



The WB1GOF Repeaters



WB1GOF 146.955
PART D*442.450
of WESTFORD D*145.330

Repeater Contributors

- Original 442.450 Team
 - Ernie-N1AEW, Terry-KA8SCP, Bill Kent – KW1G and Dave-WI1R
- The 955 Team
 - Ernie, Terry and Dave
 - Ron Reder – KA1KCU
 - With assistance from Alison-KB1GMX, Art-AB1HO, Meyer-N1EQD, Barry-N1FII, Jim David-N1HZG, Don Stevens-WQ1E, and Al Hicks-KD1D

The 4 phases of WB1GOF repeaters

- “Start up” phases
 - Putting 442.450 on the air
 - and then 146.955
- “Re-work” phase
 - Re-package the site
- “Digital” phase
 - Move to D-STAR
- Water Tower “move”

442.450 Repeater timelines

- 2/7/1991 – On The Air
 - From N1AEW's QTH
 - 60 watts
 - Dave-WI1R, Bill-KW1G, Terry-KA8SCP and Ernie-N1AEW
- 2/13/1991 – Power Amp failed
 - Cut back to 16 watts
 - Increased power to 30 watts 2/16/1991

442.450 Repeater timelines

- 3/4/1992 – Remote base capabilities added
 - Kenwood TM-221 2m & 220 MHz
- 8/18/1992 – Repeater moved from Ernie's house to water tower
 - Put on the air at 2100
 - All day job
 - All in one cabinet

442.450 Repeater timelines

- 8/28/1992 – Diamond X500 antenna replaced
 - 1st antenna was factory defective
 - Power out 50W
- 8/7/1993 – added 220MHz remote base capabilities
 - Cross-linked to UHF area repeaters
 - Cross-linked Sunday Night PART net

Prelude to 955 repeater

- 146.955 was a split-site repeater
 - Owned by Fred Collins- W1FC in Carlisle
 - Receive site – Chelmsford fire tower @ Robbins Hill
 - Transmitter site – Fred's home in Carlisle
- Fire tower was rebuilt in 1997
 - Repeater equipment removed by "state", left at bottom of tower, rain

Prelude to 955 repeater

- Fred said “no more”
 - KA8SCP worked to obtain “coordination” with NESMC
 - “Team” found new equipment to build a new 955
 - Bench tested at N1AEW’s home

146.955 Repeater timelines

- 4/10/1998 – On the air @ Prospect Hill
 - Initially antenna was on top of communications building
- 8/7/1999 – Antenna “party” – 955 antenna to the top of the water tower
 - Art Walsh-AA1HO & Al Hicks-KD1DJ (now KD1D) were the water tower climbers!
 - Ground support – N1AEW, AA1HV, N1RKB
 - Chauncey-K1OPE donated X500 replacement
 - Ron-KA1KCU donated 70cm StationMaster

