# Infrastructure Improvements Update

## Calvert RACES

MAY 23, 2022

# Project Overview

- May 2017 - Calvert County Emergency Management offered to fund a significant upgrade to the RACES infrastructure within the county.

- Plans include new antennas and feedlines installed on three County towers and two EOC's

- New radio equipment

- **All antennas & radios procured by and owned by the County**

# Status as of May 2022
## -The Chronology-

- May 2017 – Planning starts
  - meeting with County personnel and hired consultant
- June-Aug 2017 – Design effort on system architecture, tower & antenna locations
- Aug 2017 - Bill of Materials (BOM) given to County
  - funds not available
- Fund become available in summer 2020
  - Over $22,000 County funds committed (equipment plus antennas/install)
- June 2020 - BOM updated
- July-Aug 2020 – Antennas & feedlines installed (Motorola)
- Aug 2020 - County releases Request for Quote
- Sep 2020 - Bid won by Holzberg Communications, Inc. in New Jersey
- Oct 2020 – Equipment begins to arrive at County office
- Nov 2020 – Site visits to both EOC's and Barstow shelter for layout
- Nov 2021 – Courthouse EOC and Barstow Sites Operational

# The Team

- N3XMZ – Calvert RACES Officer
- N3AE – Calvert ARES EC
- K3UGA – Indispensable effort reviewing design and preparing Bill of Materials
- N3PPH, KC3RKP, W3PQS and others helping with installation
- Jack Anderson from Altairis Technology Partners
  - Consultant hired by County for their big EMCOMM upgrade
  - Also a licensed amateur radio operator

# The <u>Initial</u> Plan

- Requirements as jointly developed with the County
  - Support EOC at Prince Frederick Courthouse and backup EOC at Calvert Public Safety Department (PSD) in Barstow
  - Two RACES operator seats at each EOC
  - One voice radio and one digital mode radio
  - Computer at each seat
    - County-provided and connected to their LAN
    - WebEOC
    - Winlink Express application installed
  - Antennas at each EOC high enough to cover tri-county area

# Imposed Constraints

- Cannot install any antennas on the Courthouse that extend more than 5 ft from the roofline at the back of the Courthouse
  - Tests on Courthouse roof show marginal path to 147.105 Davidsonville (Central Regional Net)
    - Could raise 147.105 but well short of full quieting
    - Central Regional Net critical in region-wide call-up
- Need new antennas, feedline and radios at the alternate EOC in Barstow
  - Had no RACES radios or antennas at alternate EOC

38°32.31' N 76°35.03' W, FM18QM

Satellite

Overlays

**Red Line is Direction to ERN**

Hallowing Park 🌲

Calvert County Circuit Court

166° 24.5 miles

Duke St

# Altairis Proposed Approach

- Locate EOC antennas on the Barstow tower

- Use RemoteRig's from the EOC's to Barstow
  - RemoteRig connectivity using County's dedicated and redundant LAN from the EOC's to Barstow
  - LAN Independent of the internet
  - LAN interconnects EOC's and all tower sites
  - Fiber optics backed up by microwave
    - "0.99999 reliability"
      - have not seen how this was calculated.

# RemoteRig

# Calvert LAN

- Installed and supported by Motorola as part of the P25 Phase II county infrastructure update
- Motorola set up three Ethernet Pipes or Epipes for Calvert RACES
- An Epipe is a point-to-point Ethernet bridging service that forwards traffic from one site to another
  - essentially "looks" like a hardwired Ethernet cable between sites
  - isolated from all other LAN traffic
  - can use any IP addressing scheme
  - Ethernet switches at each site used to direct traffic
- Our Epipes
  - between Courthouse EOC and Barstow tower shelter
  - between Alternate EOC and Barstow tower shelter
  - between Mt Hope tower shelter and Lusby Tower shelter
    - For possible future VOIP link between CARA 2M and 70cm repeaters

