Integration with Winlink and APRS

The Complementary Stack

No single communications technology is sufficient for all emergency communications scenarios. The most resilient deployments combine multiple systems that complement each other's strengths. The three-layer stack of LoRa mesh plus Winlink plus APRS provides digital messaging, store-and-forward email, and position tracking - covering the primary data needs of an ICS-integrated emergency communications response.

Winlink Overview

Winlink is a worldwide radio email system that allows licensed amateur operators (and, under certain authorizations, non-amateur stations) to send and receive email messages via radio. Amateur-band Winlink requires an amateur radio license; separate Winlink networks exist for MARS and authorized government/EmComm stations operating under their own licensing (e.g., Part 80/government allocations) — these are not open to unlicensed users on amateur frequencies. Key components:

- **Winlink Common Message Server (CMS)**: The cloud-based message store operated by the Winlink Development Team. Messages are held until retrieved by the recipient.
- **Radio Message Server (RMS)**: A gateway station (typically a licensed operator's station with a TNC and radio) that provides radio access to the CMS. RMS gateways exist on HF (Pactor, VARA HF, ARDOP, Robust Packet) and VHF/UHF (Packet, VARA FM). Note: LoRa is not an official Winlink RMS access mode — third-party experiments bridge LoRa mesh to Winlink, but there is no LoRa RMS mode in Winlink's supported-mode list.
- **Client software**: Winlink Express (Windows) or Pat Winlink (cross-platform, open source) are used by operators to compose messages and connect to RMS gateways.

Building a Winlink Gateway for ICS Form Delivery

A Winlink RMS gateway co-located with a mesh EOC node creates a powerful hybrid: field operators compose ICS 213 messages on a mesh-connected device, and those messages are forwarded to the EOC node which relays them into the Winlink system for delivery to served agency email addresses.

> ⚠ **Legal boundary — plaintext only, licensed operator.** Winlink rides licensed amateur RF, where 47 CFR §97.113(a)(4) prohibits transmitting messages encoded to obscure their meaning. Meshtastic payloads are AES-256 encrypted by default, so the gateway must present **plaintext (decrypted) content** on the amateur Winlink leg, and a **licensed amateur** must operate that leg. Encrypted Meshtastic payloads cannot lawfully be transmitted on amateur frequencies.

Hardware Required for a VHF/VARA FM Gateway

- VHF FM transceiver (e.g., Icom IC-7100, Kenwood TM-D710)
- Sound card interface or VARA FM modem (e.g., Digirig Mobile)
- Windows PC or Raspberry Pi running Winlink Express or Pat
- Internet connection to CMS (for a full gateway); or peer-to-peer mode for offline operation

Configuration Steps (VARA FM)

1. Install VARA FM modem software and configure audio levels to the transceiver.
2. Install Winlink Express. Configure station call sign, grid square, and VARA FM as the primary radio mode.
3. Enable RMS Relay mode in Winlink Express to accept connections from client stations.
4. Register the gateway with the Winlink network (requires licensed callsign and internet access at least once for initial registration).
5. Test by connecting with a second station using Pat or Winlink Express in client mode.

ICS 213 forms composed in Winlink Express are transmitted as structured email attachments. Served agencies with standard email can receive these forms without any special software.

APRS as a Parallel Position Tracking Layer

Automatic Packet Reporting System (APRS) operates on 144.390 MHz (North America) and provides real-time position reporting, weather data, and short messaging via a nationwide network of digipeaters and I-gates (internet gateways). APRS operates under Part 97 and requires an amateur radio license to transmit: a mesh-to-APRS position bridge must be operated by a licensed amateur, and unlicensed users may not transmit on 144.390 MHz. APRS complements Meshtastic mesh in the following ways:

Feature	Meshtastic Mesh	APRS
Position tracking	Yes (GPS, within mesh coverage)	Yes (GPS, nationwide via digipeaters)
Text messaging	Yes (multi-hop; payload encrypted, but the default channel uses the public AQ== key — meaningful confidentiality requires setting a custom key)	Limited (unencrypted, short messages)
Internet connectivity required	No (self-contained mesh)	No for local; yes for APRS-IS
License required	No (ISM band)	Yes (Technician or higher)
Nationwide coverage	Only where mesh nodes exist	Yes (existing infrastructure)
Typical range per hop	2-15 km	10-100 km via digipeater

Note: Mesh text/position transport is best-effort with no guaranteed delivery. Where a message must be confirmed delivered or archived, use Winlink rather than mesh.

A field operator equipped with both a Meshtastic device and a VHF APRS tracker (e.g., Mobilinkd TNC with a handheld radio, or a Kenwood TH-D74) provides redundant position visibility: the EOC can track them on the local mesh map AND on aprs.fi via APRS-IS.

Mesh + Winlink + APRS: The Complete Stack

When all three systems are operational, the complementary roles are:

- **LoRa Mesh (Meshtastic)**: Short-range text messaging (payload encrypted, but the default channel uses the public AQ== key — set a custom key for real confidentiality),

welfare check-ins, ICS 213 relay within the incident area, GPS position sharing among mesh-equipped operators.
- **Winlink**: Store-and-forward email delivery for ICS forms to served agency recipients, long-haul message delivery via HF when VHF infrastructure is unavailable, formal record of messages (timestamped, archived).
- **APRS**: Nationwide position tracking for mobile operators outside mesh coverage, real-time map display on aprs.fi for remote coordination, weather object broadcasting.

Tools and Software

Tool	Platform	Purpose
Meshtastic app	iOS / Android / Web	Mesh node control, messaging, map view
Winlink Express	Windows	Winlink client and gateway software; ICS form templates included
Pat Winlink	Linux / macOS / Windows / Raspberry Pi	Open-source Winlink client; CLI and web UI; ideal for headless gateway builds
Direwolf	Linux / Windows	Software TNC for APRS and Winlink Packet; runs on Raspberry Pi
YAAC / APRSdroid	Java (desktop) / Android	APRS client for tracking and messaging
atak-forwarder	Android (ATAK plugin)	Forwards Meshtastic positions into ATAK/WinTAK for ICS TAK server integration

Practical Integration Workflow

1. Pre-event: Configure all mesh nodes on the agreed channel. Pre-load ICS 213 message templates on devices used by served agency liaisons.
2. At EOC: Stand up Winlink gateway on VHF. Confirm Pat or Winlink Express can reach a CMS. Test ICS 213 form delivery to served agency email.
3. At EOC: Enable APRS I-gate (via Direwolf and VHF radio) to provide internet-visible position tracking for all APRS-equipped operators.
4. Operations: Field operators use Meshtastic for local comms. When a message must reach a served agency email (hospital, county OES), it is forwarded to the EOC mesh node and injected into Winlink for delivery. The EOC gateway must hand **plaintext (decrypted)** content to a **licensed amateur**'s Winlink station — encrypted mesh traffic cannot be transmitted over amateur Winlink (47 CFR §97.113(a)(4)).
5. Position tracking: EOC staff monitor both the Meshtastic map (local) and aprs.fi (wide area) to maintain situational awareness of all resources.

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