 2025-11-28 14:40:43 |

rows per page: 10 561–570 of 594 1 ... 56 57 58 59 60

Details | Actions | APRS Status

Name: WB1GOF C
Status: Alive
Location: 4234.61N / 7126.55W
Comment: RNG0035 2m Voice 145.330 MHz -0.600MHz
Last heard: 2025-11-28 16:27:53
Type: STANDARD

**Situational awareness of APRS objects**

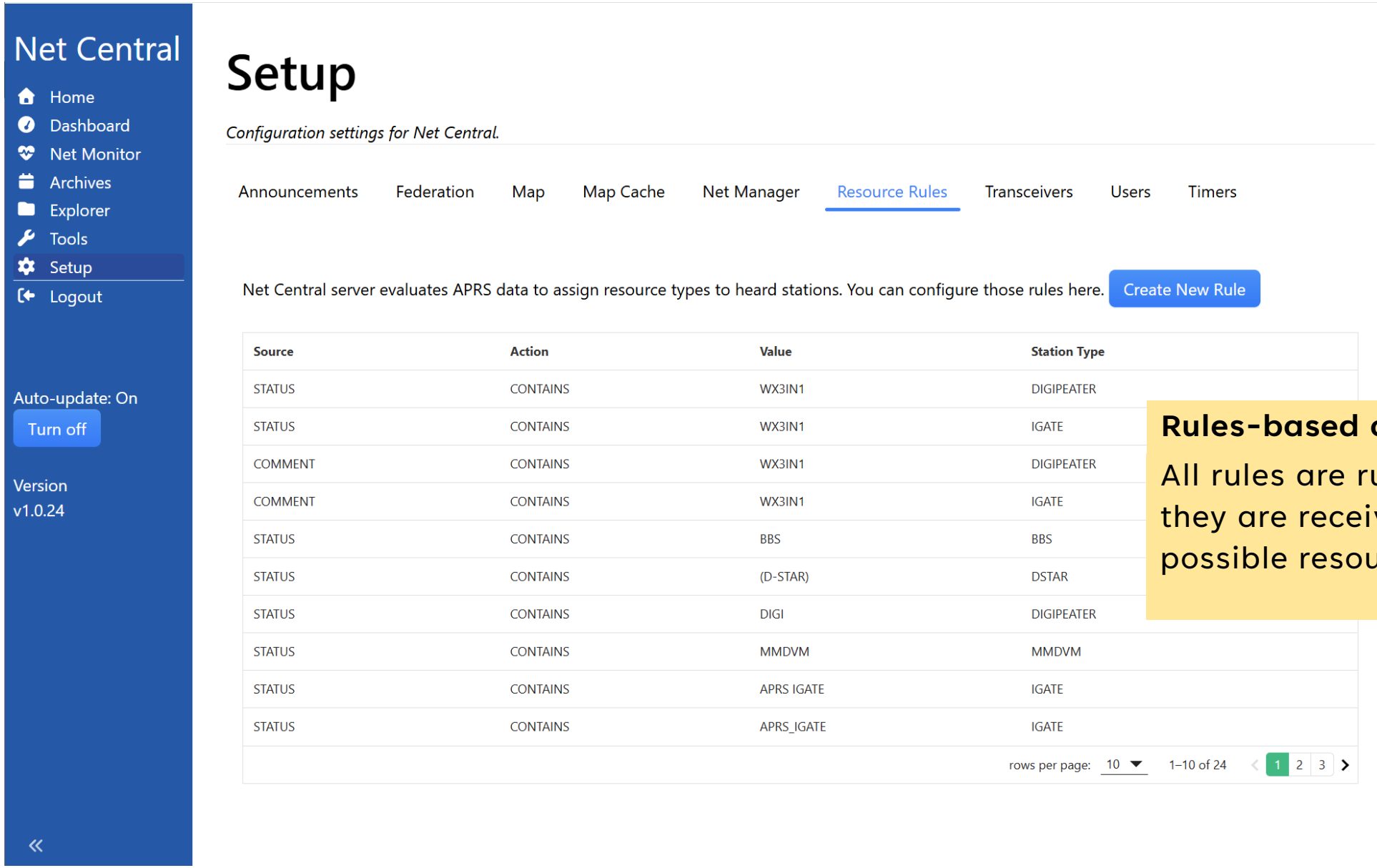
See what objects have been reported and add your own!

# RULES-BASED RESOURCE CLASSIFIER

Upon APRS packet receipt, a rules-based resource classifier is run against the message and a set of user-defined rules to determine a resource's types.

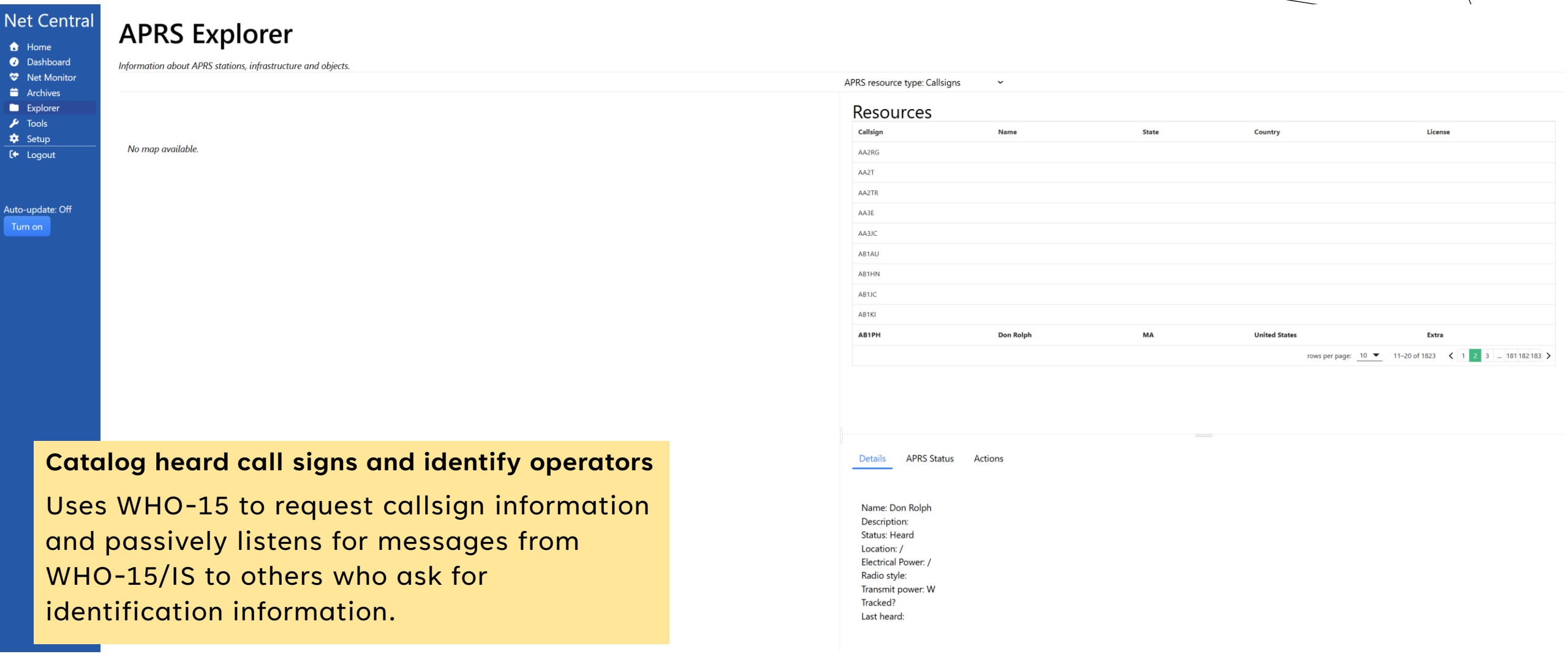
- **Source –** callsign, comment, status or symbol code/id
- **Action –** contains, equals, starts-with, ends-with
- **Value –** value contained in source
- **Resource Type –** what resource type the callsign is

Resources can be of more than one type (example: Digipeater / iGate)




**Rules-based classifier**

All rules are run against packets as they are received to determine all possible resource types.




**Catalog heard call signs and identify operators**

Uses WHO-15 to request callsign information and passively listens for messages from WHO-15/IS to others who ask for identification information.