# The Catch 22 Concern

- The new county emergency communications system will be highly capable and robust
- Unlikely to depend on RACES except in the very worse case scenario
- But the worse case scenario may include loss of the LAN, which would mean loss of RACES link from EOC's to Barstow.
  - Calvert RACES EOC ops severely limited by low antenna height restrictions
- Another downside -  remotely located RF decks make growth to sound card digital modes like VARA more difficult (but not impossible)

# Solution to LAN Loss

- Include a separate radio at Barstow capable of acting as a cross-band repeater to reach Davidsonville and elsewhere
  - Solves voice backup but not packet
  - Select a radio that can change channels by touch tone commands
  - Need to automatically generate touch tones to avoid mistakes
    - Old style auto-dialer or software  (no solution yet)

- Install two small dual-band antennas (Diamond X50A's) on the back Courthouse roof and PSD roof to reach the cross-band repeater as well as CARA repeaters & digipeaters

  - Note:  Only radio front panels at EOC seats, so RemoteRig used to reach radio RF deck's in the EOC equipment room
    - These RemoteRig connections are made by dedicated CAT6 cable.  No LAN.
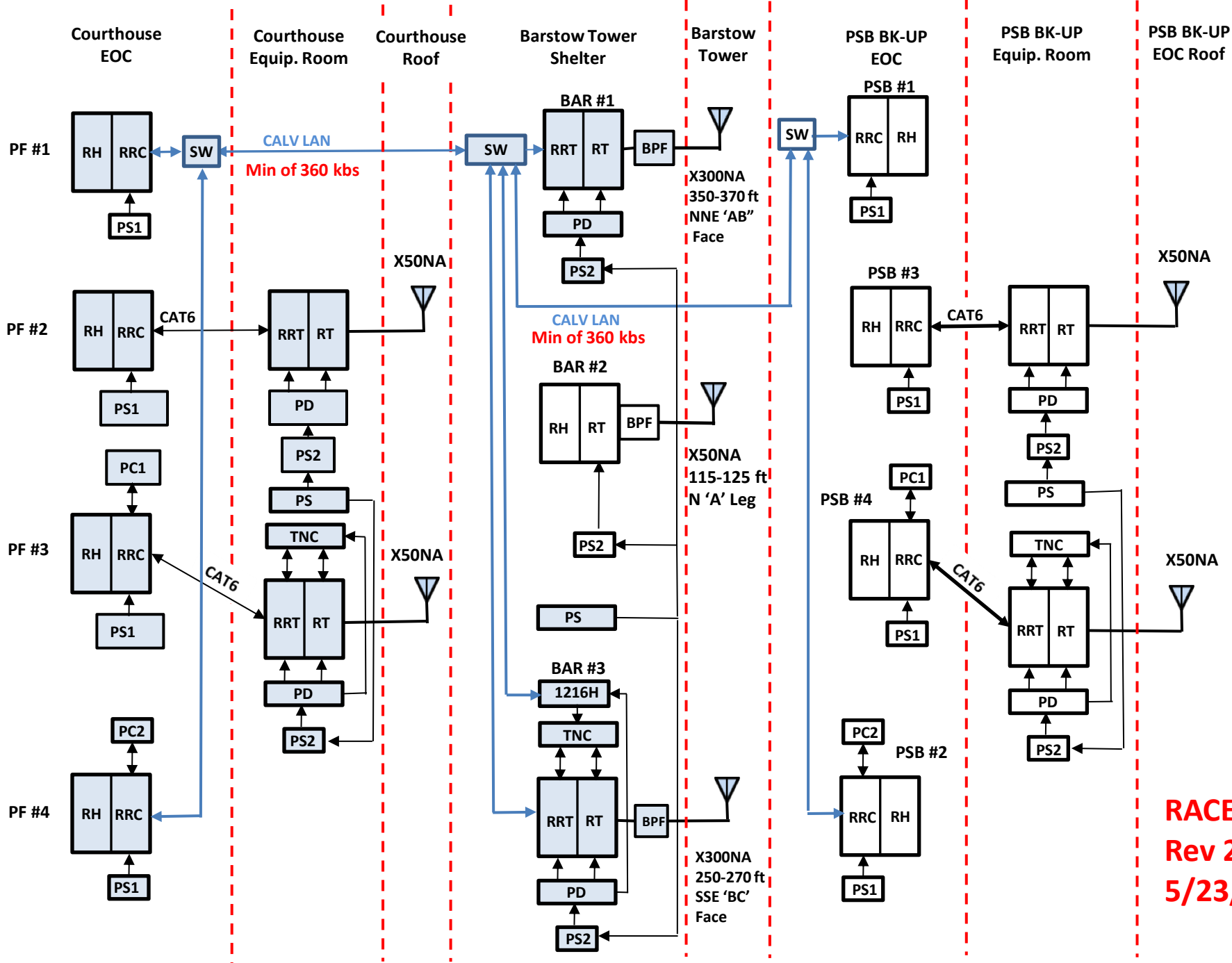    - Same configuration at primary and alternate EOC's

