

# Packet Radio Overview

March 5, 2020

Jim Oberhofer KN6PE



# Agenda

---

1. What is Packet Radio?
2. Why use it?
3. The Packet Radio Network
4. Outpost Packet Message Manager
5. Packet Radio in Cupertino



---

# ***What is Packet Radio?***

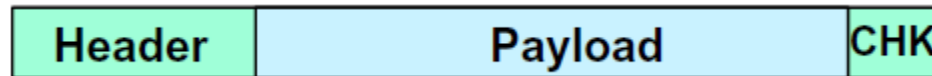


# What is Packet Radio?

... in a nutshell

---

- One of many digital modes available in Amateur Radio
- Transmitted information is received 100% error free!
- Uses the AX.25 protocol, an extension of the ITU X.25, with data transparency, error checking, and automatic control
- Divides data streams into *bite-sized* packets
- Sends a “packet” of data at a time: envelope + payload



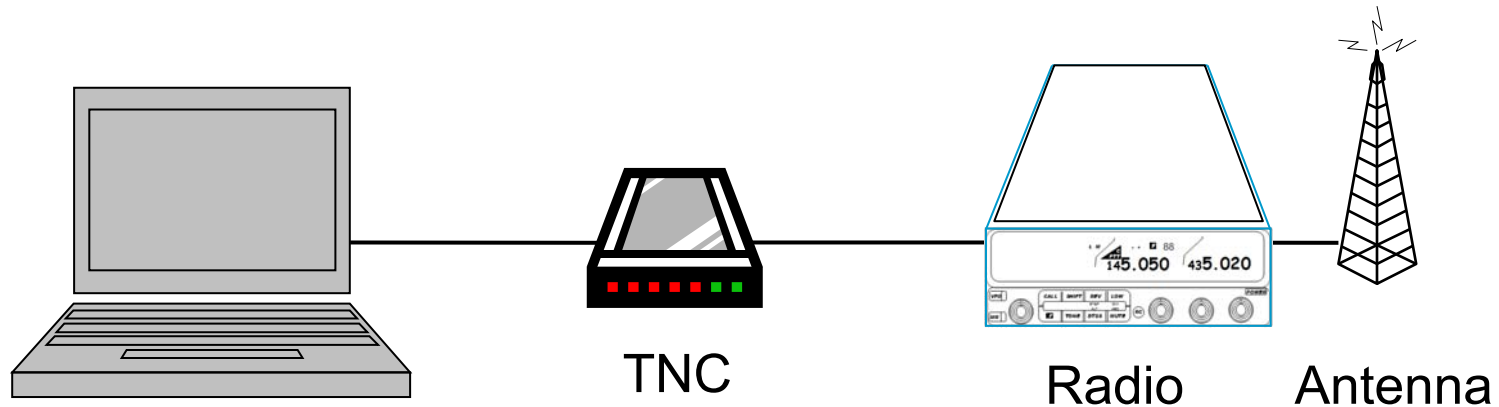
- Envelope contains a header at beginning and checksum at end
  - Header includes the From and To addressing information
  - Payload contains the data to be sent
  - Checksum determines if packet was received error free
- Data transfer speeds from 1200 baud to 19.6K Baud on VHF/UHF



# What is Packet Radio?

*What are the components?*

---



Computer: runs a “terminal emulation” program

TNC: ***Terminal Node Controller***; similar to a telephone modem; implements the AX.25 protocol, and is the interface between your radio and your computer. May be implemented in either hardware or software

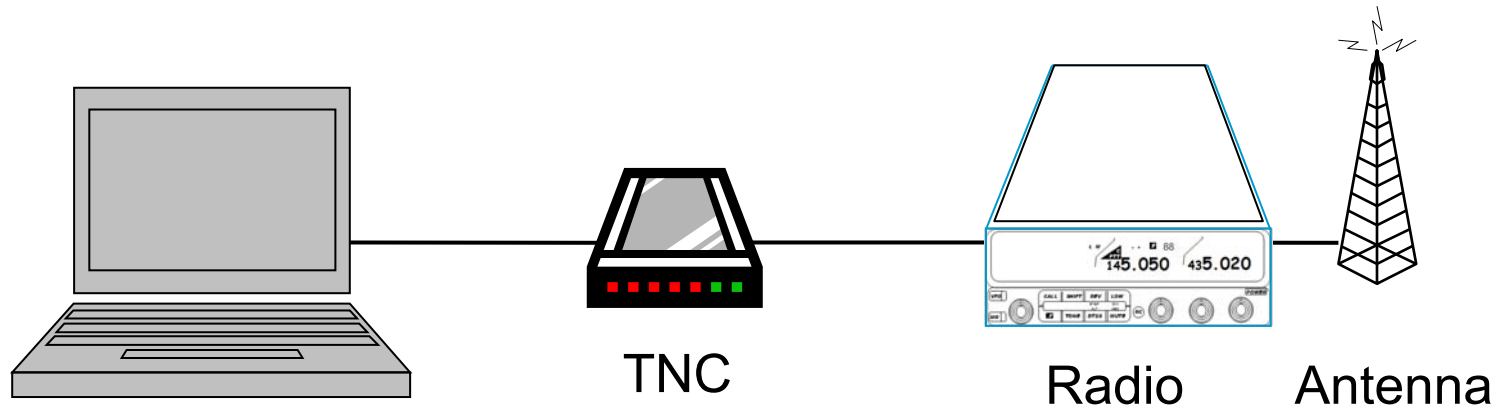
Radio: ... and antenna; transmits the digital data sent to the TNC to another packet station



# Packet Station

## System Requirements

---



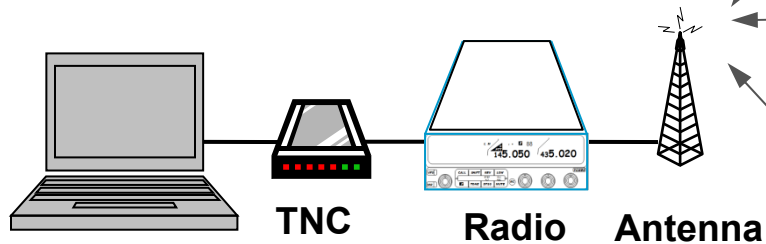
- Computer:
- Laptop or larger network with at least Windows 8.1
  - Battery runtime of at least 1 hour
- TNC:
- Hardware TNCs preferred (such as a KPC-3+)
  - Software TNCs will work, but they are tricky to set-up and operate; not recommended
- Radio:
- Mobile radio with 25 Watts or more of output
  - HTs will work, but you may become a hidden node
- Antenna:
- Get the antenna up as high as possible



# Packet Radio

*What can we connect to?*

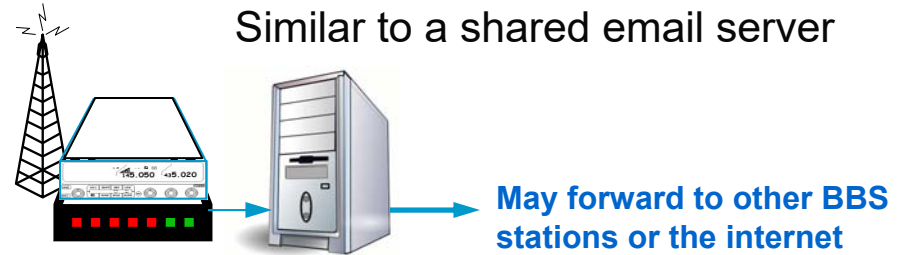
A packet station can connect to a variety of other different kinds of stations.



**Packet Station**

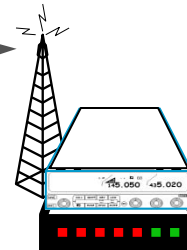
## Bulletin Board System (BBS)

Similar to a shared email server



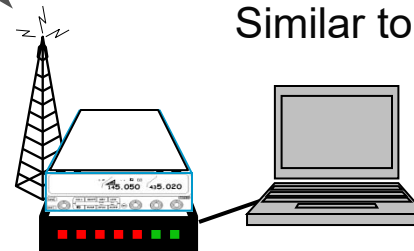
## Personal BBS and Mailbox

Similar to a private email server



## Keyboard to Keyboard

Similar to texting



---

# ***Why use Packet Radio?***



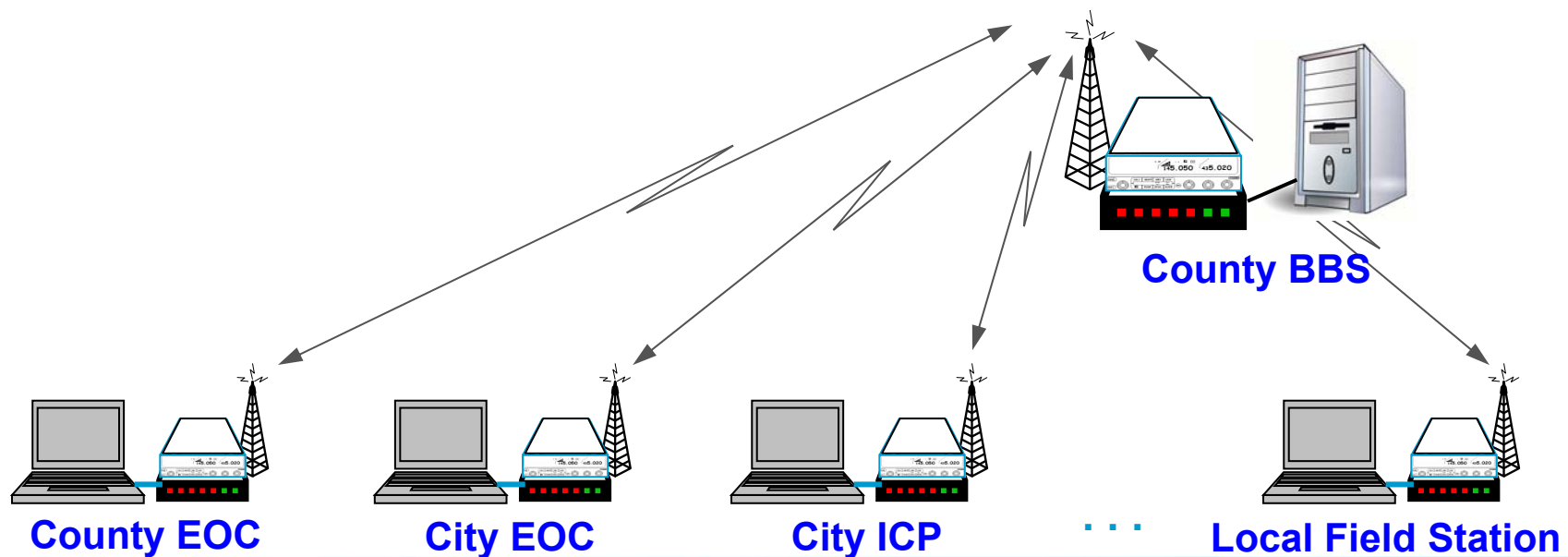


# Why use Packet Radio?

*The case for packet radio*

## 1. Message Store and Forward

- BBSs allow messages to be stored, retrieved, or forwarded throughout the connected BBS network.
- The recipient does not need to be on line to get the message, meaning that messages can be retrieved at the recipient's convenience.