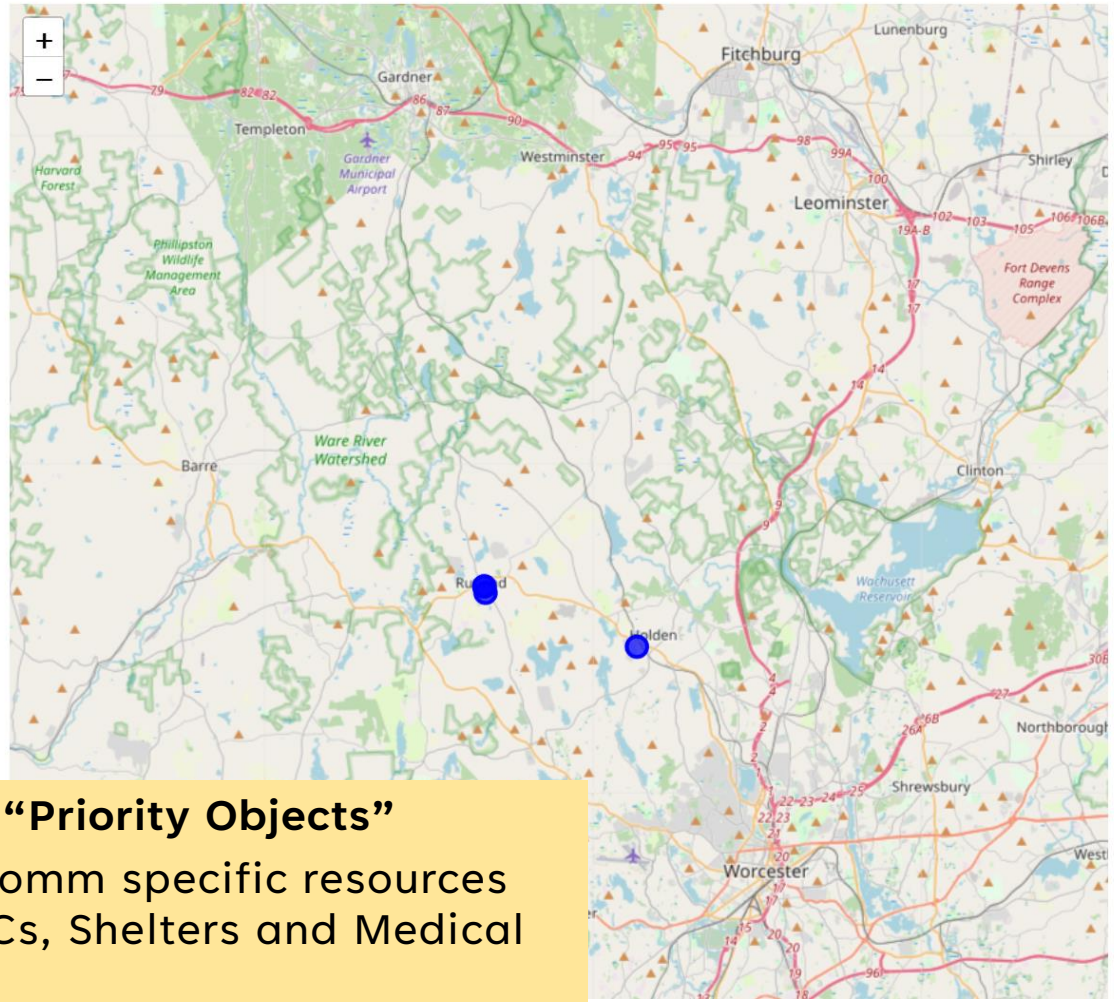
Net Central

- Home
- Dashboard
- Monitor
- Archives
- Explorer
- Tools
- Setup
- Logout

# APRS Explorer

*Information about APRS stations, infrastructure and objects.*

APRS resource type: Priority Objects




## Resources

| Callsign | Name | Type | Status | Last Heard |
|---|---|---|---|---|
| **TESTEO-2** | **TESTEO-2** | **EOC** | **Alive** | **2025-10-11 21:23:39** |
| TESTSH-2 | TESTSH-2 | SHELTER | Alive | 2025-10-11 20:23:43 |
| TSWRHS-1 | TSWRHS-1 | SHELTER | Alive | 2025-10-02 19:31:30 |
| TESTRD-1 | TESTRD-1 | EOC | Alive | 2025-10-08 18:25:11 |

rows per page: 10 1–4 of 4

Details | Mobilization | Mobilization History | Contacts | Contact History | Access | Actions

Name: TESTEO-2
Status: Alive
Location: 4222.53N / 07157.19W
Comment: test EOC
Last heard: 2025-10-11 21:23:39
Type: EOC

**Interactive “Priority Objects”**

Model EmComm specific resources such as EOCs, Shelters and Medical Facilities.

# INTERACTIVE “PRIORITY OBJECTS”

These objects model EmComm resources such as:

- Emergency Operation Centers
- Shelters
- Medical Facilities

Information specific to each can be reported by the object using user-defined APRS reports.

Information can be provided using Net Central’s web application, or by sending messages to the object’s callsign.

This allows almost any operator to interact with these objects from any APRS client or radio capable of sending messages.

# INTERACTIVE “PRIORITY OBJECTS”

Messages sent to the object’s callsign are interpreted by Net Central.

If they conform to the syntax specific to each object type and report type, the information is retained and then re-broadcast using a user-defined report for others to be aware.

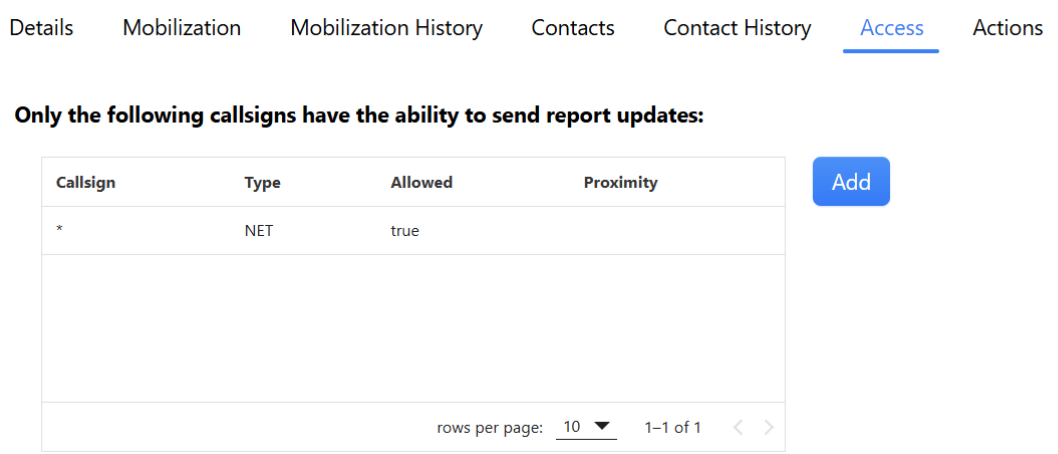
APRS clients can send a message “REPORT” to the callsign, and Net Central will send back all reports for that callsign.

```
2025-10-21 20:06:20 EDT: KC1VMZ-15>TESTRF-4: REPORT
2025-10-21 20:07:34 EDT: TESTRF-4>KC1VMZ-15: Contacts: John R:KC1VMZ:20251021
2025-10-21 20:07:41 EDT: TESTRF-4>KC1VMZ-15: MobStatus: 2120251021test Rutland
```

# INTERACTIVE “PRIORITY OBJECTS”

For added protection, each object can be configured to only listen to a certain set of callsigns for updates:

- Specific callsign
- Participants in a specific net
- Any net participant



# INTERACTIVE “PRIORITY OBJECTS”

Additional safeguards will be added to restrict stations also be proximity (geofencing)

For example, any net participant could potentially provide information about a shelter, but they must be within 100 yards of the object’s location.