WB1GOF/R

Circa 1999
Old Cabinets
Pre D-Star

146.955 TPL power
amp (55W/at Ant)

146.955 Motorola
Mitrek

Astron Power
Supply

146.955 SCOM 7K
controller

Wacom 146.955
(4 can) Duplexer

Wacom UHF (4
can)
BPBR/Duplexer
UHF Rcvr Bandpass
Cavity (1) & Preamp

Kenwood TM-
731A X-Band link
2m/220MHz

442.450 Motorola
Mitrek

Mirage 440 Power
Amp

442.450 SCOM 7K
controller

Power Distribution

Astron Power
Supply



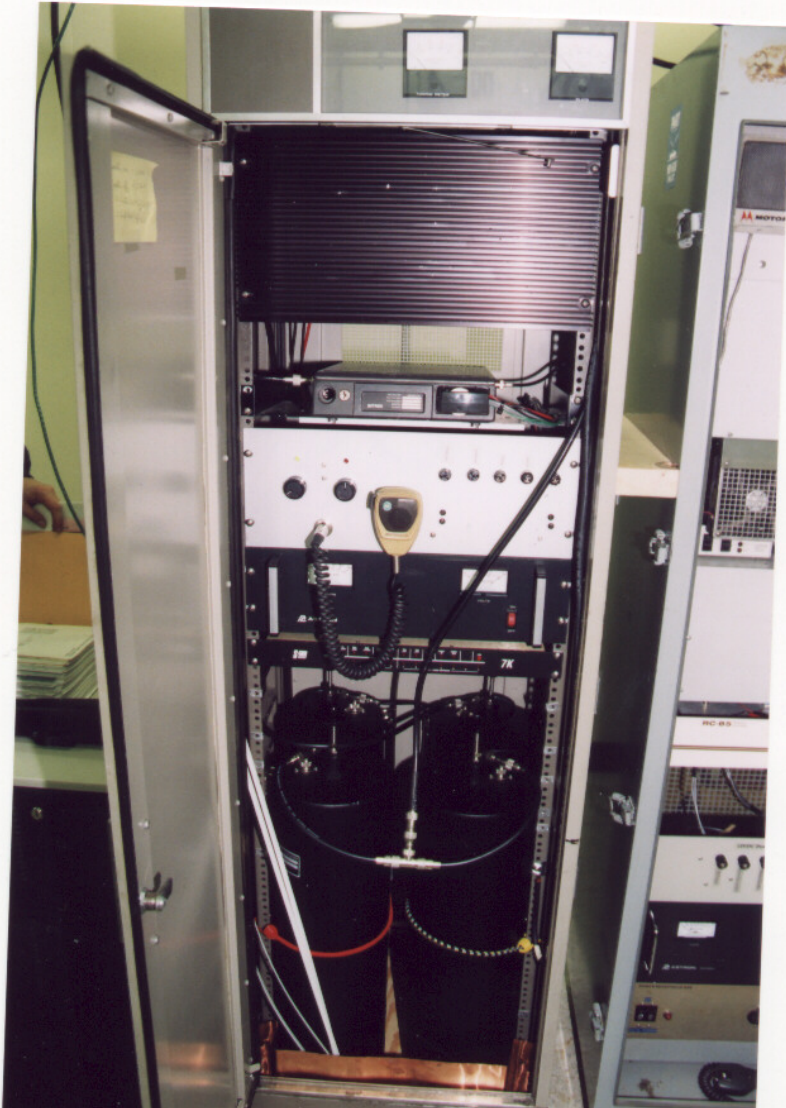
1999



1999



1999



Another antenna party

- 11/24/2002
 - New 2 meter antenna Diamond F23
 - Art-AA1HO and Al-KD1D again climbing the tower
 - On the ground-N1AEW, KB1GMX, KB1HMQ

Antennas Replaced Again!

■ June 25, 2004

- Ernie-N1AEW, Hugh-N1QGE, Terry-KA8SCP and Ken-N1TRE (radio shop)
- 440 antenna is now Cellwave PD1151-2
- 2 meter antenna DB224-E

Current 2
meter
antenna

Current
440
antenna



Out with old, in with the new!

- March 6, 2009
 - Retired “used” 955 Motorola Mitrek
 - Began it’s WB1GOF use on 4/10/1998
 - On the air 95,000 hours, 3,983 days
 - Installed NEW Kenwood TK-750-K2