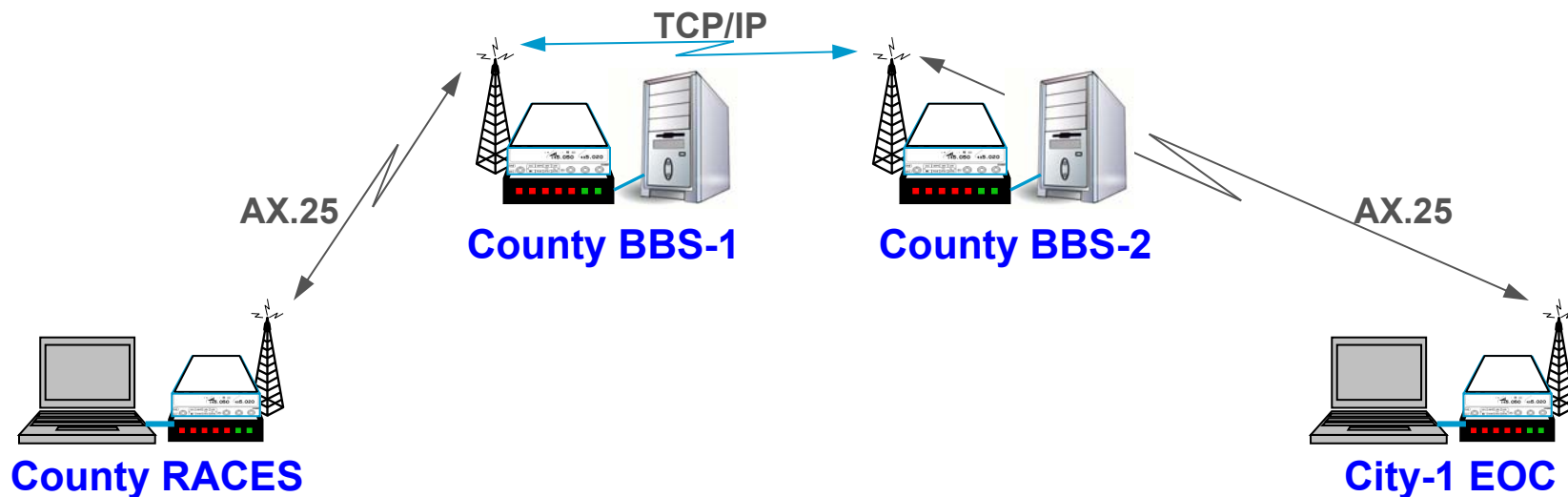


# Why use Packet Radio?

*The case for packet radio*

## 2. Communications Protocol – Error Free messaging

- Packet uses a protocol called AX.25. This is based on the ITU X.25 protocol for networked packet communications.
- AX.25 supports error correction and control that guarantees that all packets (and subsequently messages) are delivered correctly.



Cupertino ARES/RACES

# Why use Packet Radio?

*The case for packet radio*

---

## 3. Complex messaging

- Ideal for passing lists, addresses, instructions, forms, or complex words (i.e. pharmaceuticals or chemicals)
  - you do not want to confuse
    - **Hydrogen Sulphide** (a gas) with **Hydrogen Sulfate** (an acid)

Messaging by packet ensures...

1. the originator can verify the content before it is sent,
2. reduces transcription errors between the sender and receiver, and
3. keeps the voice channel clear for other critical traffic.

# Why use Packet Radio?

*The case for packet radio*

## 4. Wide range of message content

### Structured Text

- Lists
- Addresses
- Tables

### Forms

- ICS 213 messages
- 9-1-1 requests
- Status
- Logistics
- Public Notices
- Others...

### Unstructured Text (informal message)

- Health and Welfare
- Simple text messages

**CUP-174: Shelter material Request - Packet Message**

File Edit Actions Window Help

Print Send Save Delete Close Urg

Private Message

Bbs: XSCEOC

From: CUPEOC

To: SJREOC

Subject: CUP-174: Shelter material Request

Shelter: Quinlan Center  
City: Cupertino, CA  
Request: Material replenishment

| Item# | Desc           | On-Hand | Units   | Qty | Needed |
|-------|----------------|---------|---------|-----|--------|
| 1     | cots           | 30      | ea      | 25  | 18-Ma  |
| 2     | blankets       | 45      | ea      | 15  | 18-Ma  |
| 3     | water, bottles | 200     | bottles | 100 | 19-Ma  |
| 4     | First Aid kits | 3       | kits    | 12  | ASAP   |
| 5     | Toilet paper   | 50      | rolls   | 250 | 19-Ma  |
| 6     | tooth brushes  | 10      | ea      | 50  | ASAP   |
| 7     | tooth paste    | 5       | ea      | 55  | ASAP   |
| 8     | note pads      | 0       | ea      | 25  | 19-Ma  |
| 9     | pencils        | 0       | ea      | 25  | 19-Ma  |
| 10    | MRE            | 10      | cases   | 300 | 18-Ma  |



# Why use Packet Radio?

*The case for packet radio*

---

## 5. Reduces message handling

- Messages can originate from standard PC applications and sent directly to the packet application, or memory stick by *sneaker-net* to the radio room for loading and sending.
  - Spreadsheets using .csv (comma-delimited) files
  - Cut-and-paste docs
  - Direct import of text files



Because packet is digital and relies on a computer, messages also can go directly to a printer.



# Why use Packet Radio?

*The case for packet radio*

---

## 6. And finally...

### It's fast

- When there is no Internet, it's fast
- 7 to 15 times faster than voice

### It's easy

- Hardware: pre-built cables; straight-forward connections
- Software: if you can use e-mail, then you can use Outpost

### It's deployable

- Virtually anywhere in the city, county, and most of surrounding counties; no specialized radios or antennas are required

### It fits our served agencies' needs

- Preferable for long, complex, and/or high volume messages; explicit acknowledgements

---

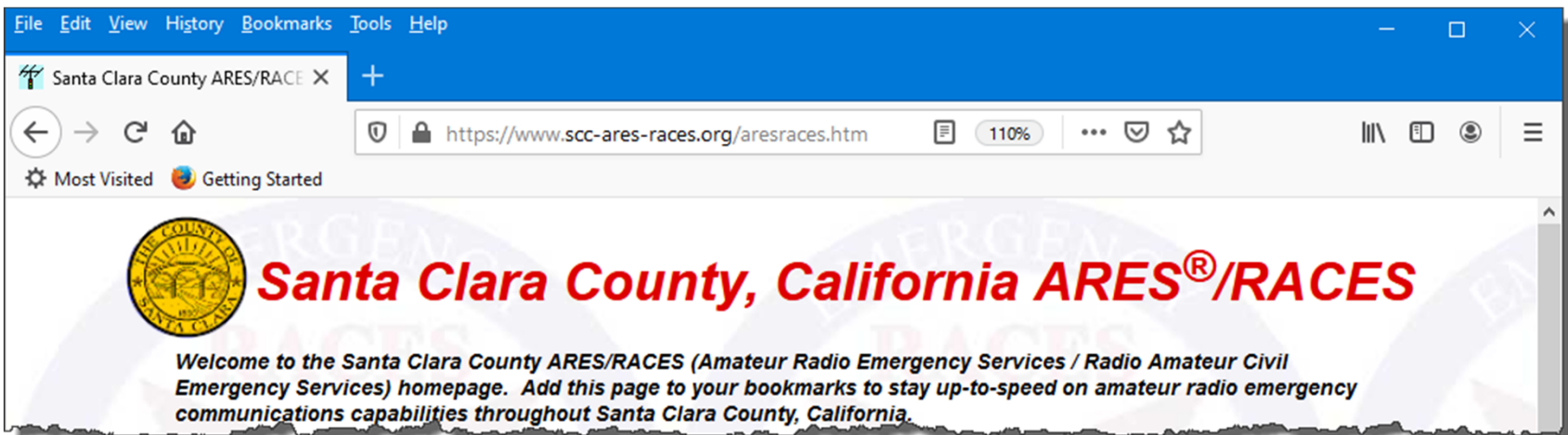
# ***Packet Radio Network***





# First, get to know this site...

<https://www.scc-ares-races.org/>



### Training & Events Calendar

Click on an event title for more detail

|                            |                                |
|----------------------------|--------------------------------|
| <b>Saturday, March 7</b>   |                                |
| 9:00 AM                    | Net Control - Type III, Part B |
| <b>Saturday, March 14</b>  |                                |
| 9:00 AM                    | Fundamentals of Emergency      |
| <b>Tuesday, March 17</b>   |                                |
| 8:30 PM                    | Training Net - Message Passi   |
| <b>Saturday, March 21</b>  |                                |
| 9:00 AM                    | Pop-Up Net Control Practice    |
| <b>Wednesday, March 25</b> |                                |
| 8:00 AM                    | Statewide Medical Health Exe   |
| <b>Wednesday, April 1</b>  |                                |
| 10:00 AM                   | Santa Clara County EOC Ori     |