**The behavior of these objects, and the use of security measures such as these, are fairly unique in the APRS world.**

# INTERACTIVE “PRIORITY OBJECTS”

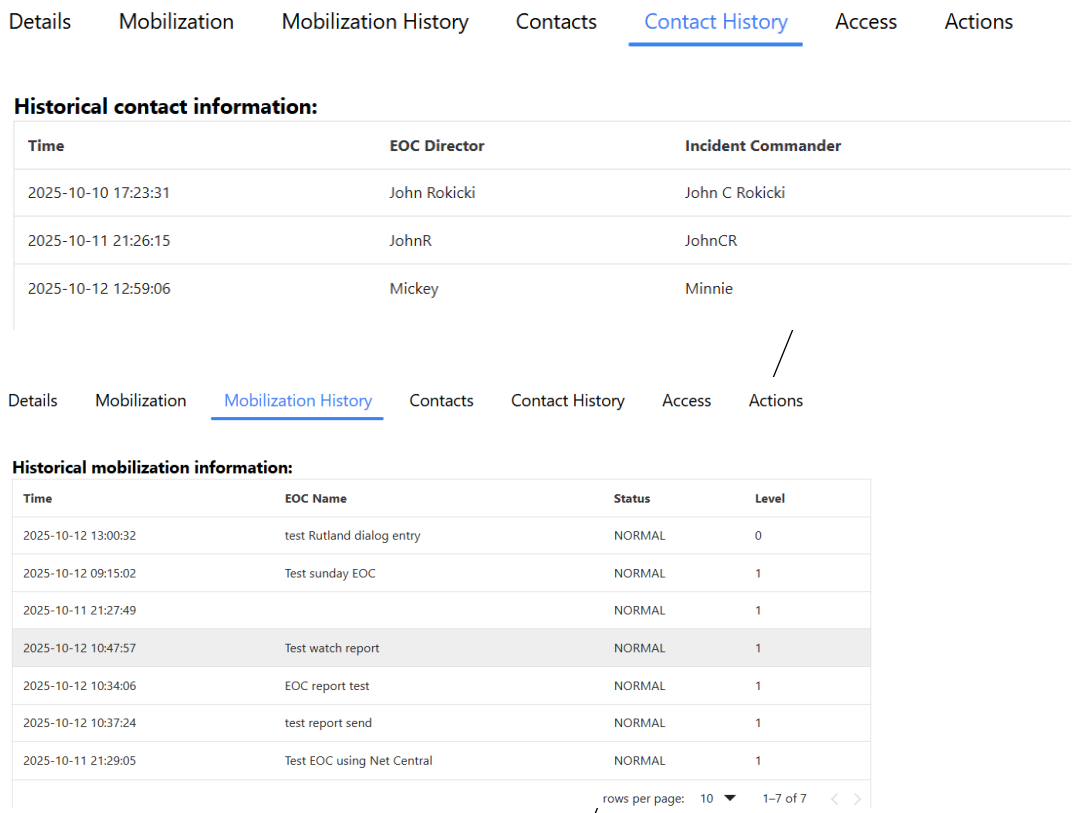
## EOCs

Mobilization information

- Incident name
- Status (Normal, Partial Full)

Contact information

- Director name
- Incident commander name



# INTERACTIVE “PRIORITY OBJECTS”

**Shelters**

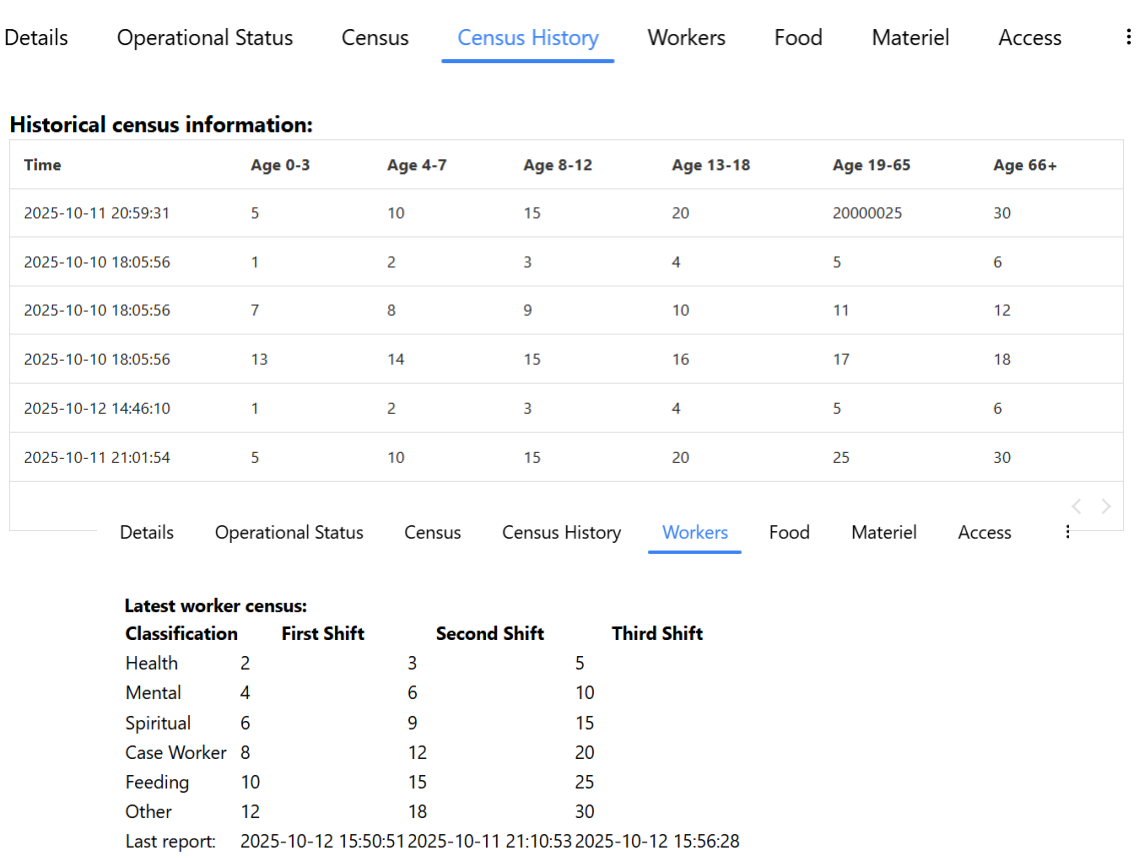
Status information

- Status (Stand-by, Active)
- State (Open, Closed)

Population census by age cohort

Worker census by job category

Food and materiel availability and needs



# INTERACTIVE “PRIORITY OBJECTS”

Soon to be supported objects are:

**Medical Facility**

Wide open currently

Would model from Winlink reports  (beds, workers, blood, etc)

**What else would you like to have?**

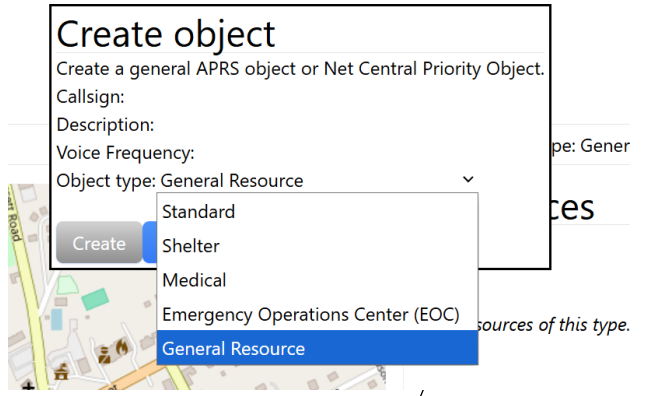
# INTERACTIVE “GENERAL RESOURCES”

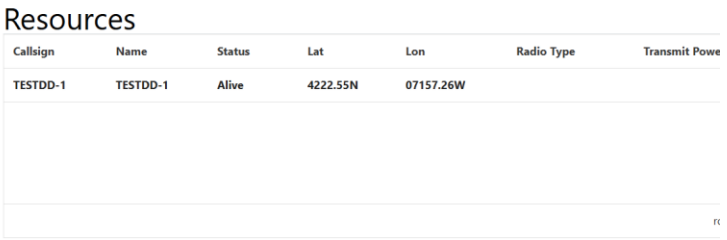
These objects model anything you want:

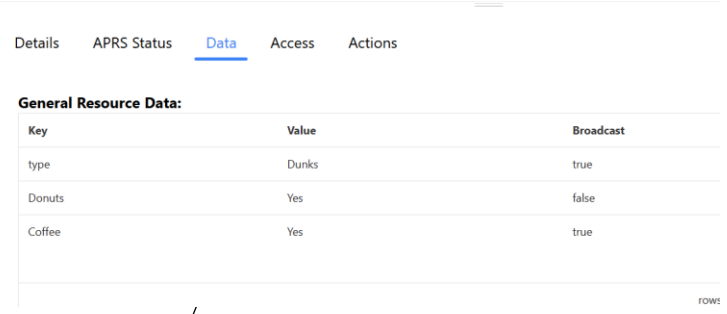
- Gas Station
- ATM
- Dunkin Donuts
- Whatever is important to you!