# Radios

- Need dual band radios capable of working with RemoteRig
- Need a radio capable of operating as a cross-band repeater that can also be remotely controlled (i.e. radio remote control of cross-band enable and disable as well as frequency changes).
- Radios tested:
  - Kenwood TM-V71A
  - Kenwood TM-D710G
- Down-selected to TM-V71A
  - note:  Remote control of the TM-V71A unavailable starting with serial number B8610081 (chip obsolescence)
  - RACES has ONE TM-V71A with an earlier S/N to use as the backup crossband repeater

# Final System Architecture

- System diagram on the next slide

- Kenwood TM-V71A radios

- For the diagram on the next slide:
  - Physical locations shown left to right
  - Equipment at each location shown top to bottom
  - Legend for diagram on slide after the diagram

- Blocks shaded in blue are complete and operational as of Nov 2021

**Courthouse EOC** | **Courthouse Equip. Room** | **Courthouse Roof** | **Barstow Tower Shelter** | **Barstow Tower** | **PSB BK-UP EOC** | **PSB BK-UP Equip. Room** | **PSB BK-UP EOC Roof**

**PF #1**
RH | RRC
SW
PS1

**CALV LAN**
**Min of 360 kbs**

SW

**BAR #1**
RRT | RT
BPF
PD
PS2

X300NA
350-370 ft
NNE 'AB" Face

SW

**PSB #1**
RRC | RH
PS1

**PF #2**
RH | RRC
CAT6
RRT | RT
PD
PS2
PS
TNC

X50NA

**CALV LAN**
**Min of 360 kbs**

**BAR #2**
RH | RT
BPF
PS2
PS

X50NA
115-125 ft
N 'A' Leg

**PSB #3**
RH | RRC
CAT6
RRT | RT
PD
PS2
PS
TNC

X50NA

**PF #3**
RH | RRC
PC1
CAT6
RRT | RT
PD
PS2
PS1

X50NA

**BAR #3**
1216H
TNC
RRT | RT
BPF
PD
PS2

X300NA
250-270 ft
SSE 'BC' Face

**PSB #4**
RH | RRC
PC1
CAT6
PS1

**PF #4**
RH | RRC
PC2
PS1

**PSB #2**
RRC | RH
PC2
PS1

**RACES Rev 2.3 5/23/22**

# Drawing Legends

- RH       Radio front panel (radio head) for RT
- RT       Radio RF deck TM-V71A
- RRC       RemoteRig radio control panel interface, p/n 1258MkIIs-Con
- RRT       RemoteRig radio RF deck interface, p/n 1258MkII-Rad
- PS1       RRC power supply "wall wart," p/n 1258-PS-US
- PS2       13.8 vdc power supply for radio, RRT and TNC. Samlex SEC-1235M
- PD       Fused power distribution panel – RigRunner 4005
- SW       Ethernet Switch – Netgear GS105Ev2
- TNC       Terminal Node Controller – Kantronics KPC-3+
- PS       Surge Protected Rack Mounted Power Strip - TrippLite
- 1216H    RemoteRig model 1216H web controlled power relay unit
- BPF       DCI 144/440MHz bandpass filter

