GOTAhams WG6OTA Amateur Radio Club

GOTAhams Monthly Membership Meeting

Wednesday January 11th

Presentation of Cross Band Repeat

By KN6NRQ Erik Dlugajczyk

Cross Band Repeat: The Definition

Crossband Repeating is a process where a Ham transmits one signal on one band (typically UHF), and it is received by another radio with a better antenna/power installation, and re-transmitted (typically on VHF) to another radio system, or a repeater.

Wisconsin Valley Radio Association W9SM / W9NA

- Cross Band Repeat (Portable Remote Base):
  - Repeating signal from one band to another band
  - Cross Band (VHF-UHF or UHF-VHF)
- Signal can be repeated in analog, digital, or both
  - Signal can be cross band repeated in analog only or digital only
  - Signal can be cross band repeated from analog to digital
  - Signal can be cross band repeated from digital to analog
  - Expect a delay when using digital

- Is a Cross Band Repeater the same as a regular repeater like AE6TV?
  - By the simple definition as defined by Part 97.3(a)(37): A repeater is an amateur station which simultaneously retransmits the transmission of another station on a different channel or channels”
  - AE6TV and other regular repeaters retransmit with an offset of 0.6 MHz on VHF or 5.0 MHz on UHF, cross band repeaters retransmit on a completely separate band
  - Regular repeaters are built to withstand constant traffic without interruption at full power, full duplex radios (the ability to send and receive simultaneously) with the ability to cross band repeat are only built for limited traffic and not at full power. Full power is only reserved for a transmission not a simultaneous transmit / receive function. Duty cycle of most cross band repeat radios is reduced especially at high power levels. Since it is not possible to prevent others from keying up on the frequency being utilized, operation at low power is strongly recommended to avoid damage to the radio.