Each object maintains its own set of data – key/value pairs – that can be read or written by sending its callsign commands.

Key / value pairs can be reported similarly to station capabilities – choose to broadcast or not.



# INTERACTIVE “GENERAL RESOURCES”

Information can be provided using Net Central’s web application, or by sending messages to the object’s tactical callsign.

The APRS client syntax is simple:

Key=value – creates or updates a key/value pair

Key= – deletes a key/value pair

Key – Net Central will send the value back to the client

REPORT – Net Central will send back all key/value pairs to the client

This allows any operator to interact with these objects from any APRS client or radio capable of sending messages.

Net Central

- Home
- Dashboard
- Monitor
- Archives
- Explorer
- Tools
- Setup
- Logout

# Dashboard

*Current statistics for Net Central*

## Nets

2 Active Nets
0 Active net participants

0 Nets started
0 Nets secured

26 Completed Nets
46 Completed net participants

## Stations

794 Stations heard
134 Digipeaters heard
310 iGates heard
0 Internet Servers heard
310 Repeaters heard
8 Weather Stations heard
1 Winlink Stations heard
1 Bulletin Boards heard
333 Others heard

0 Tracked Stations

380 Callsigns heard

## Users

3 Users
2 Users currently logged in

3 User logins
2 User logouts

## Communications

1 Registered transceivers
1 Enabled for receive
1 Enabled for transmit

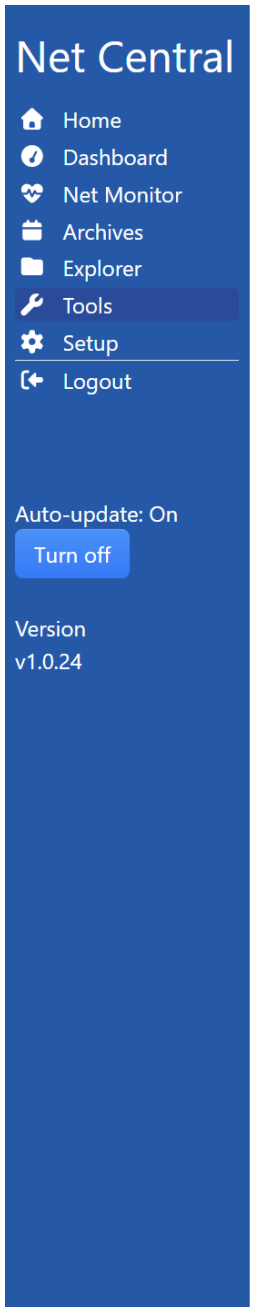
120 Objects received
5 Objects sent
0 Messages sent
0 Acks requested
0 Acks sent
10 Seconds since receiving message
297 Seconds since sending message

## Operations

10 minutes since started
0 minutes since heartbeat Report Cleanup Thread fired
0 minutes since heartbeat Scheduled Net Thread fired
0 minutes since heartbeat Object Beacon Thread fired
0 minutes since heartbeat Net Participant Reminder Thread fired

**Dashboard to quickly view activity**

See quickly what is going on with Net Central and APRS in your area.



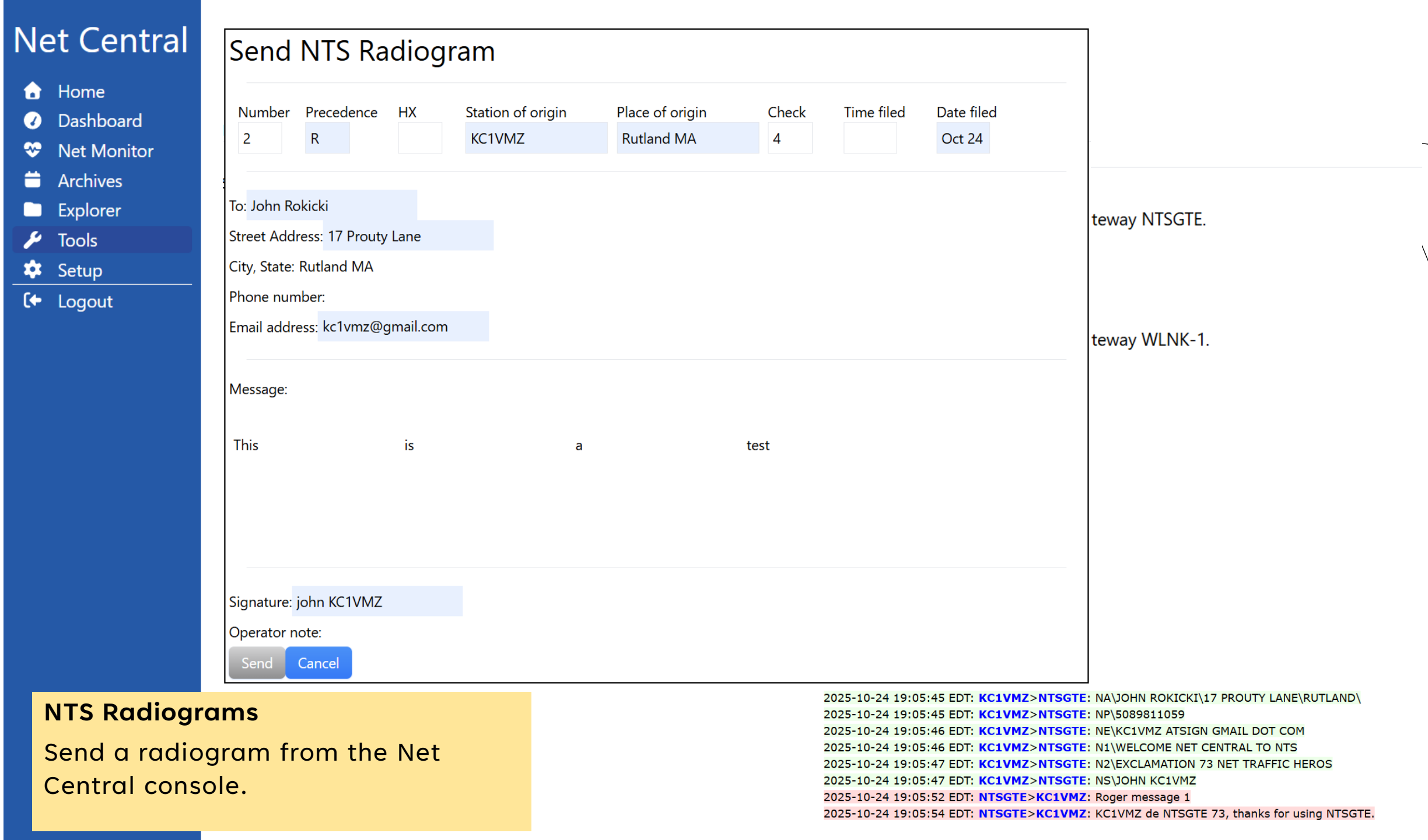

# Tools

Net Central provides a set of integrated APRS tools that you can use independently from nets.

| | |
|---|---|
| **Send NTS Radiogram** | Send an NTS Radiogram via APRS to NTS Gateway NTSGTE. |
| **Send Winlink Email** | Send a Winlink email via APRS to Winlink Gateway WLNK-1. |
| **Enable raw packet logging** | Enable raw logging of all heard packets for later download. |
| **Download raw packets** | Download all heard APRS packets to a file. |
| **Delete raw packets** | Delete all logged raw packets. |
| **Delete all APRS data** | Delete all heard APRS data so you can start fresh. |
| **Delete all Net Central data** | Delete all Net Central data (nets, archives, etc.) so you can start fresh. |