Not specifically identified on the drawing are:

- DB-9 RS-232 cable and USB converter between RRC's and PC's
- DB-9 null modem cable between RRT and TNC
- DC power distribution cables with mating connectors for PD's, RRT's, TNC's
- Audio cables between TNC's and RT's (microphone and speaker outputs)
- Microphones , speakers and headsets at EOC positions
- Any customized audio distribution equipment at EOC positions to select radio-to-headphone connections

# Antenna Summary

## (County paid for, and owns, antennas, feedline & Polyphasers listed below)

| Location | Stn # on Dwg | Ant # | Antenna Type | Freq. (MHz) | Height AGL | Orientation | Primary Function | Secondary Function |
|---|---|---|---|---|---|---|---|---|
| **Calvert RACES Tower Loadings and Antennas** | | | | | | | | |
| **Mt Hope** | - | 26 | Telewave ANT150F6-2 | 144 - 148 | 280' -300' | SE 'BC' Face | 146.985 MHz Voice Repeater | |
| **Tower Top 355' AGL** | - | 7 | Diamond X300NA | 144/440 | 330' - 350' | SE 'BC' Face | VHF/UHF Packet Digipeater | APRS |
| | - | 15 | Diamond X50NA | 144/440 | 140' -150' | S 'C' Leg | 420.050 MHz link to SHA Tower in Prince Frederick | Repeater Control |
| | | | | | | | | |
| **Barstow** | 3 | 21 | Diamond X300NA | 144/440 | 250' - 270' | SSE 'BC' Face | EOC VHF/UHF Packet | Calvert simplex voice |
| **Tower Top 403' AGL** | 1 | 12 | Diamond X300NA | 144/440 | 350' - 370' | NNE 'AB' Face | EOC to Davidsonville CRN | Calvert simplex voice |
| | 2 | 107 | Diamond X50NA | 144/440 | 115' - 125' | N 'A' Leg | Backup Cross-Band from EOC to Davidsonville CRN | Calvert simplex voice |
| | | | | | | | | |
| **Lusby** | - | 64 | Diamond X300NA | 144/440 | 205' – 215' | SSE 'BC' Face | Future Remote Receive for 146.985 | TBD |
| **Tower Top 449' AGL** | - | 15 | Diamond X300NA | 144/440 | 235' – 245' | NNE 'AB' Face | Link from Remote RX to Mt Hope | Future packet digipeater |
| | | | | | | | | |
| **Courthouse EOC** | 2 | - | Diamond X50NA | 144/440 | ~ 25' | West Roof | Access to 146.985 & 444.950 Repeaters | Backup voice to Davidsonville CRN using Cross-Band Repeater at Barstow (Barstow Station #2) |
| | 3 | - | Diamond X50NA | 144/440 | ~ 25' | West Roof | Packet, direct or via CARA digipeaters | Backup voice to Davidsonville CRN using Cross-Band Repeater at Barstow (Barstow Station #2) |
| | | | | | | | | |
| **PSB Bk-Up EOC** | 3 | - | Diamond X50NA | 144/440 | ~ 25' | Alt EOC Roof | Access to 146.985 & 444.950 Repeaters | Backup voice to Davidsonville CRN using Cross-Band Repeater at Barstow (Barstow Station #2) |
| | 4 | - | Diamond X50NA | 144/440 | ~ 25' | Alt EOC Roof | Packet, direct or via CARA digipeaters | Backup voice to Davidsonville CRN using Cross-Band Repeater at Barstow (Barstow Station #2) |

