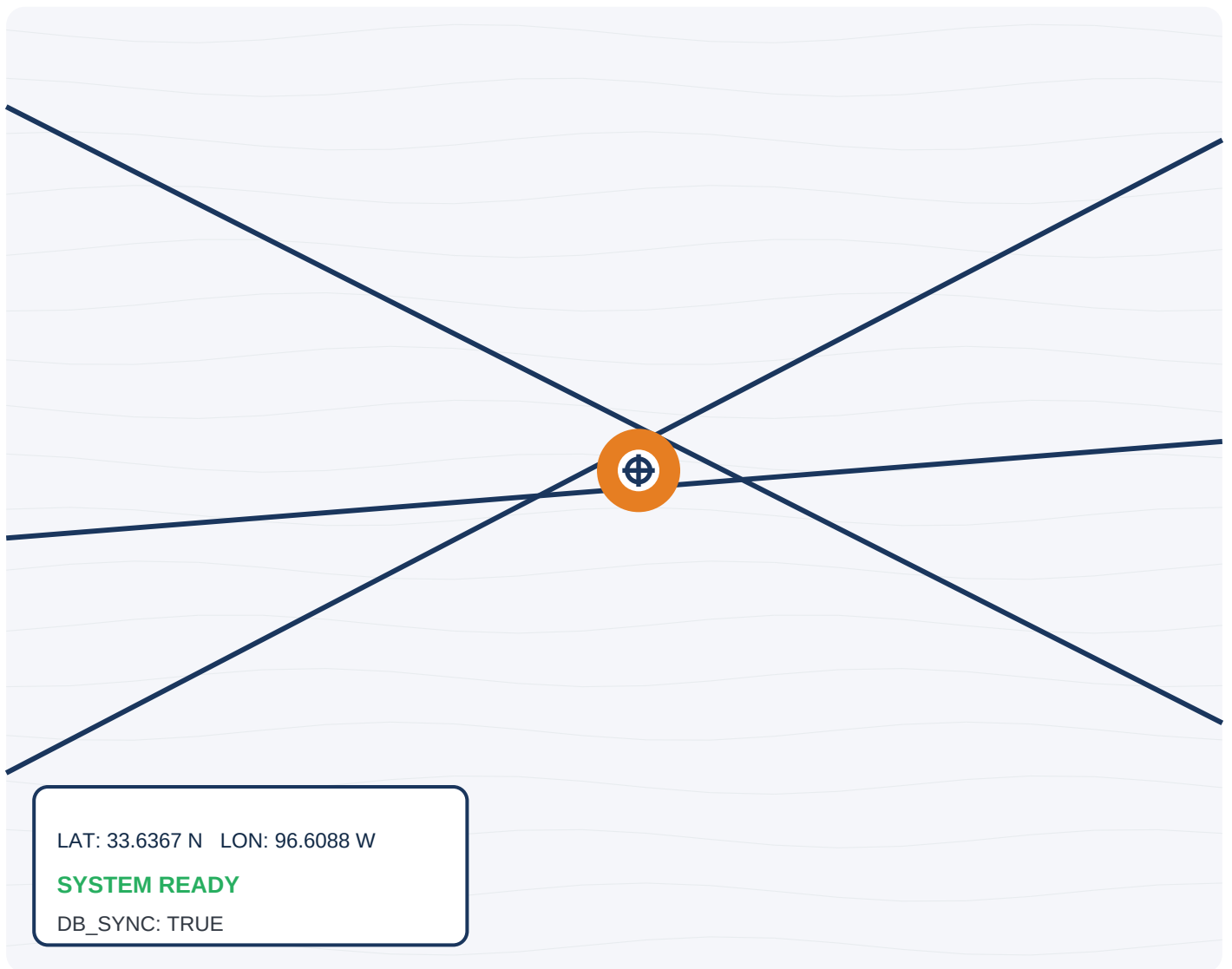


Modernizing Radio Direction Finding

The RadioOps RDF Tracker

A Tactical Field Guide • Improved Edition



All lines of bearing extend fully across the operational map — as required for unambiguous triangulation.

radioops.org • Coordinated amateur-radio interference location

THE EVOLUTION OF FOXHUNTING OPERATIONS

THE LEGACY METHOD



Paper map + protractor

LOCATION TRACKING

Manual lat/long extraction via handheld GPS. Write numbers on paper.