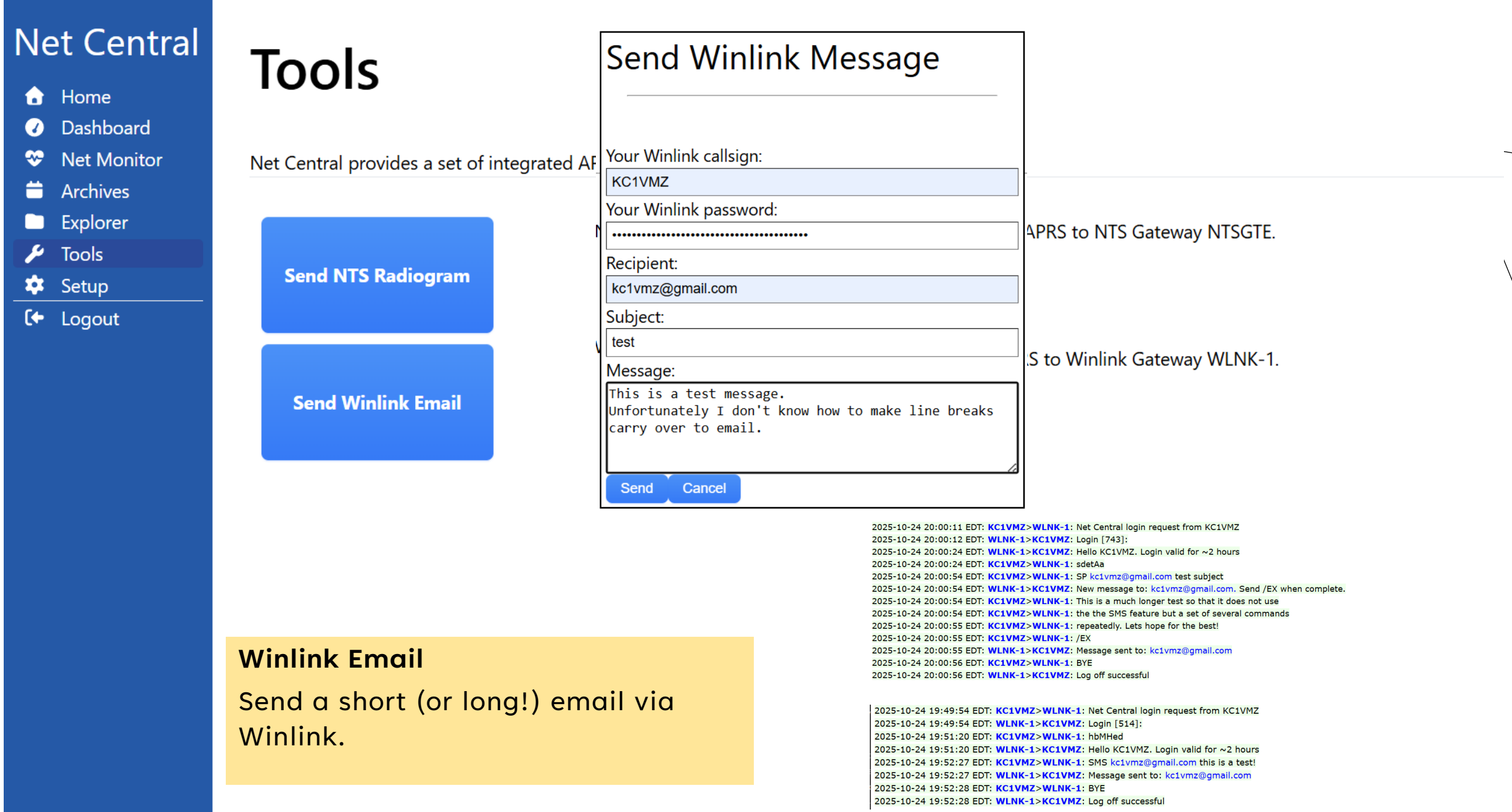
**Additional Tools**

Utilize other APRS integration services such as NTS Radiogram and Winlink gateways




**NTS Radiograms**

Send a radiogram from the Net Central console.




**Winlink Email**

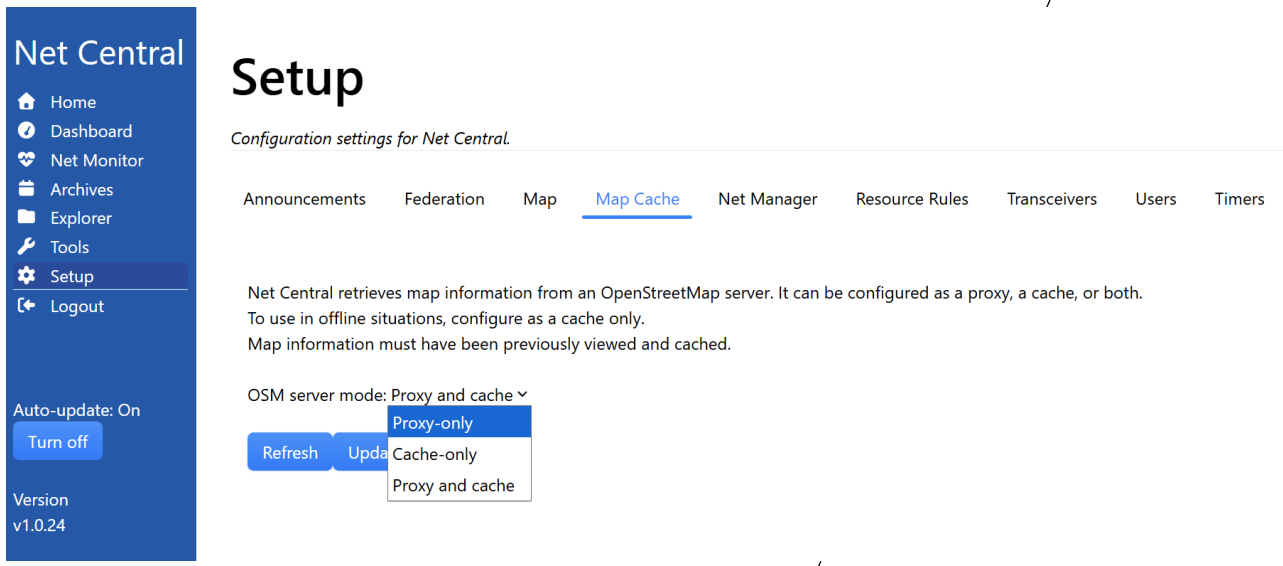
Send a short (or long!) email via Winlink.

# OFFLINE MAP USE

Net Central supports use of offline OpenStreetMap map tiles.

Use Net Central to view interested map areas and detail depths while online.

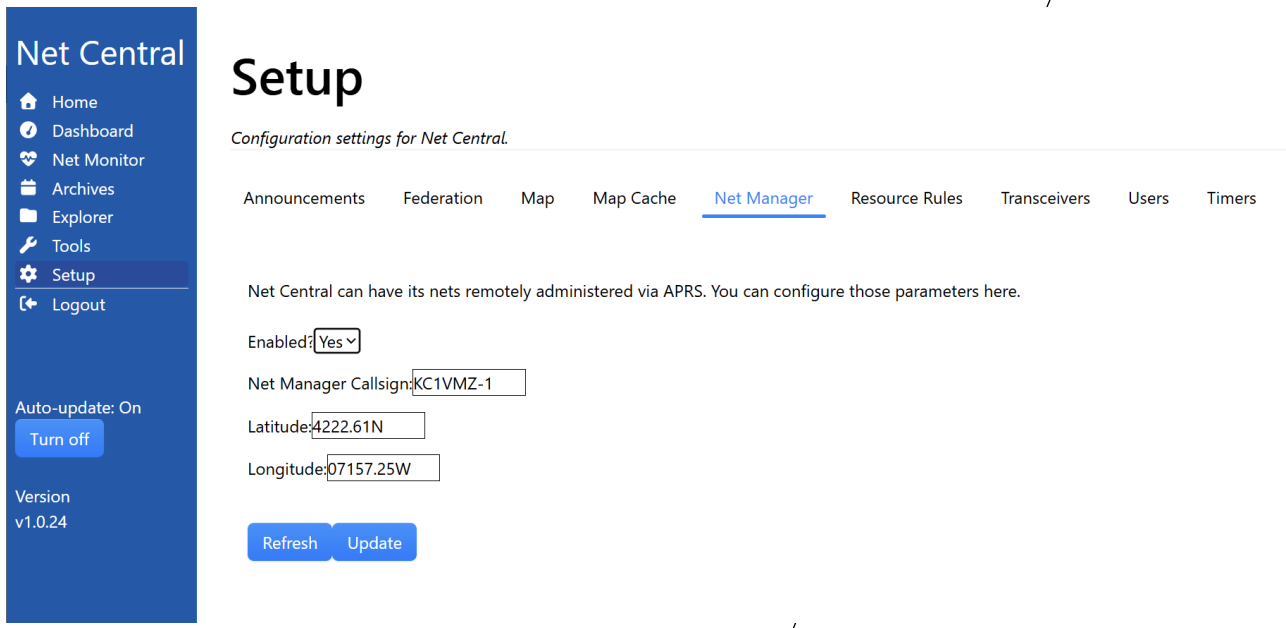
Simply change setting to run in cache mode and it will only use locally cached versions.