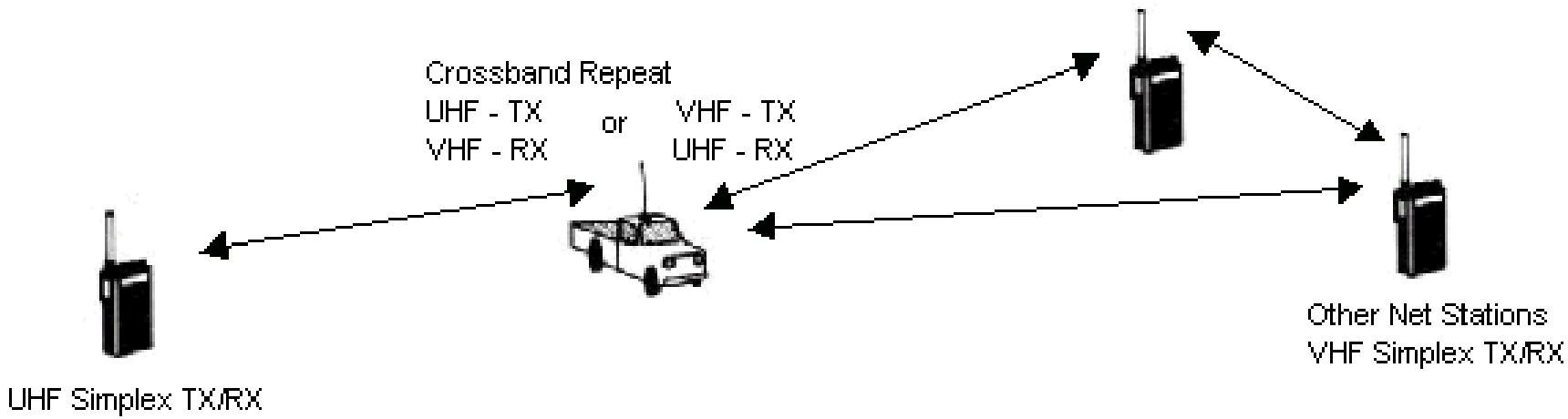
Anytone 578

Yaesu FTM-400 xdr

Kenwood TM-V71A

TYT TH-9800

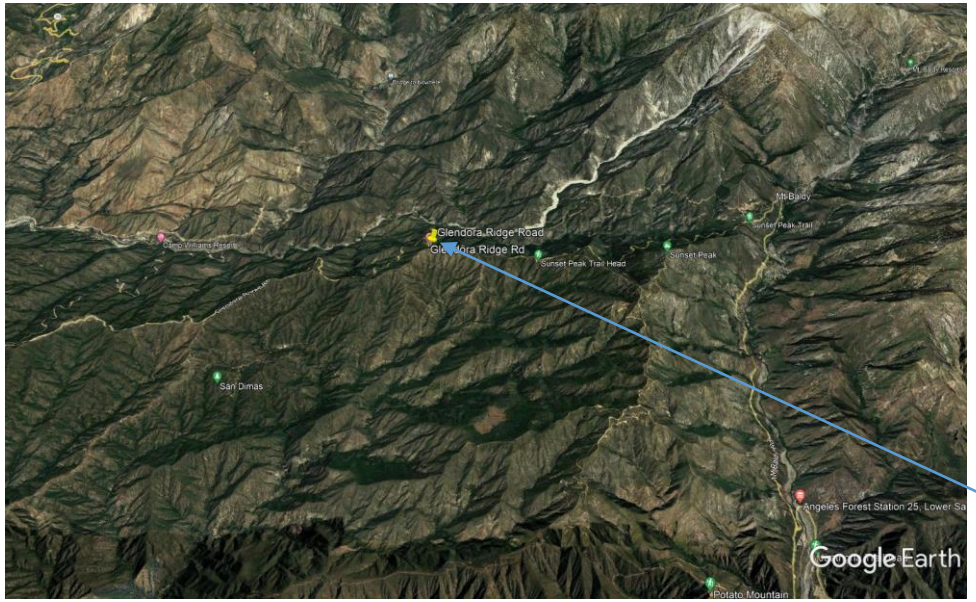
ICOM 2730A



Simplex-to-Simplex Crossband Repeat

- During the “Great Shake Out” I utilized cross band repeat in order to participate in the simplex net organized by the GOTAhams. Because my office building is surrounded by metal insulation, I would not have had an opportunity to participate in the net without walking away from my daily job, which was not an option. I connected my HT, through a UHF simplex frequency, to the simplex frequency utilized by the GOTAhams for the purpose of the net. I was able to transmit/receive from my office to my vehicle outside my office, and have that signal re-transmitted to VHF frequency utilized for the net. The following page illustrates this procedure.