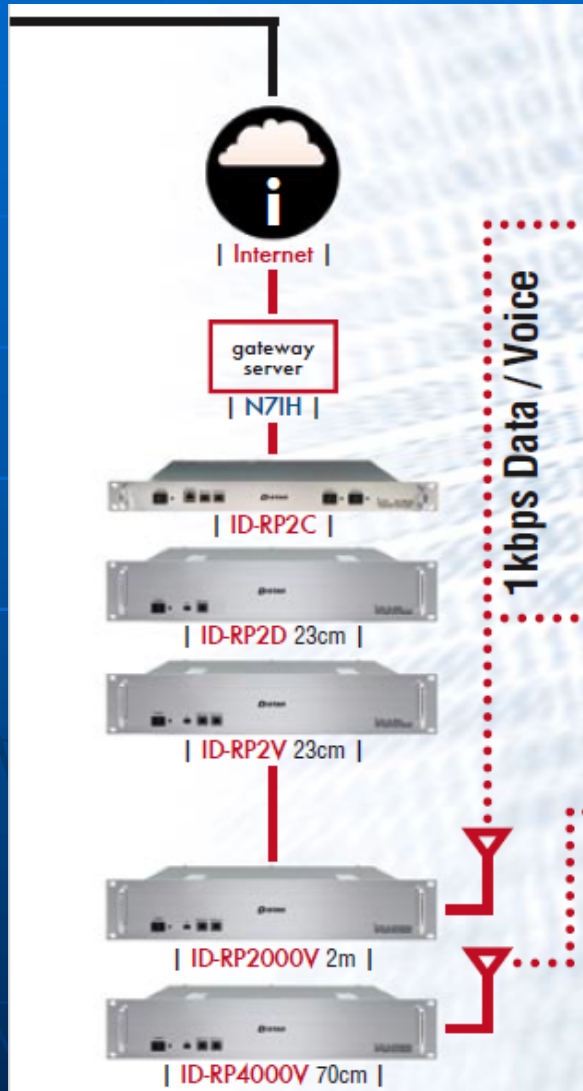


The Move to DIGITAL

- April 3, 2010
 - Retired the “used” Motorola 442.450 Mitrek
 - Continuous operation since Feb. 7, 1991
 - 167,880 hours, 6,995 days
 - Replace by Icom D-STAR
 - Repeater RP-4000V