### QUICK LINKS

**ALERTS**

Frequency Lists: [County Voice](#), [County Packet](#), [Regional](#)

### SERVICES

**Overview**

**Emergency Management:** [Op Area EOC](#), [Jurisdiction EOCs](#), [Credentialing](#), [Mutual Aid](#)

**Agencies and Community:** [Allied Health](#), [County Fire](#), [Hospitals](#), ...

### OPERATIONS

[Activation Info](#), [Contact Info](#), [DSW](#), [Forms & Signs](#), [Frequency Lists](#), [Go Kit](#), [Mutual Aid](#), [Nets](#), [Programs \(Credentialing Program, \[Hospital Net\]\(#\)\)](#), [Standards & Procedures](#), [Monthly EC report](#), [More...](#)

### DATA NETWORKING

**Overview**

**Services:** [Packet BBS](#), [E-mail](#), [Intranet Access](#), [Internet Access](#)

**Access:** [AX.25 over VHF](#), [AX.25 over IP/UDP](#), [TCP/IP over UHF](#), [TCP/IP over Mesh](#), [TCP/IP over WiFi](#), [TCP/IP over LAN](#)

### TRAINING & EVENTS

**Calendar and Sign-Up**

**For More Info. & Sign-Up, click here to visit our Training & Events System**

---

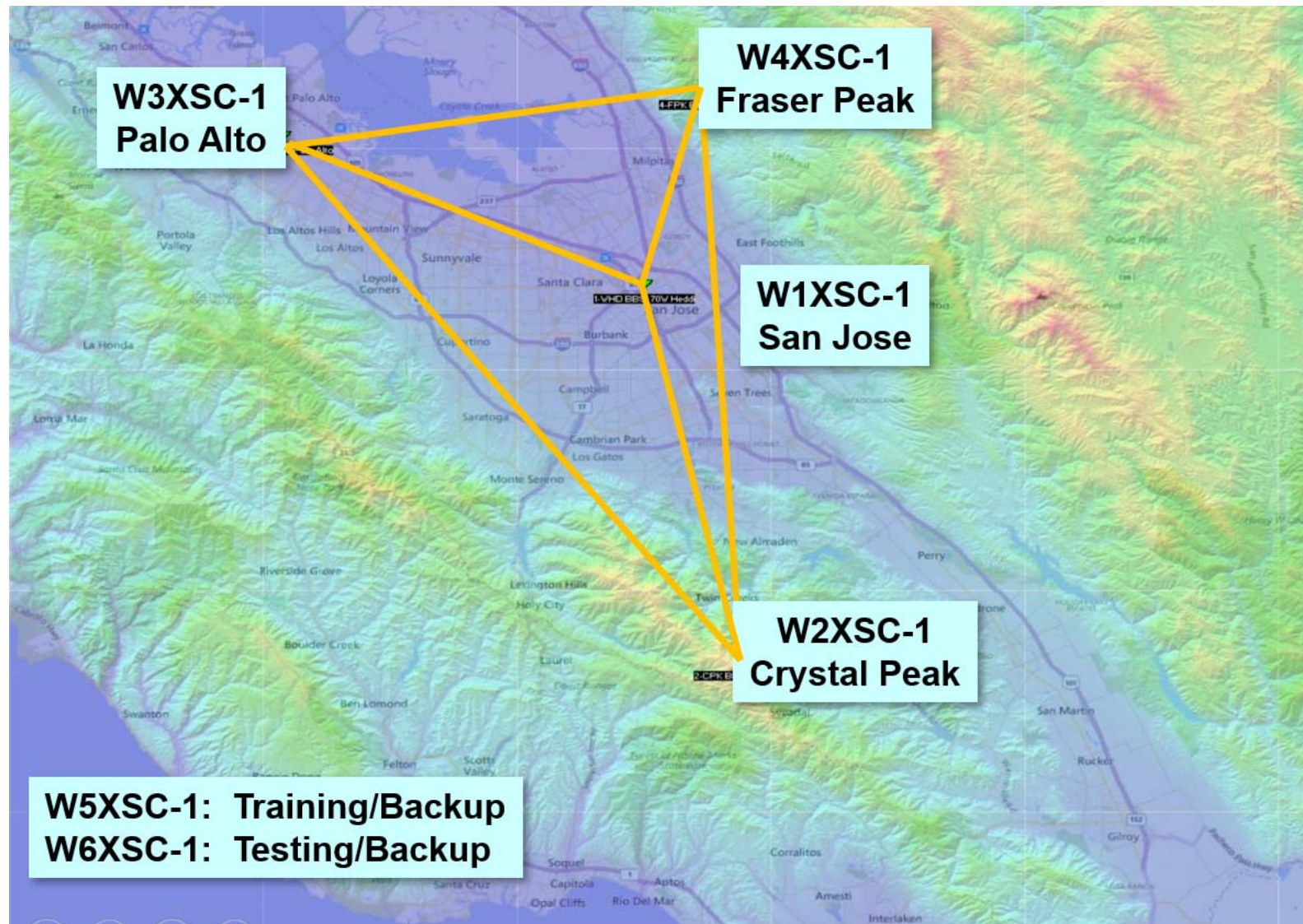
[Pictures from the Radio Direction Finding Drill August 10, 2019](#)

---

[Pictures from Advanced Packet Class](#)



# SCC RACES BBS Locations



# SCC RACES BBS Network

## Operational Concepts

---

- From anywhere/to anywhere in the county
  - Schools, shelters, hospitals, neighborhoods, parks, tents, ...
  - Even if: Internet, cellular and commercial power are all down!
- All cities/agencies can reach at least 2 BBSs
  - Provides backup in case of failure
  - All users in a city/agency can use the same primary & alternate BBSs
  - All BBSs have equivalent functionality; simplifies training
- The network is run like a commercial network
  - It is intended to work in an emergency
  - UPS, backup generators, physical and network security
  - Testing, automated monitoring, user communications
  - Avoid single points of failure
- Result: Zero unplanned service outage in 9+ years!



# SCC RACES BBS Network

## Which BBS?

- Each city/agency has a primary and secondary BBS.
- All individuals within a City use the same BBS as their city.
- Use the primary BBS whenever possible.
- If primary fails, cities on that BBS are distributed across the other three BBSs.

| #                                      | Agency                           | Prefix | Primary BBS | Secondary BBS |
|----------------------------------------|----------------------------------|--------|-------------|---------------|
| Santa Clara County Cities and Agencies |                                  |        |             |               |
| 1                                      | American Red Cross               | ARC    | W1XSC       | W4XSC         |
| 2                                      | CAL FIRE VIPs - Santa Clara Unit | SCU    | W2XSC       | W1XSC         |
| 3                                      | Campbell, City of                | CBL    | W1XSC       | W4XSC         |
| 4                                      | Cupertino, City of               | CUP    | W1XSC       | W4XSC         |
| 5                                      | Gilroy, City of                  | GIL    | W2XSC       | W1XSC         |
| 6                                      | Hospitals (all SCCo) & MHJOC     | HOS    | W2XSC       | W1XSC         |

Cupertino ARCS/RACES



# SCC RACES BBS Network

## BBS Frequencies

- Access is simplex with no tone
- 2m – User access; typically individuals, some EOCs
- 220 – User access; typically EOCs, some individuals
- 440 – Future

|                            | Call Sign | AX.25   | User Access       | BBS-BBS | Location                              |
|----------------------------|-----------|---------|-------------------|---------|---------------------------------------|
| CUPERTINO<br>PRIMARY BBS   | W1XSC     | W1XSC-1 | 145.750, 223.620  |         | Santa Clara Co Office Bldg (San Jose) |
|                            | W2XSC     | W2XSC-1 | 145.730, 223.560  |         | Crystal Peak (South County)           |
|                            | W3XSC     | W3XSC-1 | 144.310, 223.540  |         | Mountain View                         |
| CUPERTINO<br>SECONDARY BBS | W4XSC     | W4XSC-1 | 145.690, 223.600* | 223.600 | Frazier Peak (above Milpitas)         |
|                            | W5XSC     | W5XSC-1 | varies            | varies  | Training, events, backup              |
|                            | W6XSC     | W6XSC-1 | varies            | varies  | Testing, backup                       |