# NET MANAGEMENT OVER APRS

Net Central supports net management over APRS!

Configure Net Central to have a Net Management callsign and a location, and APRS messages can be sent to that callsign to manage ad-hoc nets.



# NET MANAGER COMMANDS

**Commands that can be sent to the Net Manager callsign:**

**L** - List the active public nets hosted by this Net Central server
**C callsign** - Create a public net with the provided callsign.
**CP callsign** - Create a private net with the provided callsign.

**S** - Secure an ad-hoc net

**H** - display help message of all commands

# USER ROLES

**User**

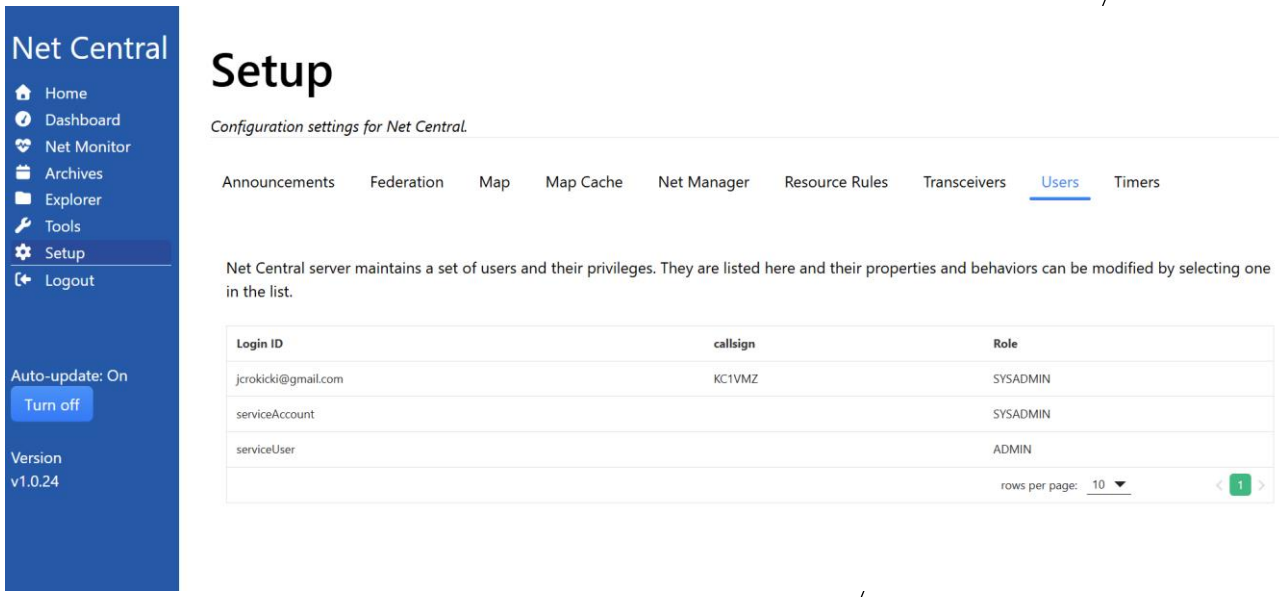
- View information

**Administrator**

- Create, modify and delete nets and objects
- Configure the application
- Configure priority object permissions

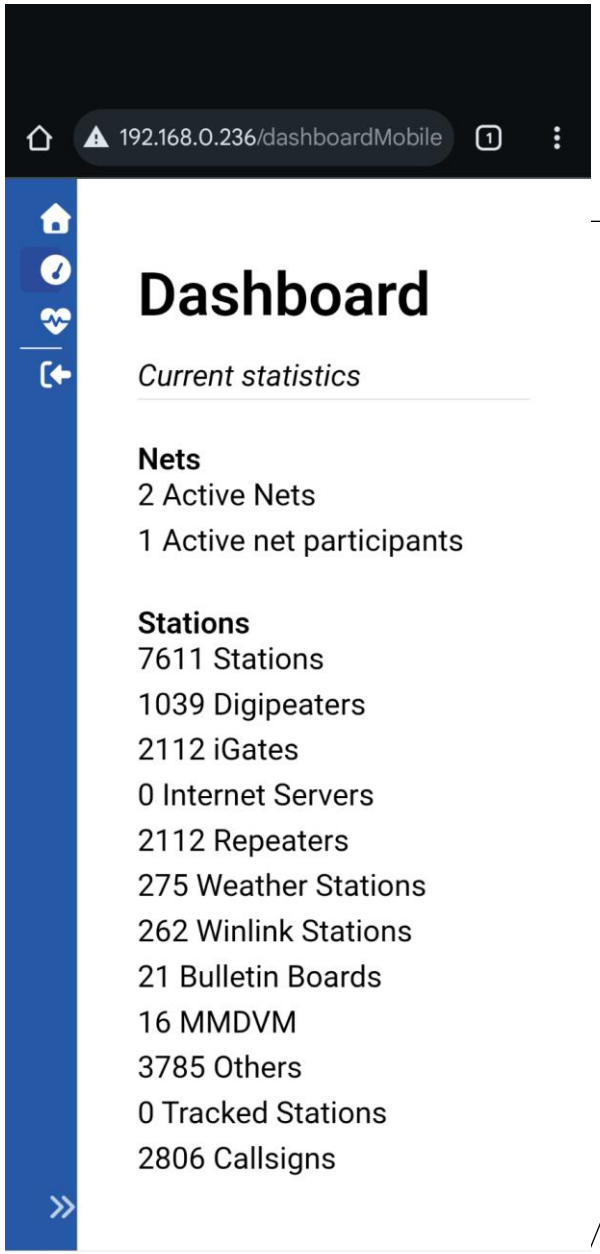
**System administrator**

- Reset data



# MOBILE-CENTRIC APP

- Monitor net activity on Net Central from a mobile device.
- View active nets, participants and messages.
- See basic dashboard statistics
- Get a list of radio commands (home page)



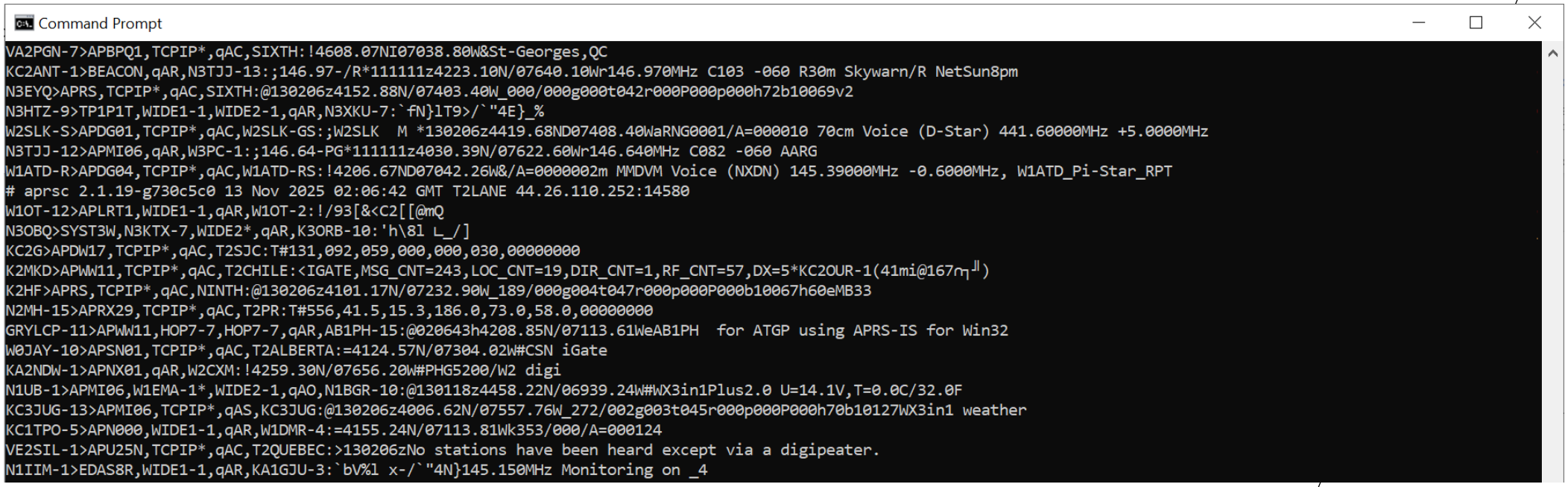
# FEDERATED SYSTEMS

- Net Central can be configured to run in “Federated” mode
- All objects and nets managed by one Net Central server are recognized by any other Net Central servers who can hear the originating server.
- Non-originating Net Central servers can see nets, their participants, messages, questions and answers.
- Non-originating Net Central servers can identify priority objects and provide type-specific information rather than being treated as generic objects.