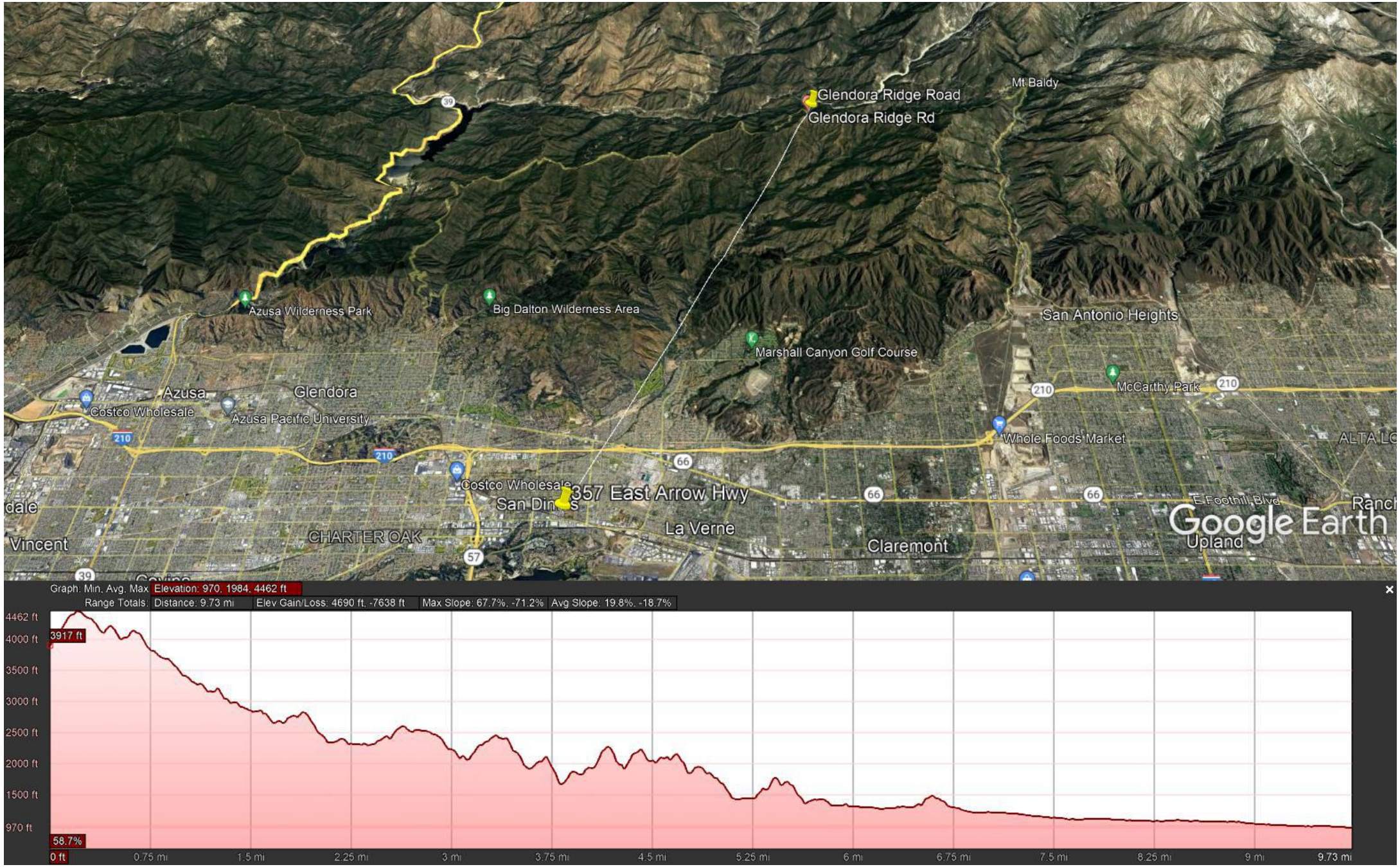
The Great ShakeOut 2021 Participation on VHF