# Northern California Packet Band Plan

<http://ncpa.n0ary.org/ncpabandplan.html>

---

## 2 Meter Band Plan

144.31 EP

144.33 Telemetry & Experimental

144.35 Keyboard to Keyboard, mailbox

144.37 BBS forwarding

144.39 APRS (USA and Canada)

144.41 APRS (secondary channel)

144.43 TCP/IP (duplex with 145.65)

144.91 EP

144.93 NA

144.95 NA

144.97 Misc. Digital

144.99 TCP/IP

145.01 WL2K

145.03 Keyboard to Keyboard, mailbox

145.05 Keyboard to Keyboard, mailbox

145.07 NA

145.09 BBS

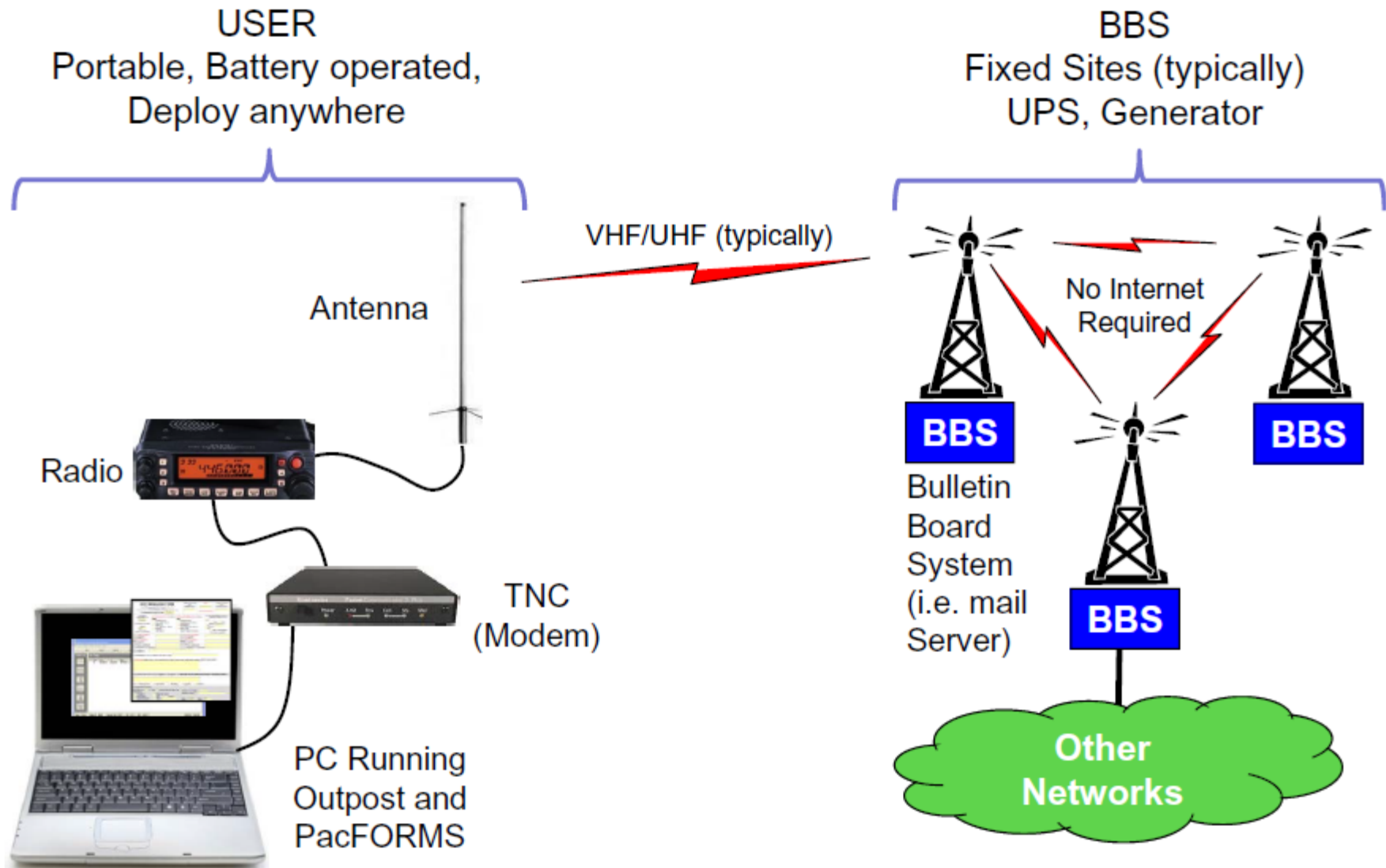
- 145.61 Duplex, cross-band
- 145.63 WL2K
- 145.65 TCP/IP 9600 baud (duplex with 144.43)
- 145.67 DX Spotting
- 145.69 EP
- 145.71 DX Spotting
- 145.73 EP
- 145.75 EP
- 145.77 DX Spotting

## NOTES

- APRS – Automatic Packet Reporting System.
- BBS – Full-service Bulletin Board System,
- DX Spotting – Northern California DX Packet Spotting Network
- EP – Emergency Packet
- NA – Not Allocated
- WL2K - Winlink2000 message server or anything involving the Winlink network.



# A typical Packet Network



---

# ***Outpost Packet Message Manager***



# Overview

## *Outpost Packet Message Manager*

---

### What is Outpost?

- A Windows-based packet messaging client that hides the complexity of the packet world
- Supports ARES/RACES teams meet the needs of their local served agencies to pass digital message traffic
- Automates and manages all message handling between you and the BBS
- Lets you read, delete, create, reply to, or forward messages back to the BBS
- SCCo Packet Installer is available from County web site  
<https://www.scc-ares-races.org/data/packet>
- General purpose version is available from Outpost web site  
<https://www.outpostpm.org>





# Overview

## *Outpost Packet Message Manager*

---

### Why Outpost?

#### **Leverages the existing packet hardware, network, and BBS infrastructure**

- Uses your existing TNC and packet radio equipment
- Compatible with many existing BBSs and TNC PBBSs
- Only your packet client (end-user program) changes

#### **Hides the complexity of the packet operating environment**

- Similar look and feel to contemporary email programs
- Shorter learning curve for packet operations
- Allows users to... *“focus on the message, not the medium”*

#### **Implements most local emergency management policies for digital communications**

# Overview

## *Outpost Packet Message Manager*

---

### Feature highlights

#### Message support

- Private, NTS, and Bulletin messages
- Text formatting in a free-form message window
- NTS Message Maker with an ARL message wizard
- On-line report builder

#### Send/Receive Session (connection) control

- Serial, AGWPE, and Telnet interfacing with over 20 PBBS and BBSs
- Controls connecting, sending messages to and retrieving messages from the BBS

#### Configurations and Setups

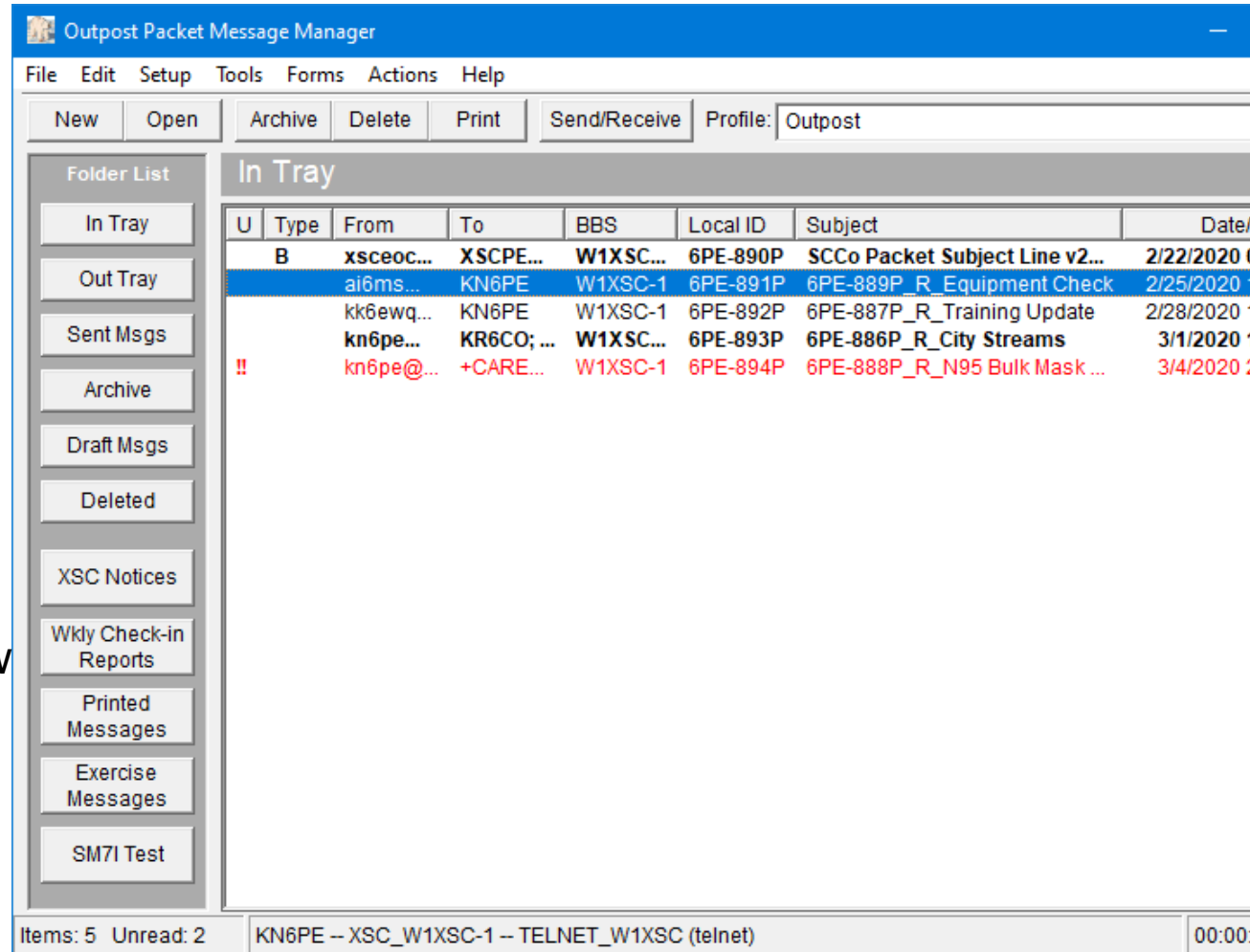
- BBS, TNC, and Interface configurations
- message type and retrieval options
- supports 3 ways for automatically initiating send/receive sessions

# Overview

## Outpost Packet Message Manager

### Message support

- Familiar email-app look & feel
- Separate folders for message storage
- Clear message identification (unread=**BOLD**, urgent=**Red**)
- Formal message workflow
- BBS and interface setups
- Additional settings control how Outpost behaves