PLOTTING

Paper maps, mechanical protractors, and string. Lines often stop short.

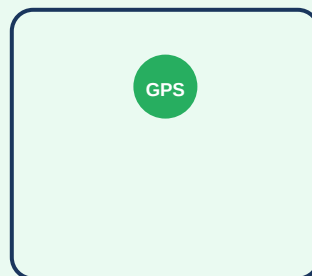
DATA SYNC

Verbally reading coordinates and bearings over crowded RF frequencies.

ERROR RATE

HIGH. Prone to bad bounces, misheard numbers, cluttered maps, transcription errors.

THE RADIOOPS METHOD ✓



LOCATION TRACKING

1-tap smartphone GPS coordinate locking. Browser location services.

PLOTTING

Digital bearing input (000°–359°) with instant rendering. Lines drawn edge-to-edge.

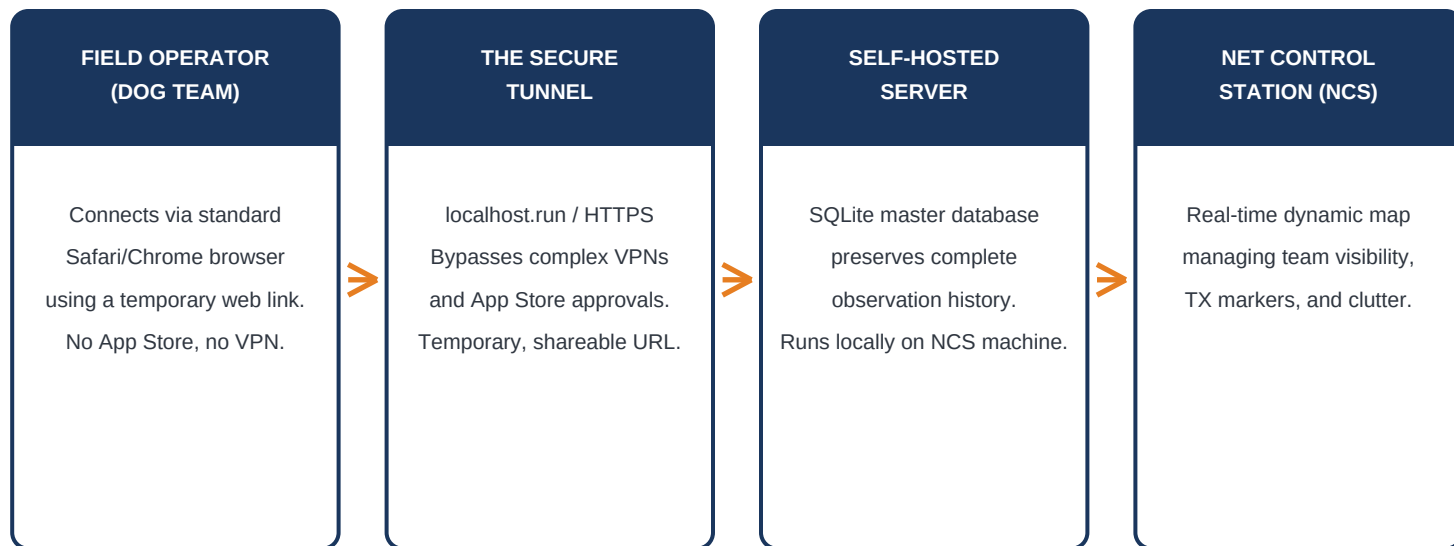
DATA SYNC

Silent, real-time database sync via secure web browser tunnel (localhost.run / HTTPS).

COMMAND & CONTROL

Dynamic Net Control map with 1-click clutter management and TX filters.

FRICTIONLESS ARCHITECTURE: NO APP REQUIRED



Why this architecture matters in the field

- No app install required — any modern phone browser works (iOS Safari, Android Chrome).
- Temporary tunnel links expire; NCS can issue a fresh link if one times out (“No tunnel here”).
- All bearings and locations land in a single SQLite database that NCS can archive or clear.
- Field operators never need to manage ports, certificates, or VPN clients under pressure.

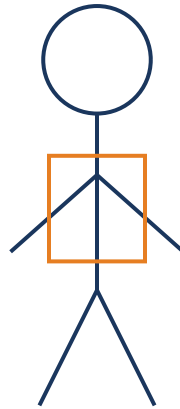
DOG TEAM LOADOUT & CONFIGURATION

COMMUNICATIONS

2 m radio (up to 50 W preferred for simplex, or 5 W/10 W if repeater usable).
Keep transmissions short & disciplined.