GOTAhams Kathi receiving signal on Glendora Ridge Road

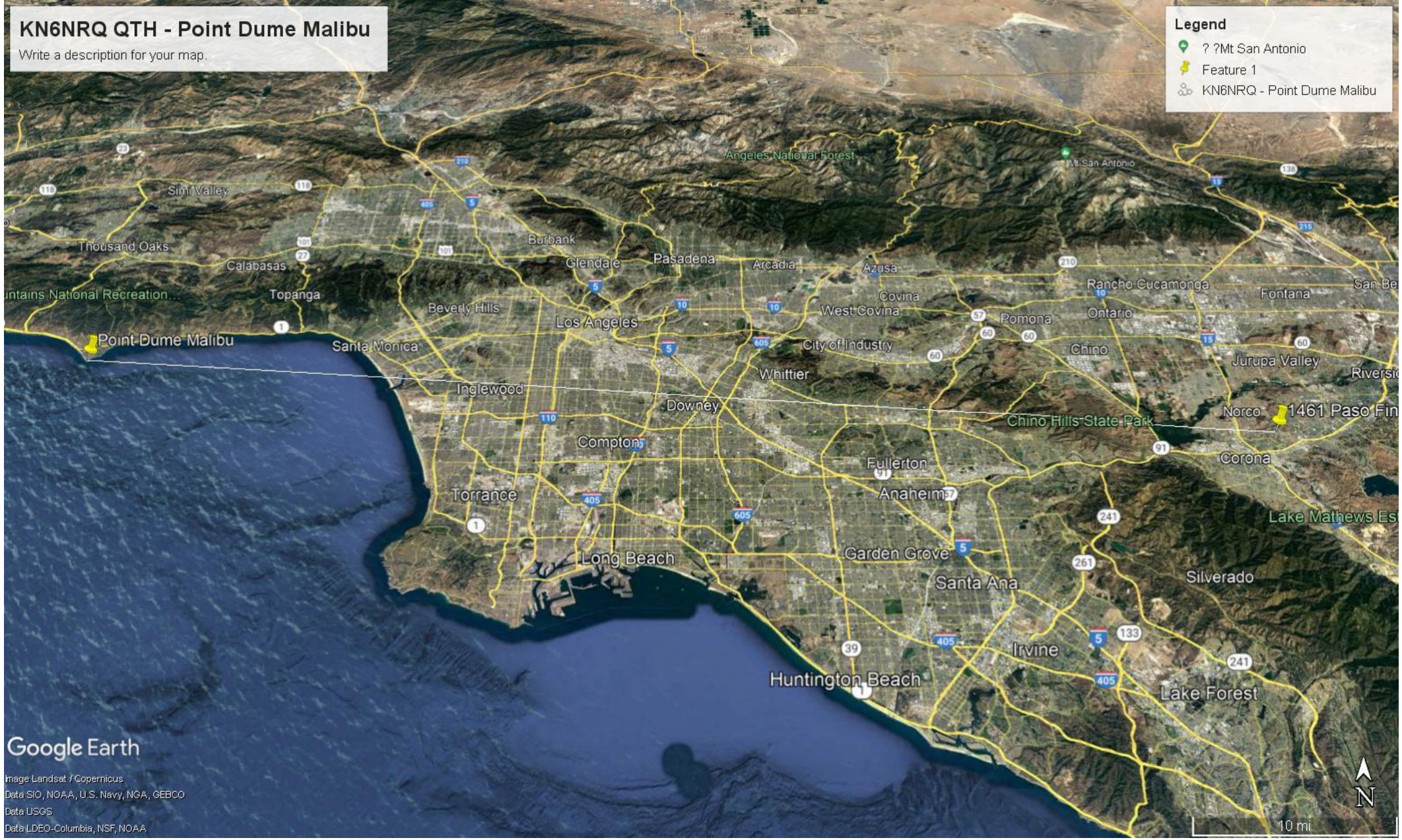
Anytone 578 Mobile receiving the UHF signal, cross-band repeating on 146.580 the Shakeout Simplex net

Anytone 878 HT inside an office, transmitting / receiving on UHF frequency using low power


Glendora Ridge Road
Glendora Ridge Rd
Mt Baldy
Azusa Wilderness Park
Big Dalton Wilderness Area
San Antonio Heights
Marshall Canyon Golf Course
McCarthy Park
Azusa
Glendora
Costco Wholesale
Azusa Pacific University
Whole Foods Market
357 East Arrow Hwy
Costco Wholesale
San Dimas
La Verne
CHARTER OAK
Claremont
Vincent
Upland
E Foothill Blvd
Google Earth
Graph: Min, Avg, Max Elevation: 970, 1984, 4462 ft
Range Totals: Distance: 9.73 mi Elev Gain/Loss: 4690 ft, -7638 ft Max Slope: 67.7%, -71.2% Avg Slope: 19.8%, -18.7%
4462 ft
4000 ft
3500 ft
3000 ft
2500 ft
2000 ft
1500 ft
970 ft
3917 ft
58.7%
0 ft
0.75 mi
1.5 mi
2.25 mi
3 mi
3.75 mi
4.5 mi
5.25 mi
6 mi
6.75 mi
7.5 mi
8.25 mi
9 mi
9.73 mi

Okay, so cross band repeat can be used to get a signal outside of the building in order to increase the distance. But can I REALLY increase my distance?

OH YEAH


KN6NRQ QTH - Point Dume Malibu
Write a description for your map.
Legend
? ?Mt San Antonio
Feature 1
KN6NRQ - Point Dume Malibu
Angeles National Forest
Mt San Antonio
Simi Valley
Thousand Oaks
Calabasas
Topanga
Burbank
Glendale
Pasadena
Arcadia
Azusa
Covina
West Covina
Rancho Cucamonga
Fontana
Ontario
Pomona
Beverly Hills
Los Angeles
Point Dume Malibu
Santa Monica
City of Industry
Chino
Jurupa Valley
Whittier
Inglewood
Downey
Norco
1461 Paso Fin
Chino Hills State Park
Compton
Corona
Fullerton
Anaheim
Torrance
Lake Mathews Es
Long Beach
Garden Grove
Santa Ana
Silverado
Irvine
Huntington Beach
Lake Forest
Google Earth
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data USGS
Data LDEO-Columbia, NSF, NOAA
N
10 mi