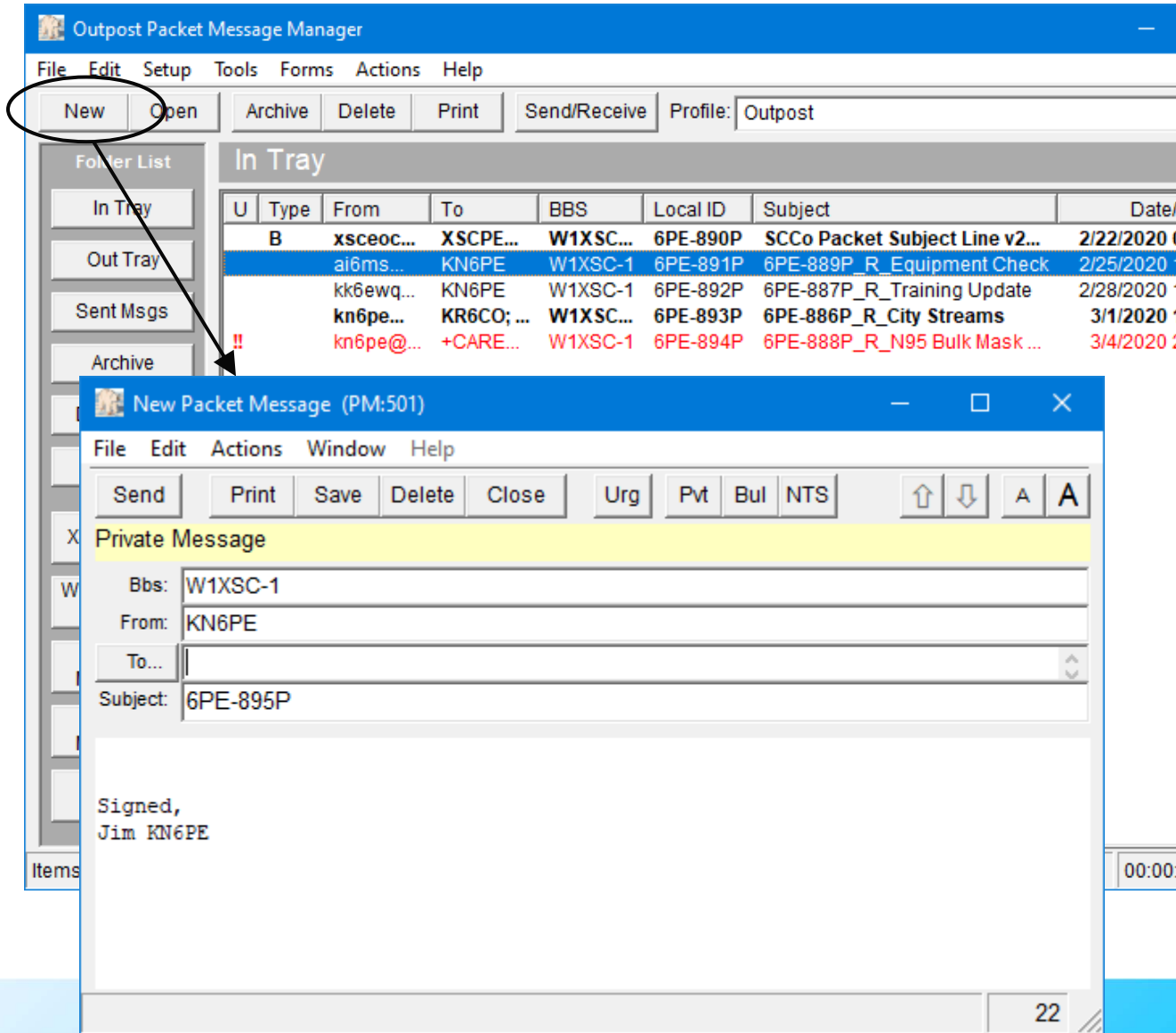


# Overview

## Outpost Packet Message Manager

### Creating Messages

- Supports Private, Bulletin, and NTS message types
- Message formatting before sending
- Set messages to **Urgent**
- Request delivery or read receipts
- Different ways for originating messages:
  - Freeform
  - Ics213mm
  - NTS Message Maker
  - PackItForms and PacFORMS

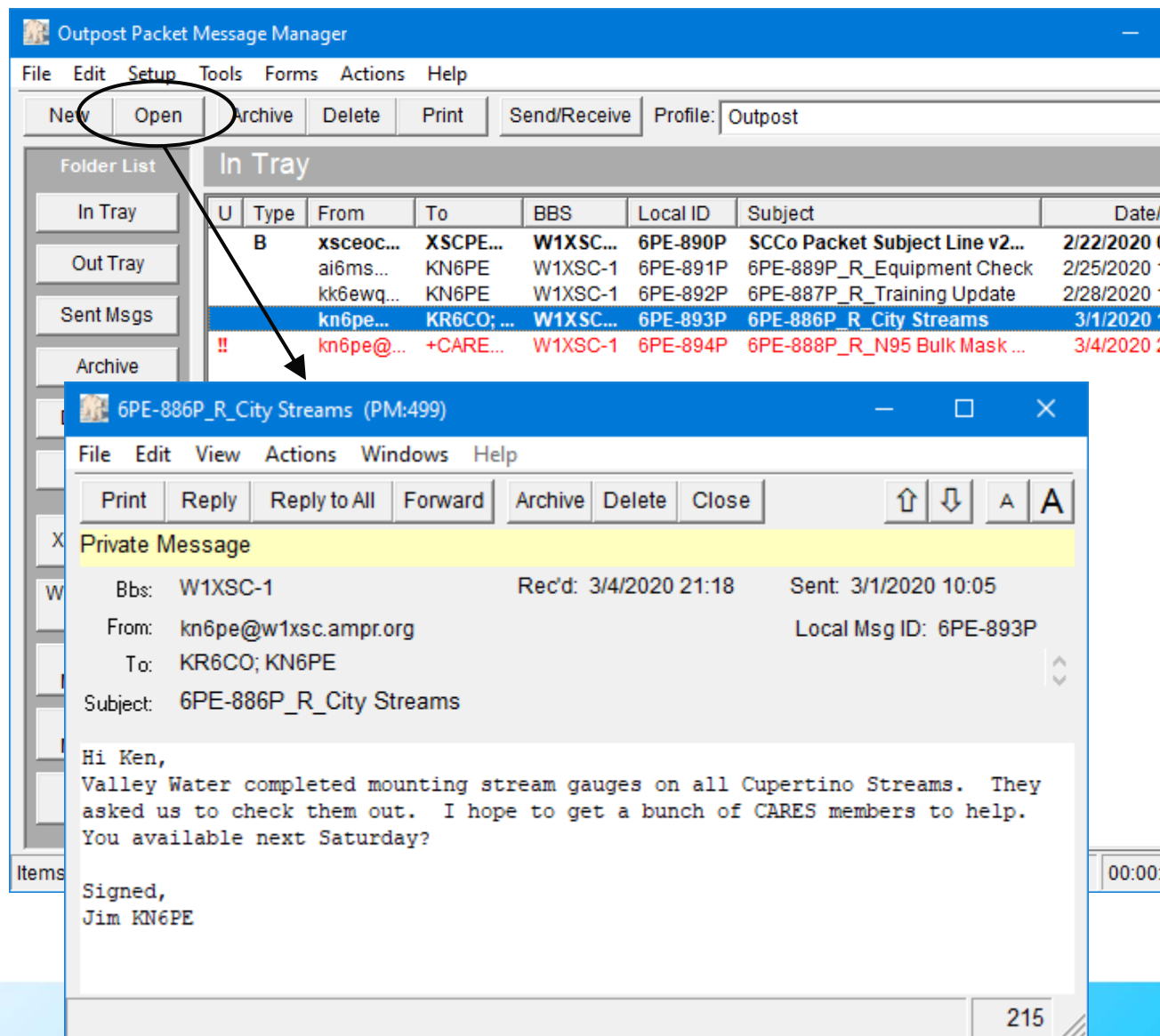


# Overview

## Outpost Packet Message Manager

### Viewing messages

- Supports viewing, printing, deleting or saving a message to a local file
- Reply and Forward message formatting

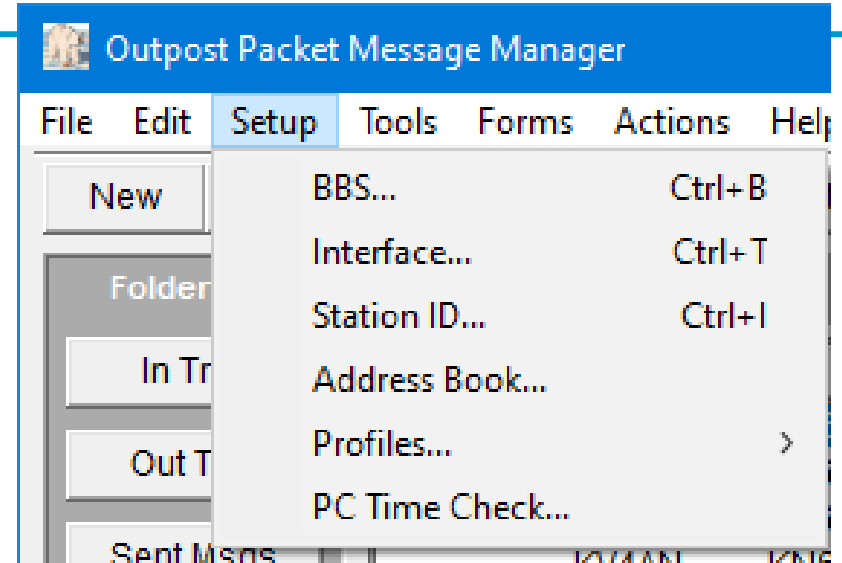


# Overview

## *Outpost Packet Message Manager*

### Managing Setups

- Select or define a BBS definition
- Select or define an interface, includes
  - Serial / Comm Port
  - AGWPE (for KISS devices)
  - Telnet
- Set the station identification.  
This section also enters telnet and Winlink account and password data.
- Set up your address book entries
- Manage Profiles – specific configurations of settings
- Run the PC Time Check Program