SPECTRUM ANALYSIS

TinySA configured for narrow-span tracking. Primary tool for signal presence, strength, and multipath.



ANTENNA ARRAY

Directional (Yagi) for long-range.
Omni (rubber duck) for close-range.
Open SMA for final proximity.

MAPPING INTERFACE

Smartphone or Tripltek tablet running the RadioOps Bearing Entry page.
Keep ≥ 2 ft from metal antennas.

ANALOG BACKUP

City/County map + physical compass.
Always carry. Digital fails; paper does not.

THE FIELD APP: RAPID DATA ENTRY

1. Select Team

Dropdown T-1 to T-6 with A/B suffixes. Match your assigned call.

2. Lock Location

Must allow system location permissions. Tap map to drop pin if GPS fails.

3. Enter Bearing

Degrees 000–359. Read from compass or Yagi peak.

4. Send It

Plot Bearing button. Data appears instantly on NCS map.

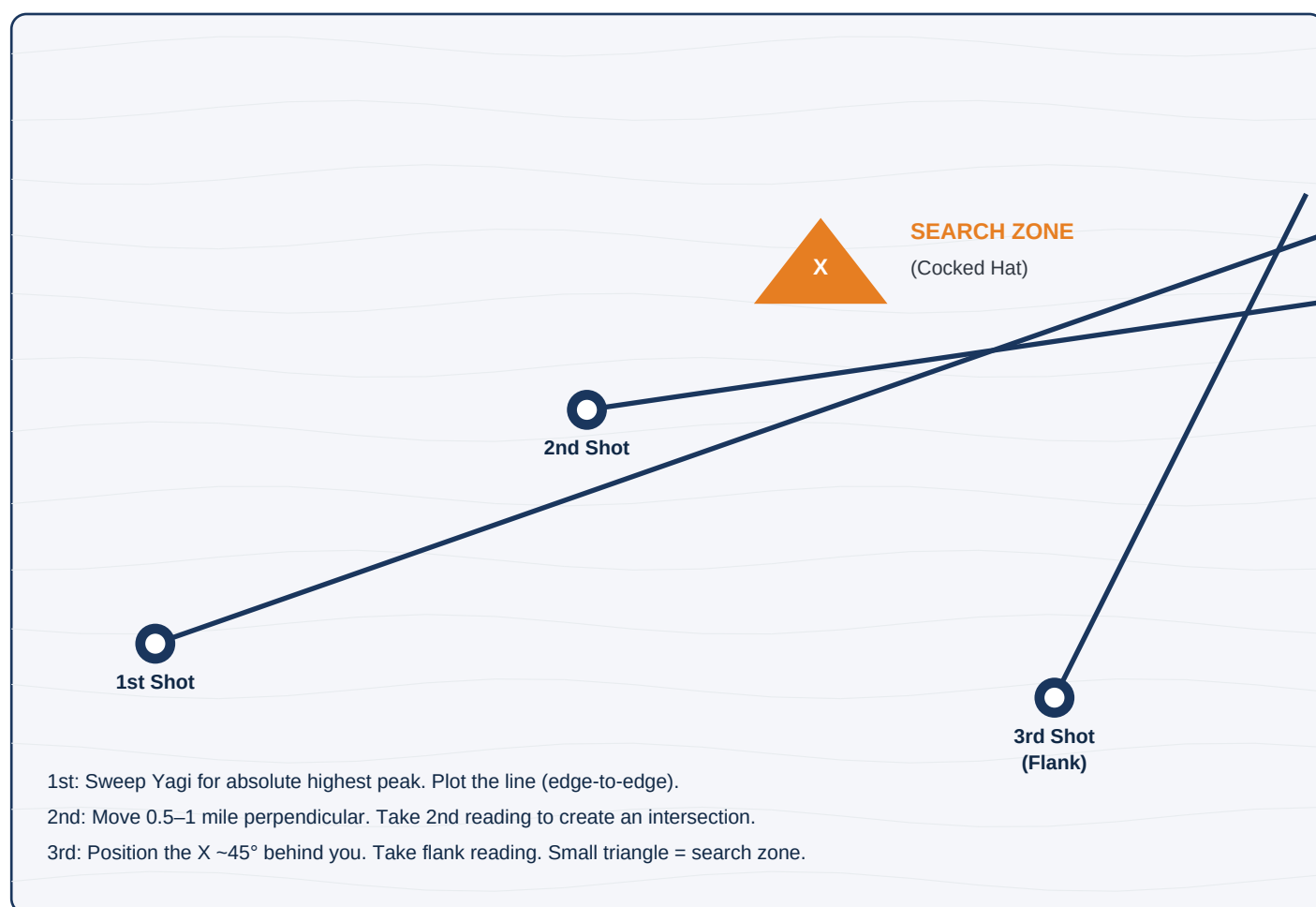
The screenshot shows a mobile app interface titled "RadioOps Bearing Entry". It features a "Team:" label followed by a dropdown menu showing "T-1" with a downward arrow. Below this is a "Current Location:" label and a green button labeled "GPS LOCK". Further down is a "Bearing (°):" label followed by a text input field containing the number "245". At the bottom is a dark blue button labeled "Plot Bearing".