Padres National Forest
Lancaster
Palmdale
Victorville
Hesperia
Angeles National Forest
Mt San Antonio
San Bernardino National Forest
Ventura
Oxnard
Camarillo
Thousand Oaks
Burbank
Santa Monica Mountains National Recreation
Point Dume Malibu
Los Angeles
Santa Monica
Ontario
San Bernardino
Riverside
1461 Paso Fino Place, Norco
Corona
Torrance
Anaheim
Long Beach
Santa Ana
Perris
Irvine
Huntington Beach
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data CSUMB SFML, CA OPC
Data LDEO-Columbia, NSF, NOAA
Google Earth
Murrieta
Temec
Dana Point
Graph: Min, Avg, Max Elevation: -3, 317, 1608 ft
Range Totals: Distance: 74.4 mi Elev Gain/Loss: 7777 ft, -6792 ft Max Slope: 29.1%, -24.6% Avg Slope: 1.5%, -2.6%
1608 ft
1250 ft
1000 ft
750 ft
500 ft
250 ft
-3 ft
0 ft
0.0%
0 ft
5 mi
10 mi
15 mi
20 mi
25 mi
30 mi
35 mi
40 mi
45 mi
50 mi
55 mi
60 mi
65 mi
70 mi
74.4 mi

Anytone 578 Mobile receiving the UHF signal, re-transmitting simultaneously to my QTH ham shack

Anytone 878 HT inside my house, transmitting on a simplex UHF frequency, on low power with a rubber ducky

KN6NRQ QTH GP-9 / Anytone 578 receiving UHF signal / cross band repeating on 146.52

146.52 QSO from Norco to Point Dume, Malibu

Ham Shack with a Anytone 578 and a GP-9 receiving / sending signals to/from HT

KN6NRQ QTH GP-9 / Anytone 578 receiving UHF signal / cross band repeating on 146.52

HT at home, using low power transmitting / receiving on UHF station

146.52 QSO from Norco to Point Dume, Malibu

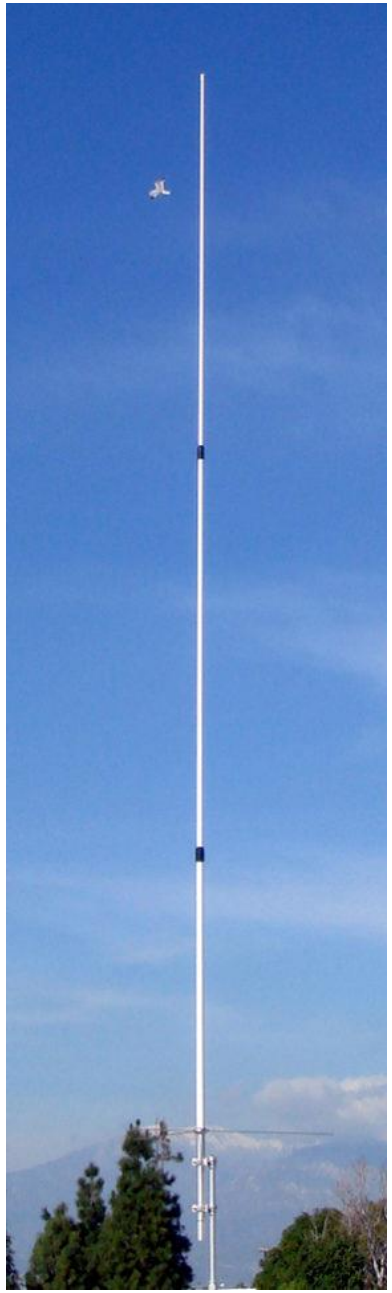
Could I have made this long distance 2M QSO with just my mobile radio and antenna?