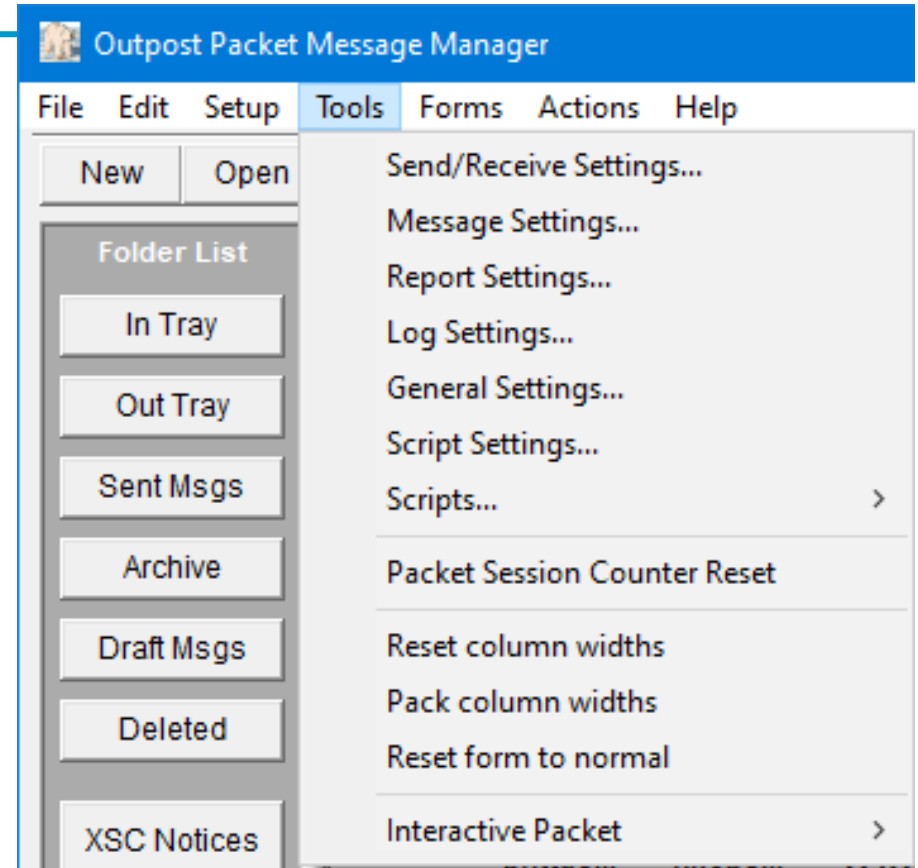


# Overview

## *Outpost Packet Message Manager*

### Program controls

- Controls the flow of Send/Receive Sessions
- Sets how messages are created and handled
- Set various data fields to automatically populate add-on reports and messages
- Set up default directory names
- Various log settings
- Outpost Scripting
- Form sizing controls
- Separate Interactive Packet Windows for...
  - Ipserial.exe – Serial TNCs
  - Ipagwpe.exe – AGWPE
  - Iptelnet.exe – Telnet



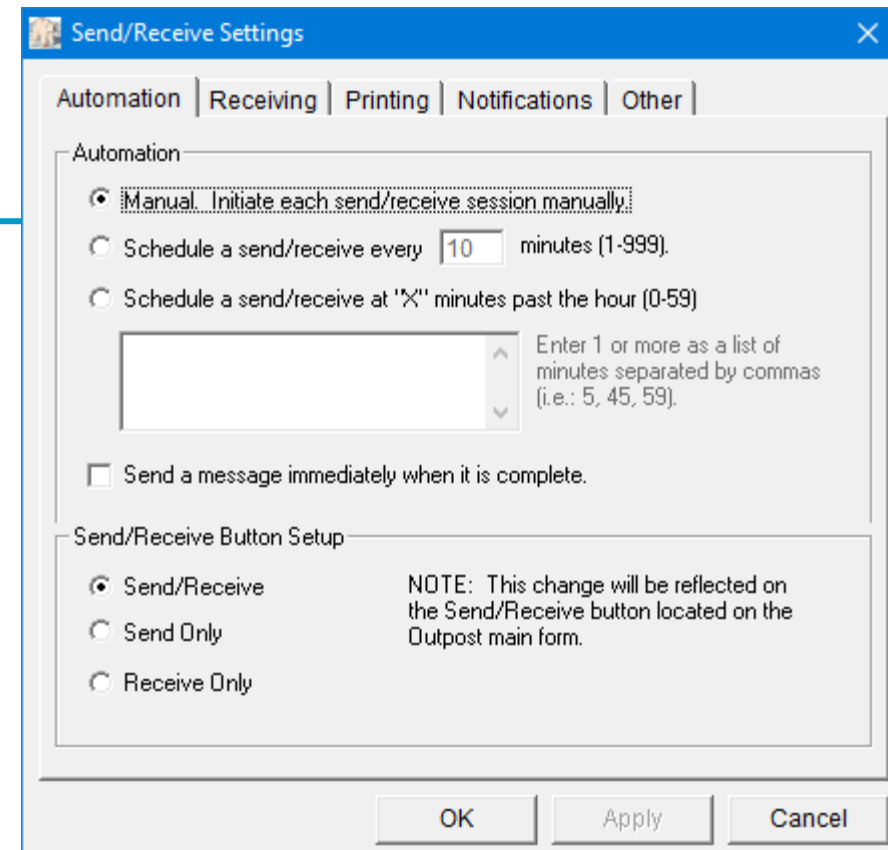


# Overview

## *Outpost Packet Message Manager*

### Send/Receive Settings

- Selects different ways to automate the message send/retrieve sessions
- Additional controls to announce when a new message arrives, manage printing, alerts, and other program settings



Send/Receive Settings

Automation | Receiving | Printing | Notifications | Other

Automation

☒ Manual. Initiate each send/receive session manually.

☐ Schedule a send/receive every  minutes (1-999).

☐ Schedule a send/receive at "X" minutes past the hour (0-59)

Enter 1 or more as a list of minutes separated by commas (i.e.: 5, 45, 59).

☐ Send a message immediately when it is complete.

Send/Receive Button Setup

☒ Send/Receive NOTE: This change will be reflected on the Send/Receive button located on the Outpost main form.

☐ Send Only

☐ Receive Only

OK Apply Cancel

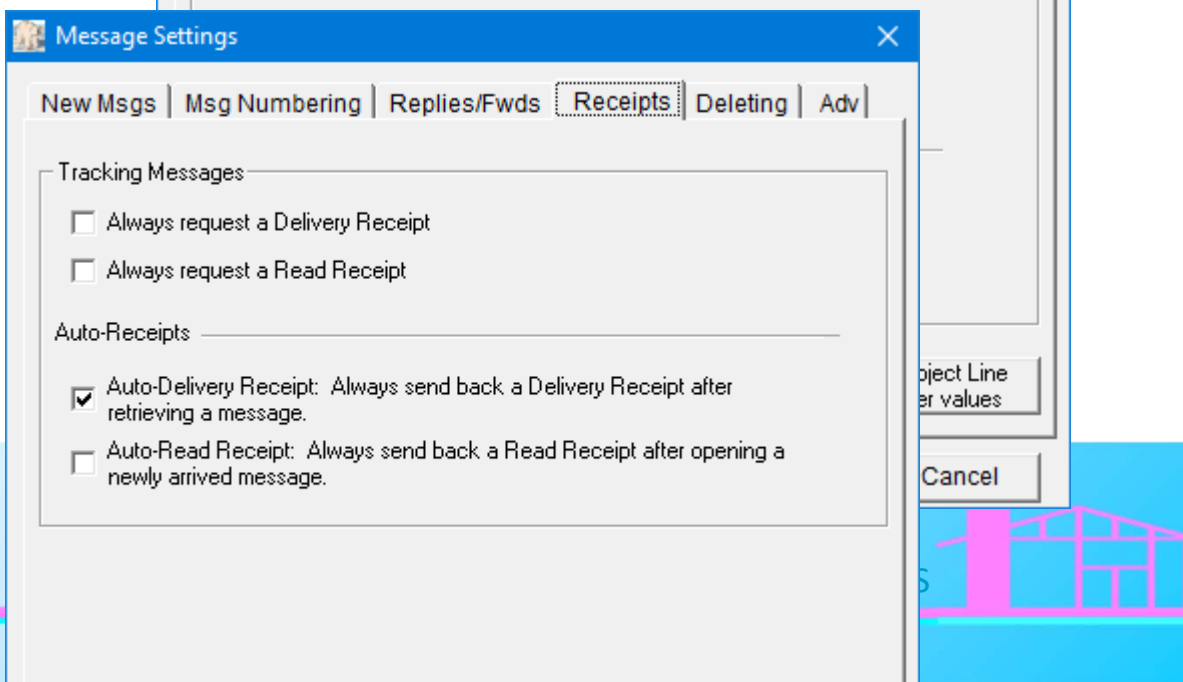
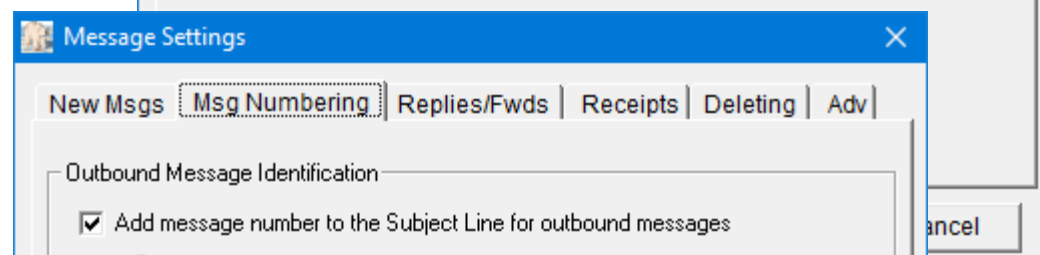
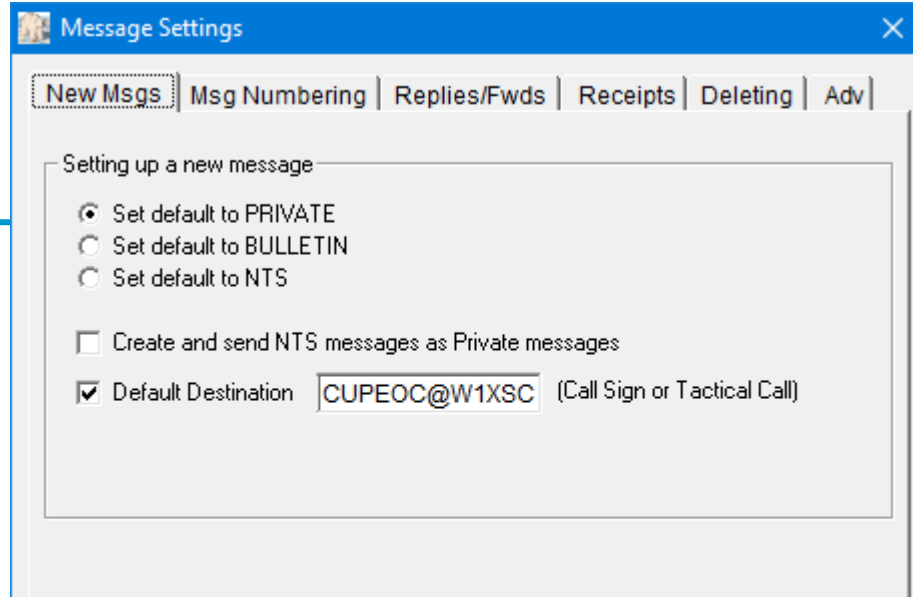