QUICK TROUBLESHOOTING

"No tunnel here" → Radio NCS for a fresh link. | GPS fails → Enable browser location or drop manual pin.

Bad bounce → Verbally radio NCS to temporarily hide your line from the master map.

THE SHOOT & PLOT METHOD



The resulting small triangle establishes the definitive search zone.

Real-world tip: Never trust a single LOB. Multipath and reflections are common. Always confirm with a second geometry.

If the triangle is large, move and re-shoot. Tight geometry beats long-range guesses.

TINYSA CONFIGURATION PROFILE

Input & Mode

Set to: LOW INPUT.
Left SMA port — ideal for frequencies through 350 MHz.
Use the low-frequency path for 2 m work.

Frequency & Span

Set Center Freq (e.g. 146.565 MHz).
Set Span to 100 kHz.
Narrow view while still allowing frequency movement observation.

Bandwidth & Level

Set RBW to 10 kHz.
Balances visibility and speed.
Set Attenuation to AUTO.
Keeps strongest signal below -25 dBm.

Tracking Protocol

Set Marker 1 to Max Search / Tracking. Auto-tracks the highest peak in the span.
Watch for jitter — that is usually multipath.

■ MULTIPATH WARNING

If the spike is jittery or unusually wide, it is almost certainly a reflection. Move 50 ft and try again.
Real-world: 3rd-harmonic sniff — if the fundamental overloads the TinySA, tune to Fundamental $\times 3$ (e.g. 146.565 $\rightarrow$ 439.695 MHz) to weaken the signal and still get a usable bearing.

THE RF TRACKING FUNNEL

PHASE 1: LONG RANGE (Miles → 500 ft)

Antenna: Yagi (Directional)

Objective: Establish reliable direction, not highest signal.

Pro-Tip: 3rd Harmonic Sniff. If overloaded, tune TinySA to

Fundamental $\times 3$ to weaken the signal while keeping direction.

PHASE 2: CLOSE RANGE (100–500 ft)

Antenna: Omni (Rubber Duck)

Objective: Find strongest area. Spin 360°. The “Null” means the fox is directly behind you. Body-fade works here too.

PHASE 3: THE KILL (< 50 ft)

Antenna: None (Open SMA port)

Objective: Proximity indicator. –40 dBm is close;