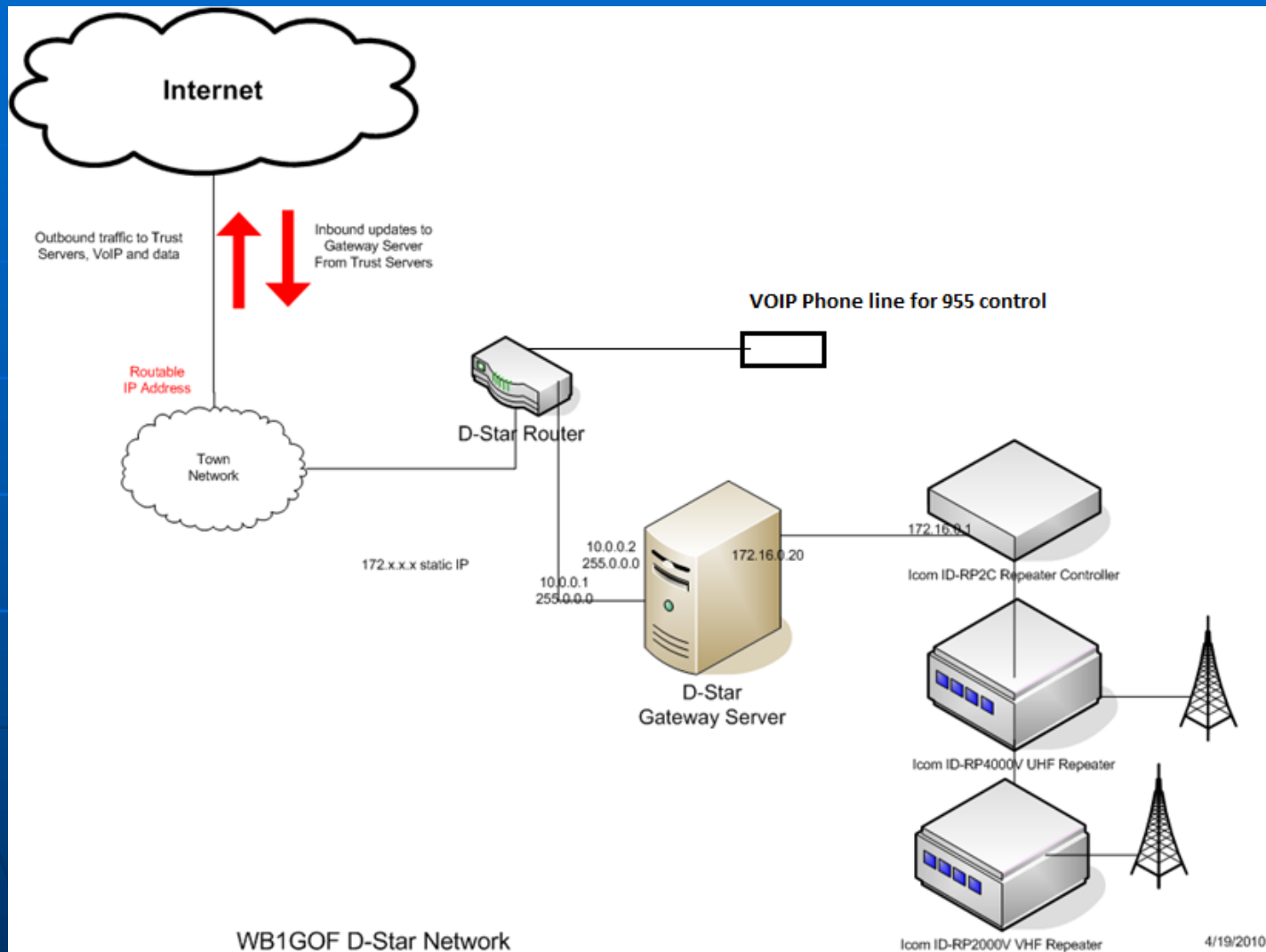


Current Icom D-Star “stack”



- WB1GOF's current “stack” has:
 - 442.450 – B module RP-4000V
 - 145.330 – C module RP-2000V
 - No 1.2 GHz (A & D modules)
 - RP-2C Controller (the G module)

WB1GOF D-STAR IP Network



4/19/2010

WB1GOF/R

As of 2012

Icom
D-Star Controller
145.330 Repeater (18w)
442.450 Repeater (18w)

Wacom UHF (4)
BPBR/Duplexer

UHF Rcvr Bandpass
Cavity (1) & Preamp

Network Router/FIOS

HP DL580 G2 (4 way)
CentOS (Linux)
D-Plus Gateway
Routing Software
Link Scheduling
User Logging
D-Star Registration

D-Star Cab

FM Analog Cab

3 Open Repeaters
On the Air 24/7

21 Years of
Continuous
Public Service

146.955 TPL power
amp (55W/at Ant)

146.955 Kenwood
TKR-750 repeater

146.955 SCOM
controller & Spare

Phelps Dodge
145.330 (back)
(6) Duplexer

Wacom 146.955
(front) (4)
Duplexer

AT&T Cell Site - Prospect Hill
Westford, Ma
579 feet/AMSL

Co Channel users

- Augusta, Maine 146.955, PL of 100.0, 146 miles away.
- Morris, CT 146.955 repeater, PL 100.0, 110 miles away
 - When band conditions are good can be heard
- Dennis, MA 146.955 repeater, PL 88.5, 86.3 miles away
 - Can often be heard underneath

Adjacent channel repeaters

- Concord, NH 146.94, PL of 114.8, 115 miles away.
- Cumberland, RI 146.940 repeater, PL 67.0, 67 miles away
- Paxton, MA 146.970 repeater, PL 114.8, 30.5 miles away
 - Biggest concern mobile operators pass thru Westford area

Westford Quadrangle



- List of Middlesex County summits
- Prospect Hill details
- Westford Conservation Prospect Hill Wildlife Sanctuary
- Prospect Hill CR Trail Map Brochure
- OpenStreetMaps