# Overview

## Outpost Packet Message Manager

### Message Settings

- Settings for new messages, includes
  - Default destinations
- Handling Message Numbering
- Set defaults for message receipts
- Other Setting for deleting messages and setting up for PacFORMS & Ics213mm

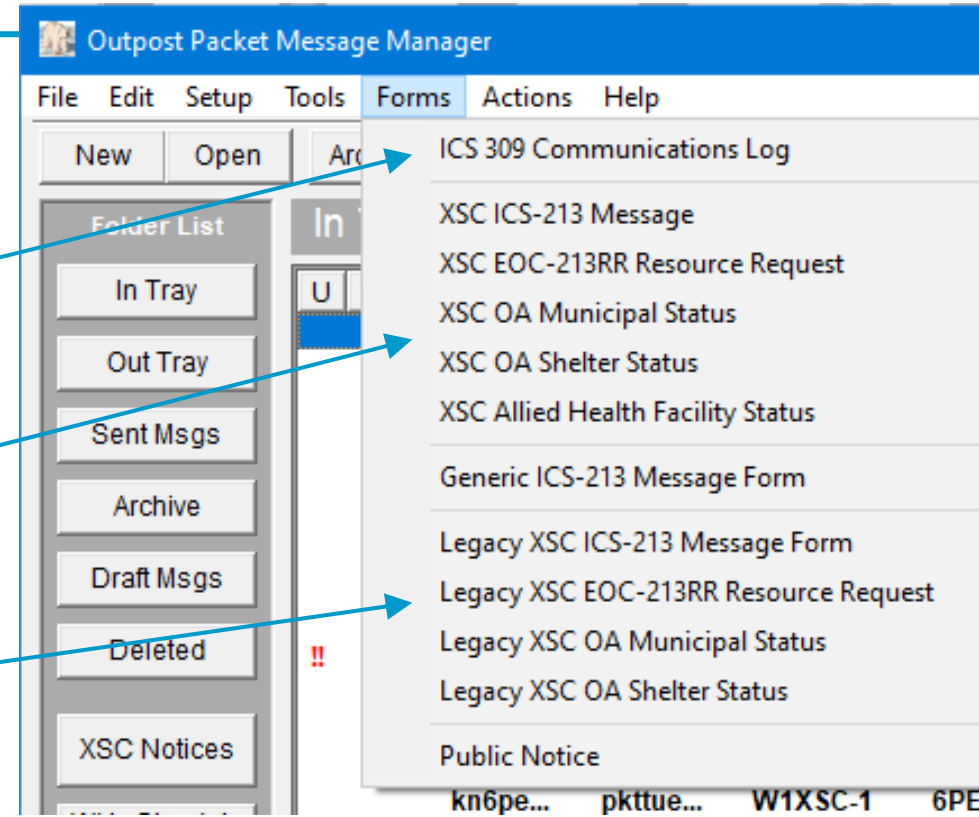


# Overview

## Outpost Packet Message Manager

### Reports and Forms

- Produces an ICS309 Communications Log
- Launches and populates specific fields in SCC RACES PackItForms.
- Launches and populates specific fields in SCC RACES PacFORMS.
- Other add-on forms



---

# ***Packet in Cupertino***



# How are we deploying packet?

---

1. Operate at the EOC for EOC-to-County message handling
2. Operate at the ARKs for ARK-to-City EOC message handling
3. Operate at Fire Stations and where ever else the city needs us
4. Leverage the County's Packet infrastructure (BBSs)
5. Continue aligning to the state's message hierarchy protocol



# Aligning Packet in California

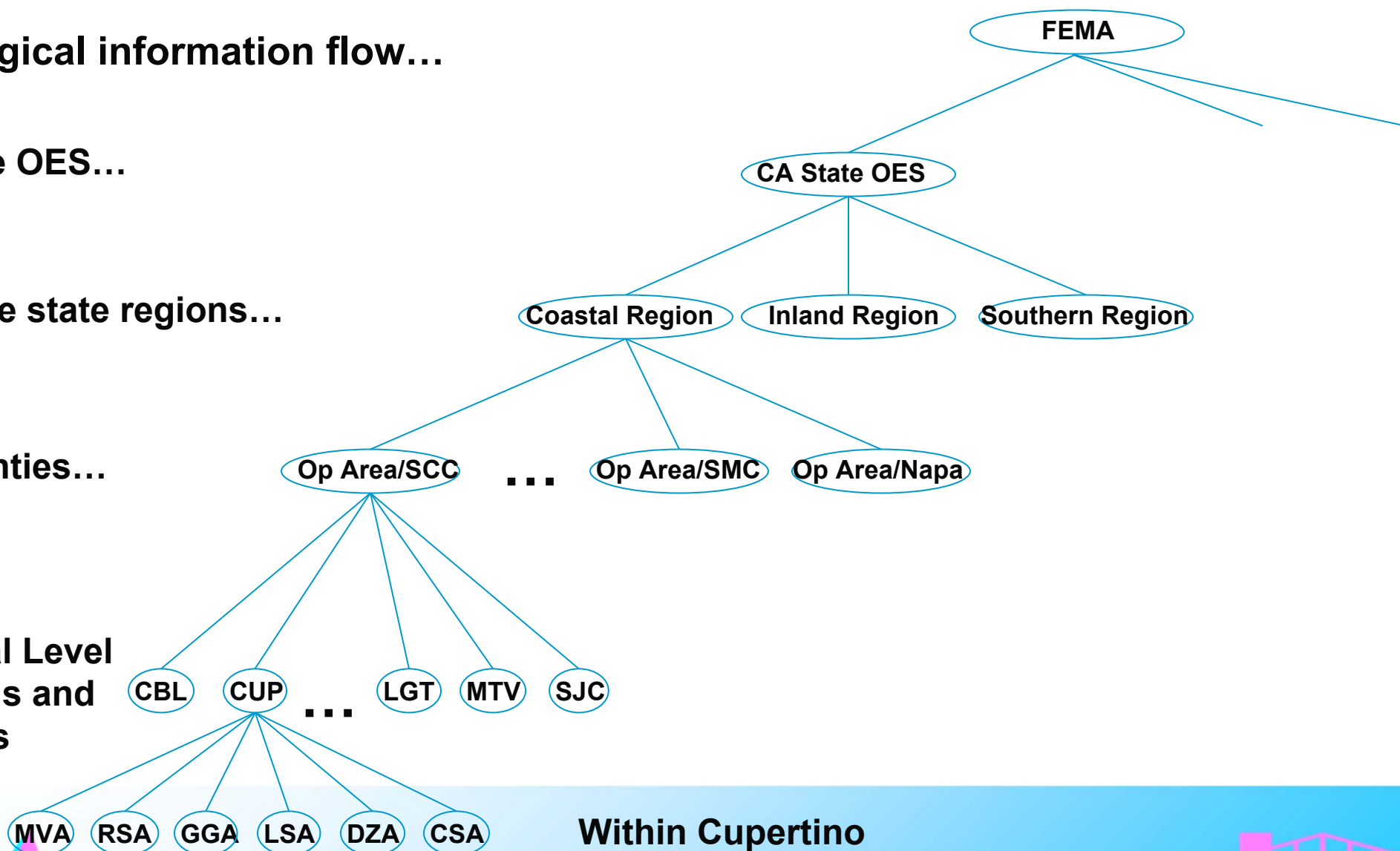
Logical information flow...

State OES...

Three state regions...

Counties...