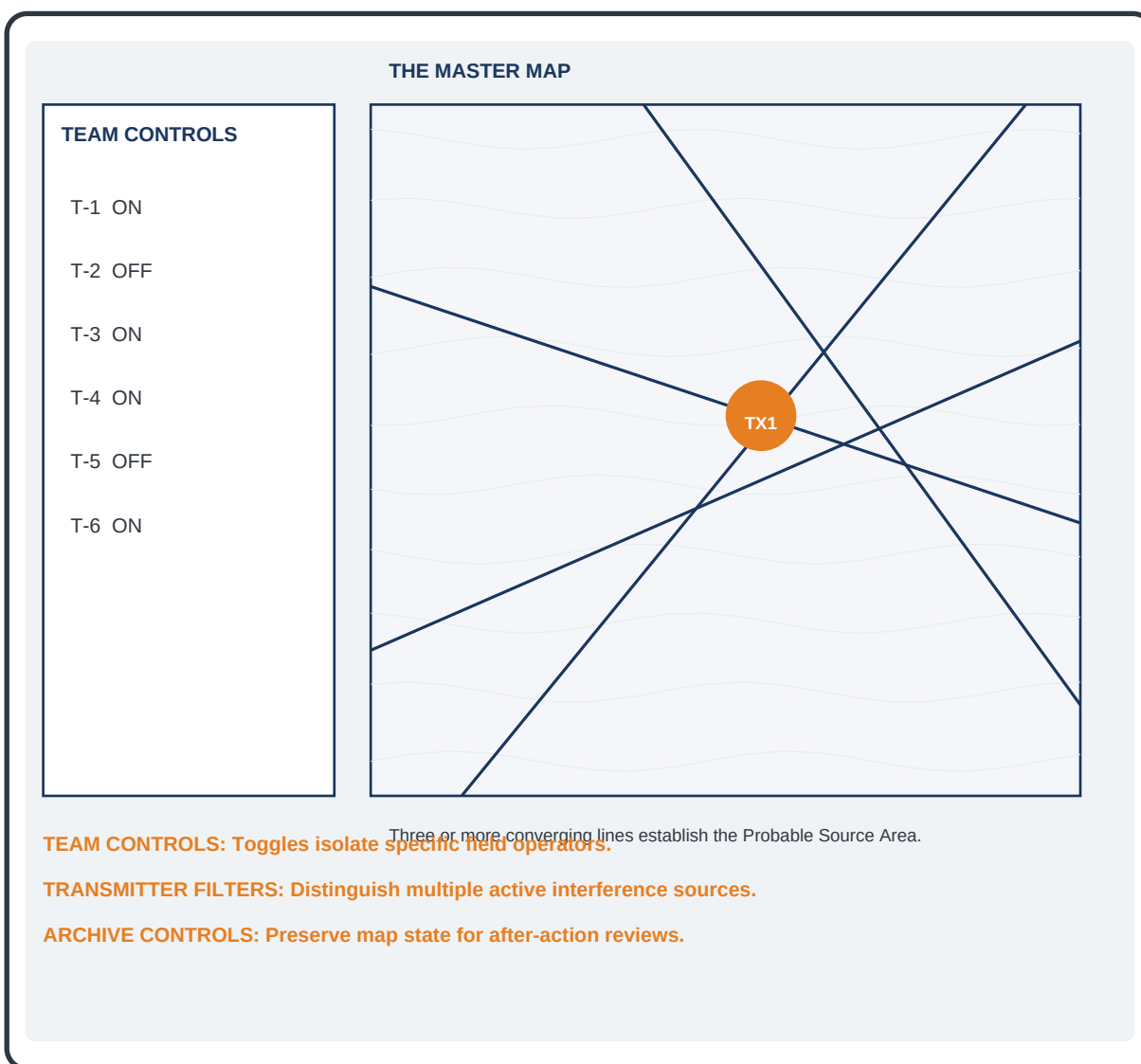
–10 dBm means you are standing on it. Open SMA is intentional.

THE GOLDEN RULE

Do not change antennas based on a specific distance.

Change when the current antenna stops providing useful information.