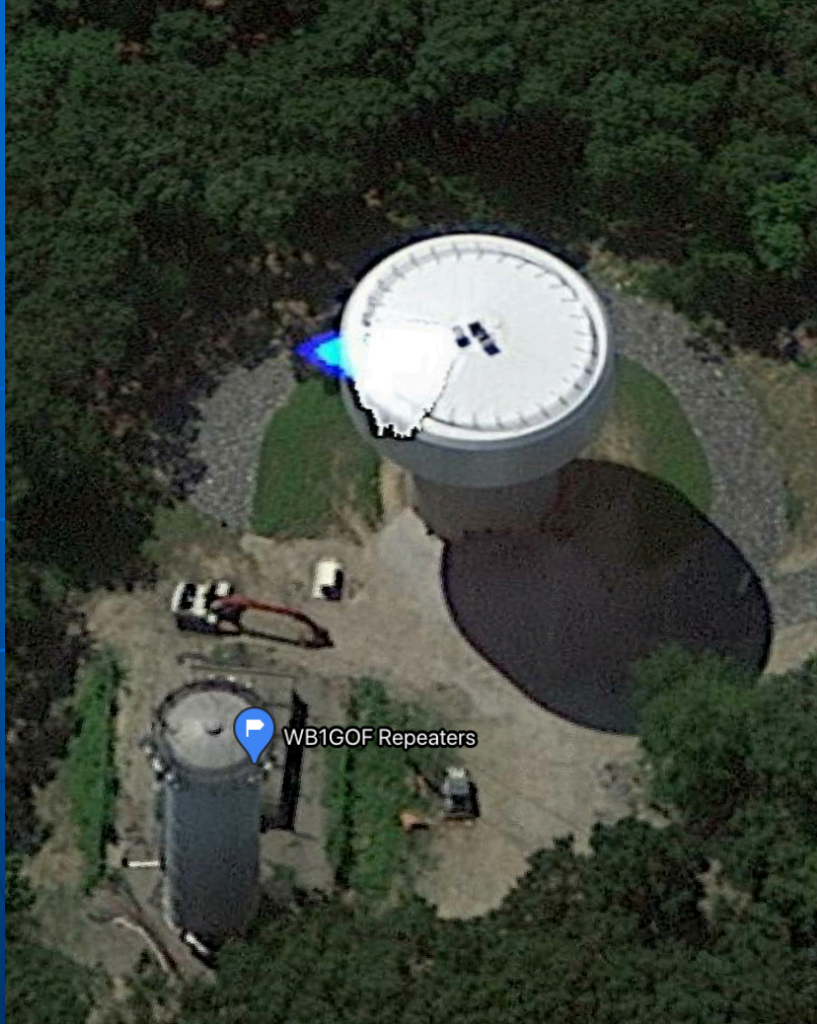
Water Tower Project

- Started discussion in 2015/2016
 - Effort to increase Repeater Fund
 - Unknown what our share of the cost would be
- Project became real in 2018/2019
- Prep work
 - Re-use or New antennas?
 - NEW!
 - Old in storage @ Highway Garage

Water Tower Project

- One week notice
 - Changeover week of April 13th
- The call @ 10:54 AM April 16 2020
 - Arrived at site 11:10
 - Forgot VOIP modem!
 - Returned at 11:25
- Review changeover process
- Repeaters off the air @ 11:47 AM
- Repeaters back on the air @ 12:38 PM

Water Tower Project



Water Tower Project



Water Tower Project



Water Tower Project



58'-0" DIAMETER

ACCESS TUBE

CONE ROOF

REVERSE CONE

S-3

S-2

S-1

C-2

C-1

BASE PLATE

UTILITY RAIL

WALKWAY

CONCRETE DOME

PEDESTAL LADDER

REST SEAT

(2) LOWER VENTS

OVERHEAD DOOR (ROTATED FOR CLARITY)

PERSONNEL DOOR (ROTATED FOR CLARITY)

FINISHED GRADE

FINISHED FLOOR

TOP OF FDN.

34'-0" HEAD RANGE

94'-10" DISTANCE TOP OF FDN. TO H.W.L.

60'-10" DISTANCE TOP OF FDN. TO L.W.L.

30'-0" INSIDE DIA. CONCRETE SHAFT

H.W.L. ELEV. 557.00'

L.W.L. ELEV. 523.00'

TOP OF PEDESTAL ELEV. 518.17'

ELEV. 510.92'

ELEV. 490.00'

ELEV. 464.50'

ELEV. 465.00'

ELEV. 462.17'

- Copyright 2020 KA8SCP

WB1GOF Site – Overall

- Town-owned water tower
 - Homeland Security restrictions
 - Restricted Access
 - Town & Regional radio systems located here
 - WPD, WFD, Westford Highway, NEMLEC, District 6 Fire
 - Town network
- AT&T cell site
 - They pay for the power and lights, building is theirs.
 - Free rent to us. Leased for \$1 in 1991
 - Emergency power
 - Natural gas generator

WB1GOF Site – Overall

- Repeaters a Westford Emergency Management resource
 - 955 is regional EmComm repeater for MEMA
 - RACES resource (Westford, Lowell-Bay State Marathon)
- Equipment is owner's expense to repair, replace, etc.
 - No expense to the "club"
 - Donations to Repeater Fund only assistance
 - Phone line paid by owner