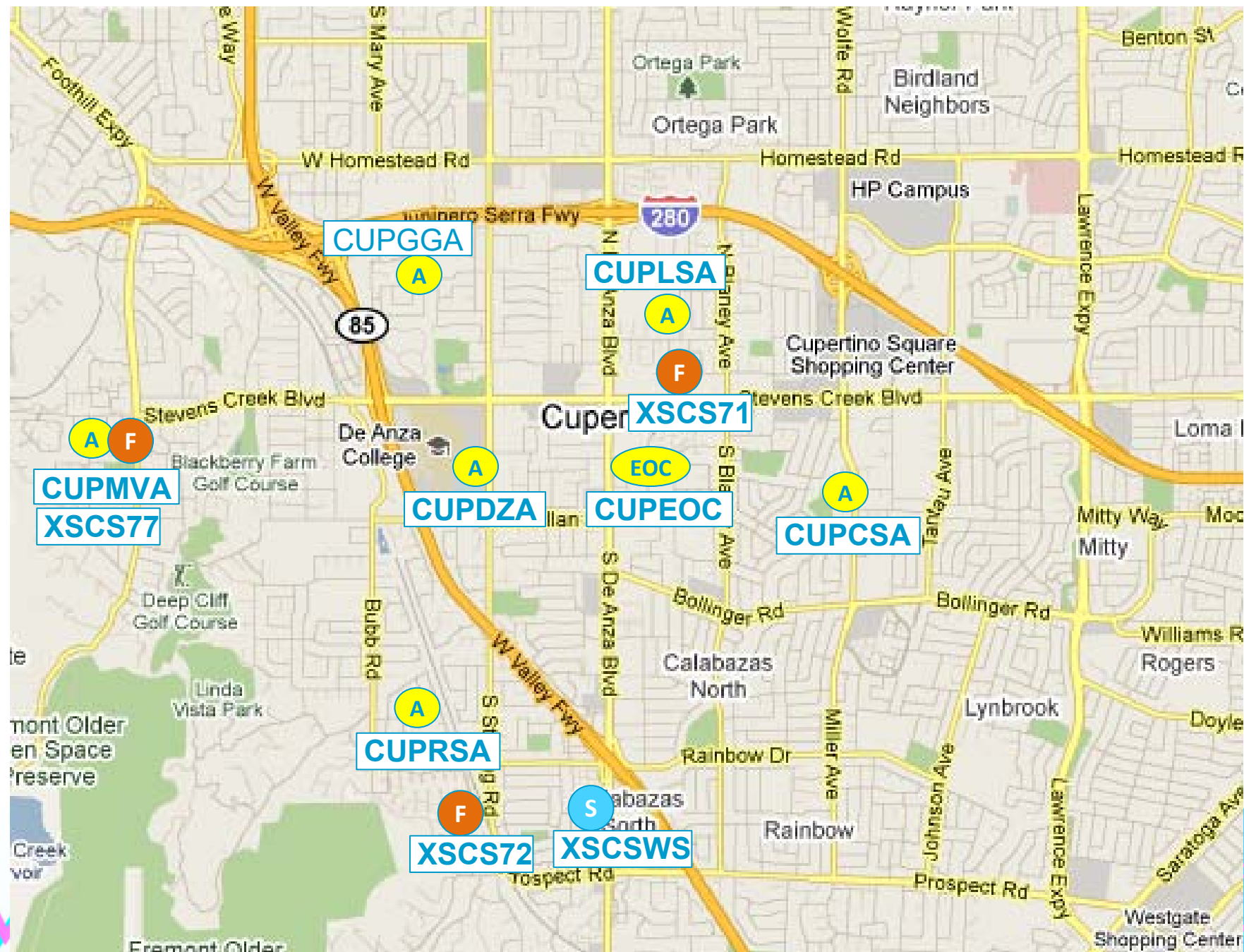
Local Level  
towns and  
cities



Cupertino ARES/RACES



# Addressing in Cupertino





# Cupertino Packet Addresses

## Tactical Calls

---

### Cupertino OES

CUPCCC Citizen Corps  
CUPDOC Citizens Corps DOC  
CUPDPW DPW/Service Center  
CUPEOC EOC  
CUPMRC Med Reserve Corps  
CUPOPS Field Ops

### Arks

CUPMVA Monta Vista ARK (Z1)  
CUPRSA Regnart School ARK (Z2)  
CUPGGA Garden Gate ARK (Z3)  
CUPLSA Lawson School ARK (Z4)  
CUPDZA DeAnza ARK (Z5)  
CUPCSA Creekside ARK (Z6)  
CUPMRA Montebello Ridge ARK  
CUPSCA Stevens Canyon ARK

### Shelters

CUPSH1 Shelter 1  
CUPSH2 Shelter 2  
CUPSH3 Shelter 3  
CUPSH4 Shelter 4

### City Parks

CUPBBF Blackberry Farm  
CUPCSP Creekside Park  
CUPJOL Jollyman Park  
CUPMEM Memorial Park  
CUPPOR Portal Park  
CUPWIL Wilson Park  
CUPLVP Linda Vista Park

### Public Safety

XSCSWS County Sheriff, West Side  
XSCF71 Cupertino Fire  
XSCF72 Seven Springs Fire  
XSCF77 Monta Vista Fire

### Services

CUPSAN Cupertino Sanitary District  
CUPWVS West Valley Community Srv  
SJWEOC San Jose Water

### Ten SPARE Addresses

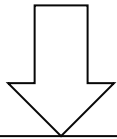
CUP001 through CUP010



# Addressing a message

---

The message we want to send from  
the ARK to the City's Ops Chief



**From: Regnart School Ops**  
**To: Cupertino Ops**  
**Subj: Ark Staffing Summary**

~~~~~

~~~~~

~~~~~

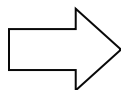
~~~~~

**Signed,**  
**Dave Miller Ops Chief**



# Addressing a message

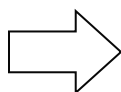
We want to “embed” our message below into a packet message with additional addressing information



**From: Regnart School Ops**  
**To: Cupertino Ops**  
**Subj: Ark Staffing Summary**

~~~~~  
~~~~~  
~~~~~  
~~~~~

**Signed,**  
**Dave Miller Ops Chief**



**BBS: W1XSC-1**  
**From: CUPRSA**  
**To: CUPEOC**  
**Subj: RSA-134: Ark Staffing Summary**

**From: Regnart School Ops**  
**To: Cupertino Ops**  
**Subj: Ark Staffing Summary**

~~~~~  
~~~~~  
~~~~~  
~~~~~

**Signed,**  
**Dave Miller Ops Chief**



# Anatomy of a message

## 1. Packet Address header

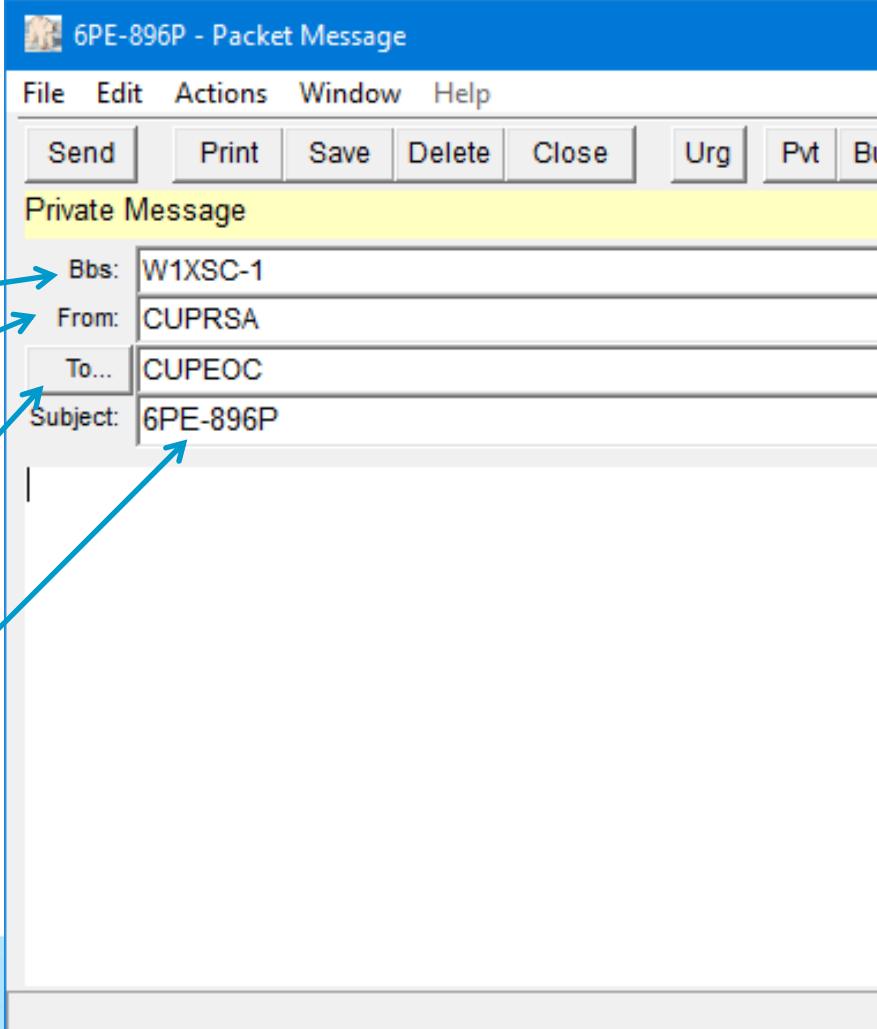
The packet header gets the message to the correct Packet Station

**BBS:** the “Store and Forward” mail drop where this message will be sent. **Automatically filled in**

**From:** The tactical call of your packet station. **Automatically filled in.**

**To:** Defaults to the destination station set up in Outpost. This can be changed.

**Subject:** The Message ID is **automatically added**



The screenshot shows a software window titled "6PE-896P - Packet Message". It has a menu bar with "File", "Edit", "Actions", "Window", and "Help". Below the menu bar are buttons for "Send", "Print", "Save", "Delete", "Close", "Urg", "Pvt", and "B". The main area is titled "Private Message" and contains the following fields:

|          |          |
|----------|----------|
| Bbs:     | W1XSC-1  |
| From:    | CUPRSA   |
| To...    | CUPEOC   |
| Subject: | 6PE-896P |

Four blue arrows point from the text on the left to the corresponding fields in the form: from "Automatically filled in" to Bbs, from "Automatically filled in." to From, from "Defaults to the destination station set up in Outpost. This can be changed." to To..., and from "automatically added" to Subject.

# Anatomy of a message

## 2. Recipient Address and Message

Once the message gets to the destination Packet Station, address the message to the right person.

**Subject** – Fill in the rest of the subject line

### Message Body

**From:** Who is this message from?  
ICS position or function

**To:** Exactly to whom do you want this message to go? ICS position or function

**The Message:** Will in the details of the message.

**Signature:** Put who the message is from

6PE-896P\_R\_ARK Staffing Summary - Packet Message

File Edit Actions Window Help

Send Print Save Delete Close Urg Pvt B

Private Message

Bbs: W1XSC-1

From: CUPRSA

To: CUPEOC

Subject: 6PE-896P\_R\_ARK Staffing Summary

From: IC, Regnart School ARK  
To: Ops Chief, Cupertino EOC

The following staff are in place at the Regnart School  
Incident Commander  
Ops Section Chief  
Logistics Section Chief  
Planning & Intel Section Chief  
First Aid Station is set up  
Communications function is set up  
... and no others.

Signed,  
Dave Miller, Ops Chief

# Packet Radio Users Guide

## Table of Contents

1. Packet Startup Procedure
2. Client Software
3. ALT911 Packet Message Handling
4. Creating Packet Messages
5. Ham Radio Packet Overview

## Amateur Packet Radio Field Reference

Cupertino ARES/RACES

December 2019



# What's next?

---

14-Mar-2020: Hands-on Packet Intro, Cupertino EOC  
02-Apr-2020: CARES General Meeting, ALT911 Intro  
18-Apr-2020: Hands-on Packet ALT911, Cupertino EOC  
25-Apr-2020: ARK Open House, MVA, RSA, CSA  
02-May-2020: ARK Open House, DZA, LSA, GGA  
07-May-2020: CARES General Meeting, Drill Prep  
16-May-2020: Power & Comm Outage Field Exercise





# Thank you

*Any Questions?*