MAYBE

Typically with line of sight 2M/70cm simplex line of sight, the antenna makes all the difference, let’s compare the 2 antennas involved:

MOBILE
Comet CSB-790A
CSB: Comet Super Beam
2M/440MHz high gain mobile antenna
2M: 7/8 wave 5.1 dBi
440 MHz: Three 5/8 Waves in phase, 7.7 dBi
SWR: 1.5:1 or less
Length: 62”

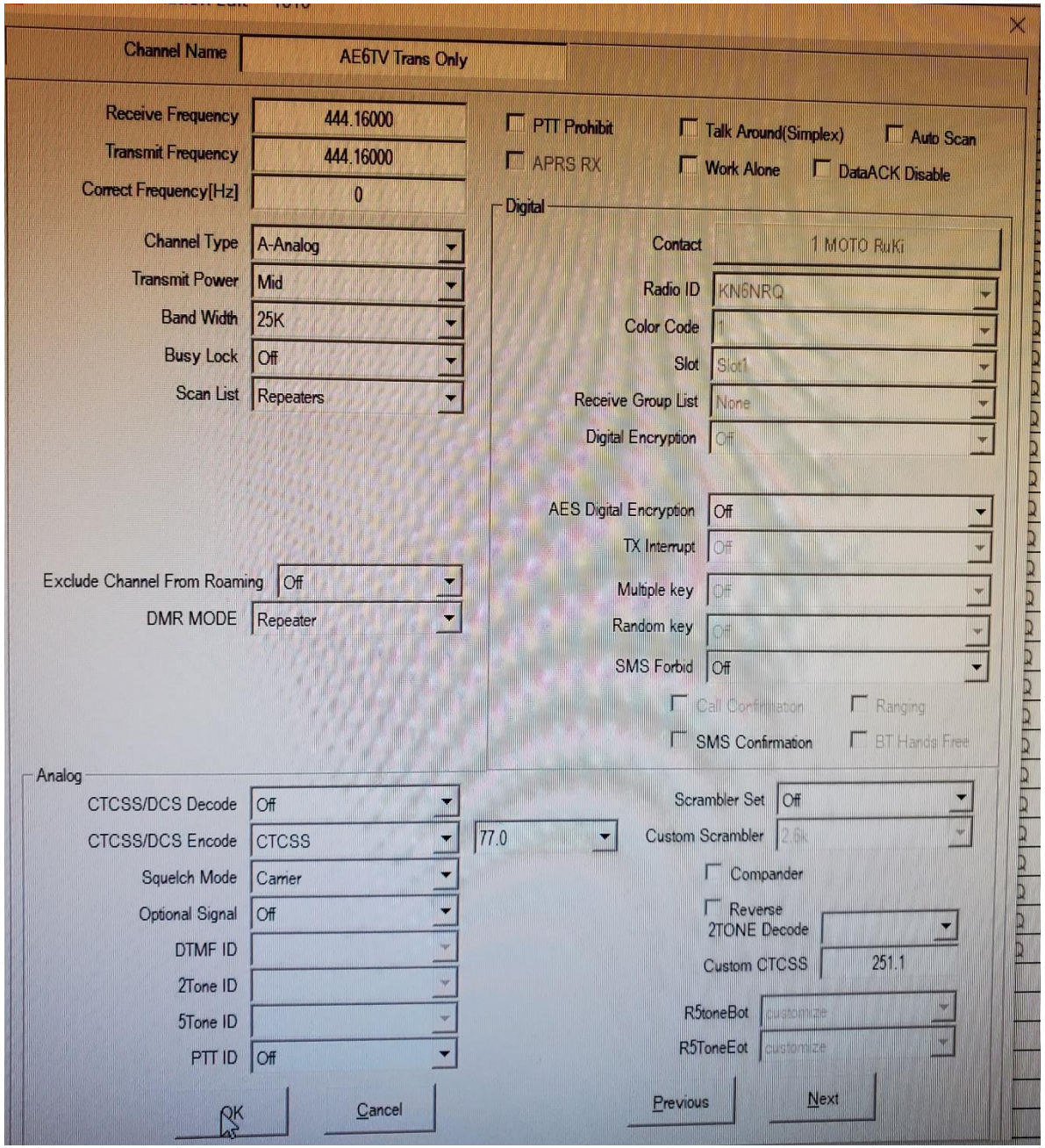
BASE (QTH)
Comet GP-9
2M/440MHz Base Antenna
2M: 5/8 Wave x3, 8.5 dBi
440MHz: 5/8 Wave x3, 11.9 dBi
SWR: 1.5:1 or less
Length: 16’9”



Can you listen to AE6TV or other repeaters on the HT while using cross band repeat only to transmit?