- All data is read-only for non-originating Net Central servers to allow for situational awareness.

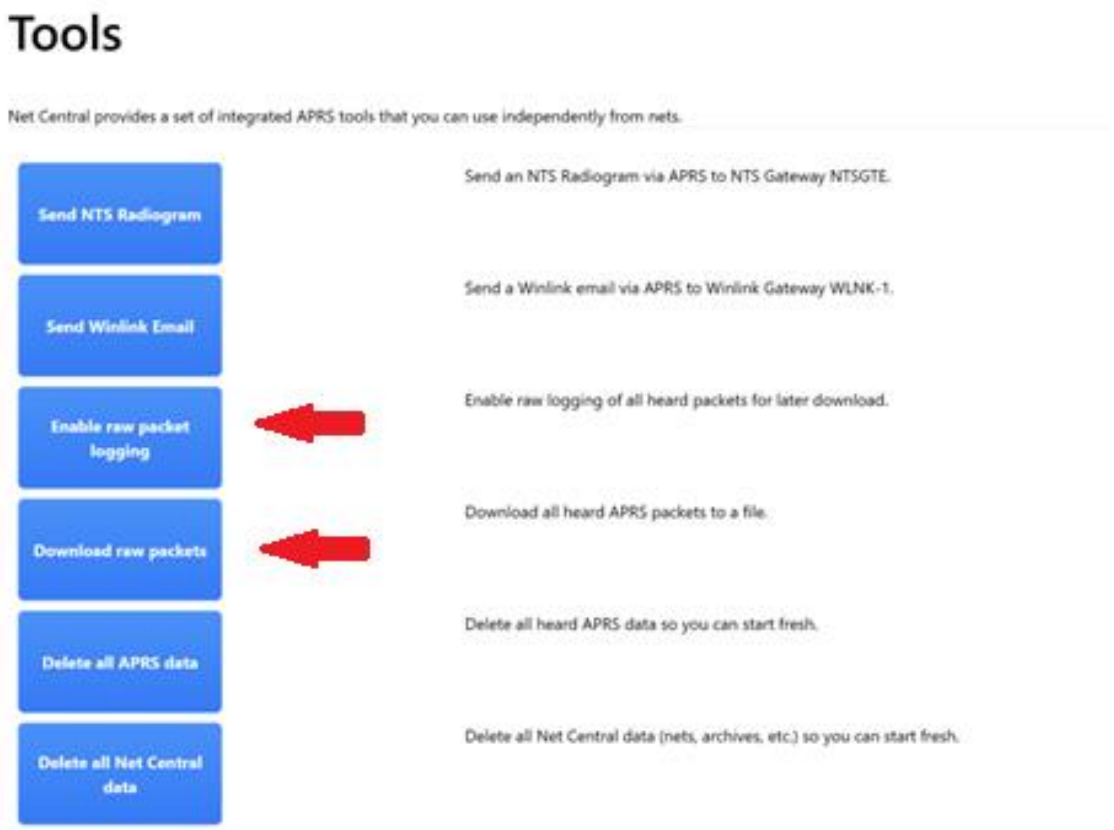
# PACKET LOGGING

Transceiver modules can be configured to log all received packets to a file.



# PACKET LOGGING

Net Central can be configured to retain raw packets and allow you to download from the web user interface



# DIRECTED STATION QUERIES

**APRS has standard way of interrogating callsigns for information – a directed station query.**

Each resource managed by Net Central has its own set of valid directed queries.

**Net**

- ?INFO - returns net info and participants
- ?CMD - returns list of valid directed query commands
- ?APRSO - returns object information
- ?APRSP - returns object position
- ?APRSS - returns object status
- ?NCNTI - returns net info
- ?NCNTP - returns net participants

# DIRECTED STATION QUERIES

**Priority Object – EOC**

- ?INFO - returns name, comment and supported directed query commands
- ?CMD - returns list of valid directed query commands
- ?APRSO - returns object information
- ?APRSP - returns object position
- ?APRSS - returns object status
- ?NCPI - returns name, comment
- ?NCPES - returns EOC status
- ?NCPEM - returns EOC mobilization report

# DIRECTED STATION QUERIES

**Priority Object - Shelter**

- ?INFO - returns name, comment and supported directed query commands
- ?CMD - returns list of valid directed query commands
- ?APRSO - returns object information
- ?APRSP - returns object position
- ?APRSS - returns object status
- ?NCPI - returns name, comment
- ?NCPSS - returns shelter status
- ?NCPSC - returns shelter census
- ?NCPSF - returns shelter food reports
- ?NCPSM - returns shelter materiel reports
- ?NCPSW - returns shelter worker census reports

# DIRECTED STATION QUERIES

**General Resource Object**

- ?INFO - returns name, comment and supported directed query commands
- ?CMD - returns list of valid directed query commands
- ?APRSO - returns object information
- ?APRSP - returns object position
- ?APRSS - returns object status
- ?NCGRI - returns name, comment
- ?NCGRV - returns token=value pairs stored for object

# UNDER CONSTRUCTION

- Additional Priority Objects such as medical facilities, incident locations, etc.
- Using Lifeline status for incidents
- Send Winlink reports via Winlink for Priority Objects
- Skywarn – how to enhance?
- Power outage reporting:
  - Example: model http://mema.mapsonline.net/power_outage_public.geojson in APRS
- What else?