WB1GOF Site – 146.955

- Cable Loss per 100 ft at Operating Frequency = .55 dB
- Cable Length = 130 Ft. (LDF5-50A)
- Calculated Loss = 0.7 dB
- Power into Cable = 55 Watts
- Power out of Cable = 46.7 Watts
- Gain of Antenna = 8.1 dBd
- ERP of Antenna System = 301.2 Watts

WB1GOF Site – 145.330

- Cable Loss per 100 ft at Operating Frequency = .55 dB
- Cable Length = 130 Ft. (LDF5-50A)
- Calculated Loss = 0.7 dB
- Power into Cable = 18 Watts
- Power out of Cable = 15.3 Watts
- Gain of Antenna = 8.1 dBd
- ERP of Antenna System = 98.6 Watts

WB1GOF Site – 442.450

- Cable Loss per 100 ft at Operating Frequency = .817 dB
- Cable Length = 130 Ft. (LDF5-50A)
- Calculated Loss = 1.1 dB
- Power into Cable = 18 Watts
- Power out of Cable = 14.1 Watts
- Gain of Antenna = 8 dBd
- ERP of Antenna System = 88.9 Watts

Repeater Links



- General Info:
<http://www.wb1gof.org/repeaters>
- Rules of Conduct:
<http://www.wb1gof.org/repeaters/repeaterrules>
- D-STAR status:
<http://www.wb1gof.org/repeaters/dstarstatus> or <https://wb1gof.dstargateway.org>

Upgrades? Additions?

- Past discussions
 - 900 MHz repeater
 - 220 MHz repeater
 - DMR and/or Fusion
 - Highway garage site
- New Thoughts
 - None now
 - Feel out new site first
 - Some RF side pieces needed

Prominent digital modes – D-Star, DMR & Fusion

- D-Star
 - The oldest of the three
 - Designed for Amateur Radio
- DMR – Digital Mobile Radio
 - MOTOTRBO is Motorola's version.
 - Commercially developed, adapted to ham radio
- Fusion
 - Yaesu only

Comparison of digital modes

| Feature / Item | D-Star | DMR | Fusion |
|------------------------------------|------------|------------------|-------------|
| Ease Of Use | Easy | Easy | Easy |
| Ease Of Programming | Medium | Low | High |
| Cost | Low-Medium | Low-High | Medium |
| Flexibility | High | Low | High |
| Survivability | High | Low | Low |
| Extendability | High | Low | Low |
| Multiple Manufactures | Few | Lots | One |
| Access The Network via "Non Radio" | Yes | No | No |
| Multi-band Radios Available | Yes | No | Yes |
| Field Programmable | Yes | Some | Yes |
| Connectability | Yes | Yes | Yes |
| Voice Quality | Good | Great | Great |
| Digital ID | Yes | No | Yes |
| GPS | Yes | No | Yes |
| Can Send Data | Yes | No | Yes |
| Bandwidth | 6.25 | 12.5 | 12.5 / 6.25 |
| Concurrent Voice Channels | 1 | 2 | 1 |
| Error Correction | Good | Great | Great |
| Mixed Mode Repeaters | No | With Limitations | Yes |
| Ease of Multi-User | Good | Poor | Good |

Major differences

- D-Star – end user defines connectivity versus repeater Admin defines connectivity options with DMR
- DMR and Fusion use newer vocoder, audio quality is viewed as better than D-Star
- DMR can have 2 channels on 1 repeater

Multi-Mode Capabilities?

D-STAR to DMR & Fusion available now

- When D-STAR is connected to XRF038A, multimode option is active
 - XRF038A tied to super-reflector XRF905B
 - Linked to XLX416D
 - BM TG 302050
 - YSF 36010
 - <http://freestar.homelinux.net/>

Repeater Owner “statement”

The three WB1GOF repeaters (including all hardware and associated components with each repeater), found on the coordinated (New England Spectrum Management Council, www.nesmc.org) frequencies of 145.330 MHz, 146.955 MHz and 442.450 MHz, are owned solely by individuals who are considered the “owners”.

Repeater Owner “statement”

PART and individual contributors from time to time have provided financial support to the repeater owners. Neither PART, nor its members by virtue of their membership status, has any ownership rights to the repeaters.

Repeater Info

- Email interference reports to:
repeater@wb1gof.org
- Questions to:
 - Terry – ka8scp@wb1gof.org