YES

You can program your radio for the “transmit” frequency of the repeater, which is the offset frequency. That way you’re not hearing the receive frequency of the repeater and it is not being constantly repeated, only when you are transmitting.


Channel Name
AE6TV Trans Only
Receive Frequency
444.16000
Transmit Frequency
444.16000
Correct Frequency[Hz]
0
Channel Type
A-Analog
Transmit Power
Mid
Band Width
25K
Busy Lock
Off
Scan List
Repeaters
PTT Prohibit
Talk Around(Simplex)
Auto Scan
APRS RX
Work Alone
DataACK Disable
Digital
Contact
1 MOTO RuKi
Radio ID
KN6NRQ
Color Code
1
Slot
Slot1
Receive Group List
None
Digital Encryption
Off
AES Digital Encryption
Off
TX Interrupt
Off
Multiple key
Off
Random key
Off
SMS Forbid
Off
Call Confirmation
Ranging
SMS Confirmation
BT Hands Free
Exclude Channel From Roaming
Off
DMR MODE
Repeater
Analog
CTCSS/DCS Decode
Off
CTCSS/DCS Encode
CTCSS
77.0
Squelch Mode
Carrier
Optional Signal
Off
DTMF ID
2Tone ID
5Tone ID
PTT ID
Off
Scrambler Set
Off
Custom Scrambler
Compander
Reverse
2TONE Decode
Custom CTCSS
251.1
R5toneBot
customize
R5ToneEot
customize
OK
Cancel
Previous
Next

Is this stuff really legal?

YES

Let’s hear from the authority

The following is copied from ARRL's "Auxiliary Station FAQ":

"A cross-band repeater (or "portable remote base") is okay as long as several conditions are met: 1) The user communicates with his cross-band rig via the UHF side. Since this serves as his control and voice uplink, it is a form of auxiliary operation and must be conducted above 144-MHz. Since the operator is the control operator, that person must actually be able to control the station! That person must be able to turn it off remotely if a problem develops. If the operator can't control it, it's not legal [97.7, 97.201, 97.213]. 2) If the control link fails, the remote station must shut down within three minutes which means a 3-minute timer is required [97.213]. 3) The unattended station must be identified on all frequencies it transmits on. Since this is a form of remote base, the user's ID over the UHF uplink to the dualband radio also serves to ID the VHF output of the mobile rig. In the other direction, however, there is no way for the control operator to ID the UHF downlink from the mobile remote base, so some form of automatic ID must be employed [97.119]."
http://www.arrl.org/auxiliary-station-faq

Unfortunately, few manufacturers include the capabilities listed above in their rigs. Hence, to be fully legal, some form of add-on controller may be necessary. Another use for cross-band operation is to link together two existing repeaters on different bands. This is usually done on a temporary basis during an emergency, a drill or a special event. Again, the requirements for proper station identification and control on both sides of the dualband radio's transmissions still apply. If both the VHF and UHF transmitters are not properly identified and controlled, the operation is not legal. In the examples cited above, the control requirement can be satisfied by having a control operator at the station, thus making it a locally controlled station. Although this may not always be convenient, it is a way to satisfy all of the station control required. Additionally, at least one of the radios featured in this presentation (Kenwood TM-V71A) can be set up for automatic station identification in both CW and voice.

In order to maintain control from off site, Wi-Fi smart home devices can be utilized such as the power strip below

§ 97.7 Control operator required.

When transmitting, each amateur station must have a control operator. The control operator must be a person:

(a) For whom an amateur operator/primary station license grant appears on the ULS consolidated licensee database, or

(b) Who is authorized for alien reciprocal operation by § 97.107 of this part.

§ 97.119 Station identification.

(a) Each amateur station, except a space station or telecommand station, must transmit its assigned call sign on its transmitting channel at the end of each communication, and at least every 10 minutes during a communication, for the purpose of clearly making the source of the transmissions from the station known to those receiving the transmissions. No station may transmit unidentified communications or signals, or transmit as the station call sign, any call sign not authorized to the station.