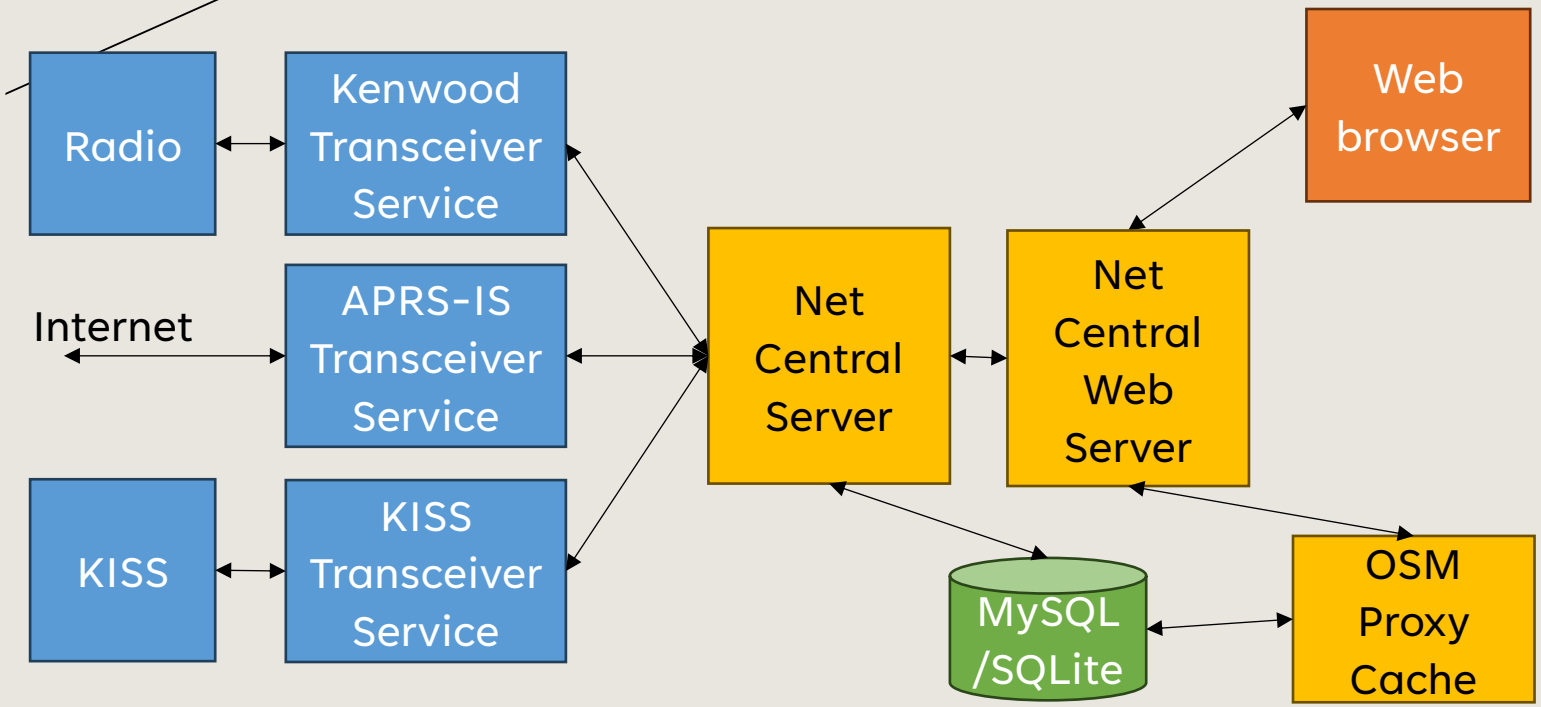
# SIDE DREAMS

- My motivation is to create improved APRS tools for Emergency Communications.  But this can be used just for fun by anyone ☺

- I'd love this to spawn one or one hundred new ideas!

# NET CENTRAL ARCHITECTURE AND TECHNOLOGIES

# NET CENTRAL ARCHITECTURE




**Modern architecture**

Net Central is a REST-based microservice architecture.

Transceiver modules handle technology-specific communication and send consistent information to Net Central REST end points.

Services can run on the same or multiple systems connected over a LAN.

Each transceiver is optional and can be configured for send and receive.

# NET CENTRAL TECHNOLOGIES

**Modern tools and programming languages**

- Using open-source technologies
- Open source licensed under GPL v3.
- Available on Github
- Built from source or install from pre-built binaries.

**Technologies used**

- Java 17
- Micronaut
- Vue3
- MySQL / SQLite database
- javAPRSlib
- Leaflet

# IN THE FIELD – ATGP 2026

# IN THE FIELD – ATGP 2026

## Appalachian Trail Golden Packet

www.atgoldenpacket.net

Licensed amateur radio operators coordinate 15+ sites along the length of the Appalachian Trail from Maine to Georgia using transceivers to exchange packet data between each site with the goal of sending the "golden packet" the entire length of the trail!

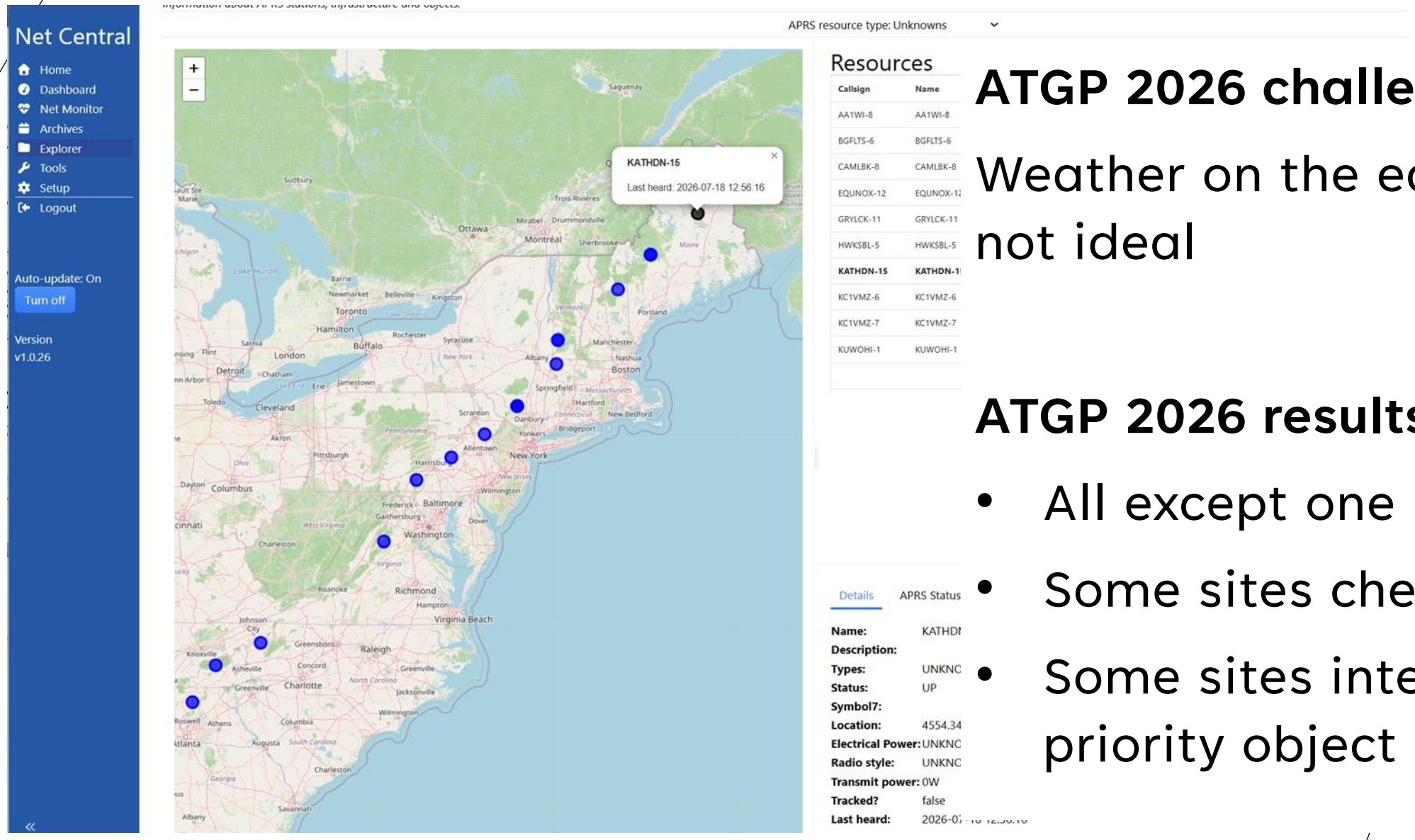
Robert Bruninga (WB4APR - Silent Key), the creator of the APRS protocol, founded the Appalachian Trail Golden Packet event. The intent is to get licensed amateur radio operators ("hams") to feel more comfortable with operating in the field, while demonstrating the ability to send real-time messages along 2200+ miles without the need for any infrastructure!

# IN THE FIELD – ATGP 2026

Normally, ATGP verifies that all sites can hear the other sites, and then a “Golden Packet” is sent from Georgia to Maine.

In 2026, Net Central was used to establish a net via APRS and have all sites check into the net, send messages, interact with a priority object, and secure.

# IN THE FIELD – ATGP 2026




## ATGP 2026 challenges:

Weather on the east coast was not ideal

## ATGP 2026 results:

- All except one site seen
- Some sites checked into net
- Some sites interacted with priority object

# IN THE FIELD – ATGP 2026

Kenwood D710-GA w/SlimJim

- Digipeater for network

B-TECH UV50-PRO w/Comet

- Secondary voice comms

B-TECH UV-PRO HT w/BT

- Net Central link

50Ah Battery

Windows Laptop for Net Central

**Thanks to the ATGP team!**

# INTERACTIVE DEMO

# INTERACTIVE DEMO

- With your APRS messaging-enabled device, check into a net:
  - HAMX-1  send command “CI” for “check-in”
- Send a location beacon
- Answer the question (Q 1 answertext)
- When done, send command “CO” for “check-out”

- View Net Central Web UI from computer or phone browser

# THANK YOU AND 73!

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