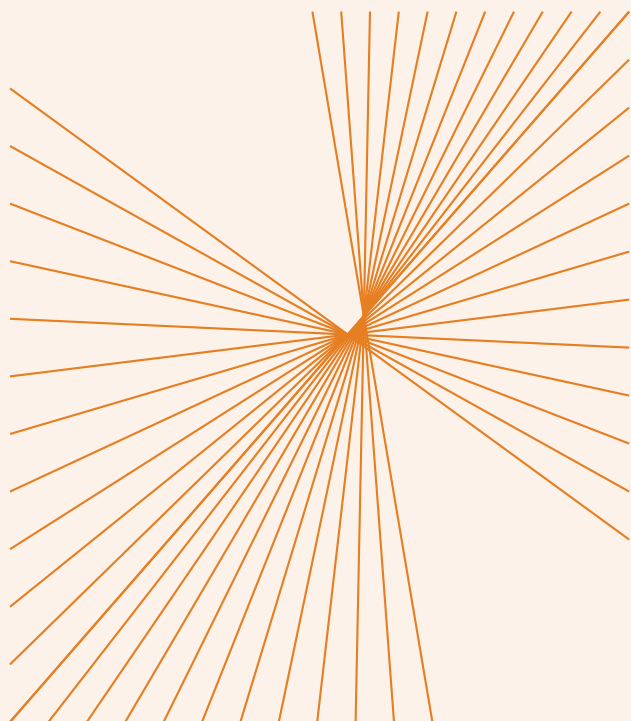
NCS DASHBOARD: COMMAND & CONTROL



MANAGING MAP CLUTTER & SIGNAL TRUTH

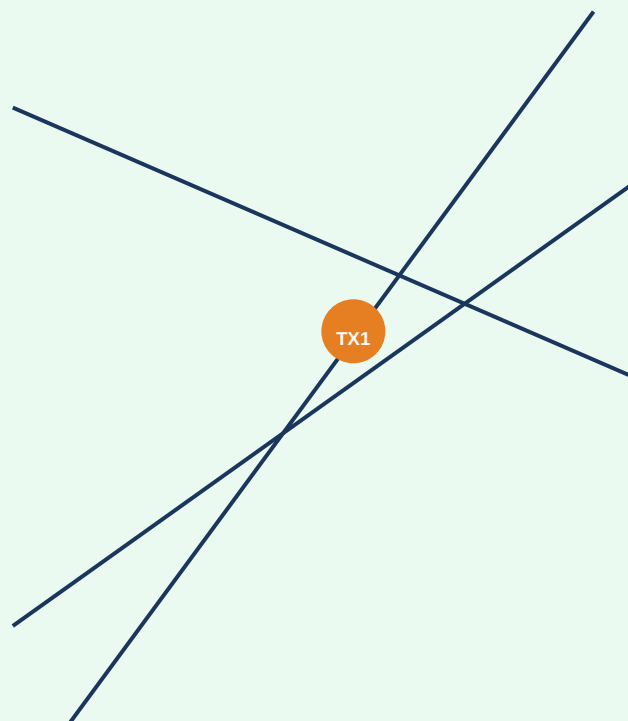
THE MESSY REALITY

Historical observations remain forever.
Bad bounces ruin operational clarity.



NCS ISOLATION

NCS clicks the “T-2” toggle to hide
bad data. Convergence becomes clear.