(b) The call sign must be transmitted with an emission authorized for the transmitting channel in one of the following ways:

(1) By a CW emission. When keyed by an automatic device used only for identification, the speed must not exceed 20 words per minute;

(2) By a phone emission in the English language. Use of a phonetic alphabet as an aid for correct station identification is encouraged;

(3) By a RTTY emission using a specified digital code when all or part of the communications are transmitted by a RTTY or data emission;

(4) By an image emission conforming to the applicable transmission standards, either color or monochrome, of § 73.682(a) of the FCC Rules when all or part of the communications are transmitted in the same image emission

§ 97.201 Auxiliary station.

(a) Any amateur station licensed to a holder of a Technician, General, Advanced or Amateur Extra Class operator license may be an auxiliary station. A holder of a Technician, General, Advanced or Amateur Extra Class operator license may be the control operator of an auxiliary station, subject to the privileges of the class of operator license held.

(b) An auxiliary station may transmit only on the 2 m and shorter wavelength bands, except the 144.0-144.5 MHz, 145.8-146.0 MHz, 219-220 MHz, 222.00-222.15 MHz, 431-433 MHz, and 435-438 MHz segments.

(c) Where an auxiliary station causes harmful interference to another auxiliary station, the licensees are equally and fully responsible for resolving the interference unless one station's operation is recommended by a frequency coordinator and the other station's is not. In that case, the licensee of the non-coordinated auxiliary station has primary responsibilty to resolve the interference.

(d) An auxiliary station may be automatically controlled.

(e) An auxiliary station may transmit one-way communications.

§ 97.213 Telecommand of an amateur station.

An amateur station on or within 50 km of the Earth's surface may be under telecommand where:

(a) There is a radio or wireline control link between the control point and the station sufficient for the control operator to perform his/her duties. If radio, the control link must use an auxiliary station. A control link using a fiber optic cable or another telecommunication service is considered wireline.

(b) Provisions are incorporated to limit transmission by the station to a period of no more than 3 minutes in the event of malfunction in the control link.

(c) The station is protected against making, willfully or negligently, unauthorized transmissions.

(d) A photocopy of the station license and a label with the name, address, and telephone number of the station licensee and at least one designated control operator is posted in a conspicuous place at the station location.

My radio does not list Cross Band Repeat in the instruction manual, but through Youtube I realize that it's capable. Why isn't it listed?

Depending on the manufacturer of your radio there are 2 likely reasons:

1. Radio does not deploy some form of automatic ID [97.119].
2. Radio duty cycle is unable to maintain repeater-like performance for extended periods of time and current safety nets only exist within the user, not within the radio.

Suggested Simplex Frequencies

2 Meter Simplex:

Frequency MHz	Comments
144.310-144.375	Un-channelized Simplex, Multiple use. Avoid band edges.
144.405-144.475	Un-channelized Simplex, FM. Avoid band edges.
144.490	Uplink FM to Int'l Space Station. Avoid for other use.
145.510	FM Simplex channel
145.525	FM Simplex channel
145.540	FM Simplex channel
145.555	FM Simplex channel
145.570	FM Simplex channel
145.585	FM Simplex channel
145.600	FM Simplex channel
145.615	FM Simplex channel. Some D-Star
145.630	FM Simplex channel
145.645	FM Simplex channel
145.660	FM Simplex channel
146.520	**National US FM Calling Frequency. Short QSO.**
146.535	FM Simplex channel
146.550	FM Simplex channel
146.565	FM Simplex channel. T-hunt. Avoid if T-hunt in progress
146.580	FM Simplex channel
146.595	FM Simplex channel
147.480	FM Simplex channel
147.510	FM Simplex channel

70 Centimeter Band Simplex

Frequency MHz	Comments
441.500	Simplex Digital/packet
441.520	Simplex Digital/packet
446.000	**FM Simplex. No Digital. National Calling Frequency. Short QSO.**
446.500	FM Simplex. No Digital
446.520	FM Simplex. No Digital

Southern California channel spacing: 20KHz

QUESTIONS
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