Note: Antenna # refers to the antenna number on the official Motorola tower loadout spreadsheets

# Courthouse EOC Station Function Descriptions

- Station PF #1
  - Connects to BAR #1 (Antenna on Barstow Tower at 350')
  - <u>Primary</u>:  Voice to CRN & Outside County
  - <u>Secondary</u>: Simplex voice within Calvert
- Station PF #2 (Antenna on Courthouse Roof)
  - <u>Primary</u>: Access to Calvert voice repeaters
  - <u>Secondary</u>: UHF simplex link to the Barstow VHF/UHF crossband repeater in the event of RemoteRig equipment failure or County LAN link failure

# Courthouse EOC Station Functions, continued

- Station PF #3 (Antenna on EOC Roof)
  - <u>Primary</u>:  Packet/Winlink digital messaging within Calvert County either by simplex or using digipeaters
  - <u>Secondary</u>:  Backup UHF simplex link to the Barstow crossband repeater in the event of RemoteRig equipment failure or County LAN link failure.

# **Station Functions, continued**

- Station PF #4
  - Connects to BAR #3 (Antenna on Barstow Tower at 250')
  - <u>Primary</u>:  Provide direct VHF/UHF packet/Winlink peer-to-peer messaging communications to adjacent counties and jurisdictions
  - <u>Secondary</u>:  Calvert voice simplex

# Alternate EOC Station Functions

- The alternate EOC in Barstow is basically a repeat of the primary EOC but the station number sequence on the diagram is different (to match station numbering in Altairis meeting minutes of May 27, 2017)

# Status & Open Issues
## (as of May 2022)

- All antennas, feedlines and Polyphasers have been installed at both EOC's, Barstow, Lusby and Mt Hope

- Courthouse EOC and Barstow radios controlled by the Courthouse EOC are fully operational (voice and packet/Winlink)

- Still need to install crossband TM-V71A at Barstow

- Still need to duplicate Courthouse EOC setup at the alternate EOC in Barstow
  - Alternate EOC being remodeled so work limited to equipment room for now

# Status of Other Calvert RACES Infrastructure

# Mt Hope Status

- 146.985 repeater is located at the new Mt Hope tower
  - County paid for antenna, hardline and installation
- DMR repeater on new Mt Hope tower using UHF portion on one of the Diamond X300NA's
  - 2M radiator not currently in use
- Lower Diamond X300NA currently not in use
  - future UHF link to Lusby to link 2M and 70cm repeaters

# Prince Frederick Status
# State Highway Tower

- Decibel DB-224 2M dipole array and Decibel DB-416 70cm dipole array and/or feedline highly suspect

- K3CAL-1 digipeater on 145.750 currently operational at PF using abandoned DNR VHF antenna
  - Good commercial grade VHF antenna & hardline

# CalvertHealth Hospital

- W3PQS 6M repeater transmitter installed
  - 6M antenna, link antennas, repeater and voter property of W3PQS
  - 52.170MHz input; 53.170MHz output, PL 100
  - RX sites at N3AE and N3PPH with a 3rd in work at W3PQS
- Plans to install CARA-owned Diamond X300NA for possible Winlink gateway, APRS repeater or digipeater
- Investigating stability of WiFi internet access at roof equipment room

# Lusby/Appeal Site

- Two Diamond X300's and hardline installed on tower
  - County paid for and owns
  - 205 ft facing SSE
  - 235 ft facing NNE
- CARA 444.950MHz repeater installed & operational using the higher antenna
  - CARA owns the repeater/controller/duplexer
- Also have a VOIP capable LAN channel from Lusby tower shelter to Mt Hope tower shelter
  - UHF radio link as primary or backup using lower antenna
- Required VOIP equipment NOT in the County purchase
  - Would be a CARA responsibility

# Need Help with Cable Construction, Equipment Rack Tray Mounting, Installation and Checkout for Alternate EOC