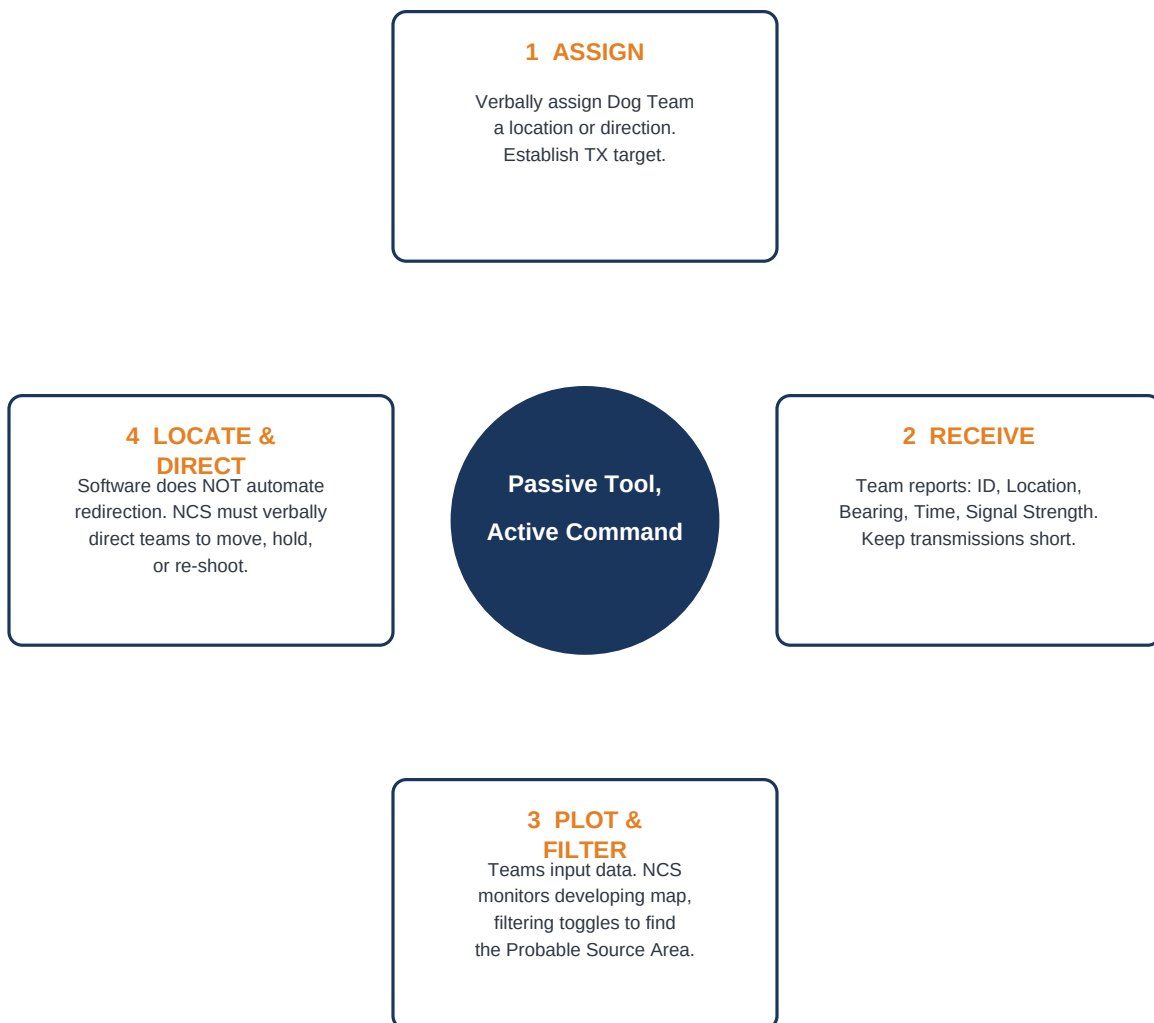


Historical observations remain in the SQLite master database forever.

NCS uses team toggles and TX filters so the live map stays operationally useful.

Real-world: Bad data is not deleted — it is filtered. The log still holds the full truth.

NCS OPERATIONAL WORKFLOW



The tracker is a shared picture. Decision-making and radio discipline remain human.

STANDARDIZED TRAINING SCENARIOS

Scenario A: Constant Interference (The Baseline)

Simulation: Stationary 5 W transmitter constantly blocking a repeater; simplex required.

Focus: Testing basic mapping, field concepts, antenna progression, and Shoot & Plot geometry.

Difficulty: Moderate. Highly recommended as the first club exercise.

Real-world notes: Expect multipath near buildings and vehicles. Practice the 3rd-harmonic sniff early.

NCS should deliberately inject one “bad bounce” so teams learn to request a hide.

Success criteria: Tight cocked-hat within 15 minutes of first solid LOB.

Scenario B: Intermittent Interference (Real-World)

Simulation: Mobile bad operator tracking the 147.600 uplink frequency, keying unpredictably.

Focus: Time-logged observations. Teams must precisely log when a signal was present.

Difficulty: High. Tests radio discipline and NCS timeline correlation.

Real-world notes: The signal may stop before a team arrives. Time stamps in the master log become critical.

NCS must correlate multiple short observations across teams to reconstruct the path.

Success criteria: Correctly identify the last known location and direction of travel of the mobile source.

IT ADMINISTRATION: TEST-TO-PROD PIPELINE

1. Test Environment

App runs at /home/jimmy/Ham_radio_TEST/ on Port 8003.
Managed by radioops-rdf-test.service.

2. Backup Prod

Create a timestamped backup of existing rdf_map.py
in the Prod directory before any change.

3. Promote & Isolate

Copy (do not move) code from Test to Prod.
Manually change internal script port to Port 8002.

4. Systemd Restart

Run: `sudo systemctl restart radioops-rdf.service`
Never manually launch a duplicate process.

THE GOLDEN RULE

Test is the development environment. Production is the deployment environment.
Never develop directly in production.

THE ANATOMY OF A PERFECT HUNT

PILLAR 1 Hardware Precision (Dog Teams)

Execution of the Shoot & Plot method and intelligent TinySA antenna progression based on utility, not distance. Multipath awareness and 3rd-harmonic technique.

PILLAR 2 Software Architecture (RDF Tracker)

Frictionless mobile deployment (1-tap GPS) and immutable SQLite database creating a shared operational reality. Edge-to-edge LOBs and 1-click clutter management.

PILLAR 3 Human Protocol (NCS Discipline)

Strict radio discipline, continuous clutter management, and authoritative verbal redirection. The software is a tool; the net is led by a human.

CENTRAL INSIGHT

The tracker does not replace fieldcraft; it modernizes it.
When hardware, software, and human protocol align, interference is eliminated.

radioops.org • Interference Team