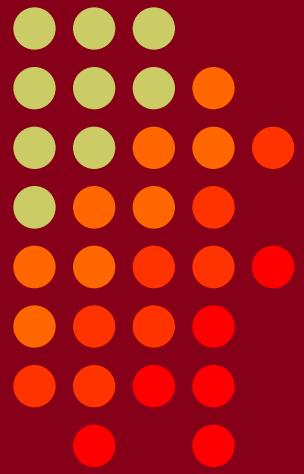
CTU Presents

VHF Contesting

Joel Harrison, W5ZN



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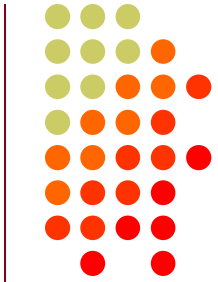
2014 CTU VHF Contesting Presentation



Special Thanks to:

Bob Striegel, K2DRH

VHF Contest winner & record holder Low Power

Jeff Klein, K1TEO

VHF Contest winner & record holder High Power

Steve Kostro, N2CEI

VHF Contest Winner & Record hold – Rover and K1WHS Multi-op

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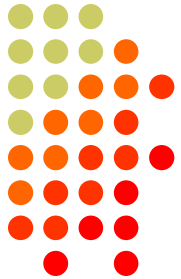
VHF Contesting – Expectations



- **Magic Bands**

with

- **Super Results**

from

- **Average Stations**

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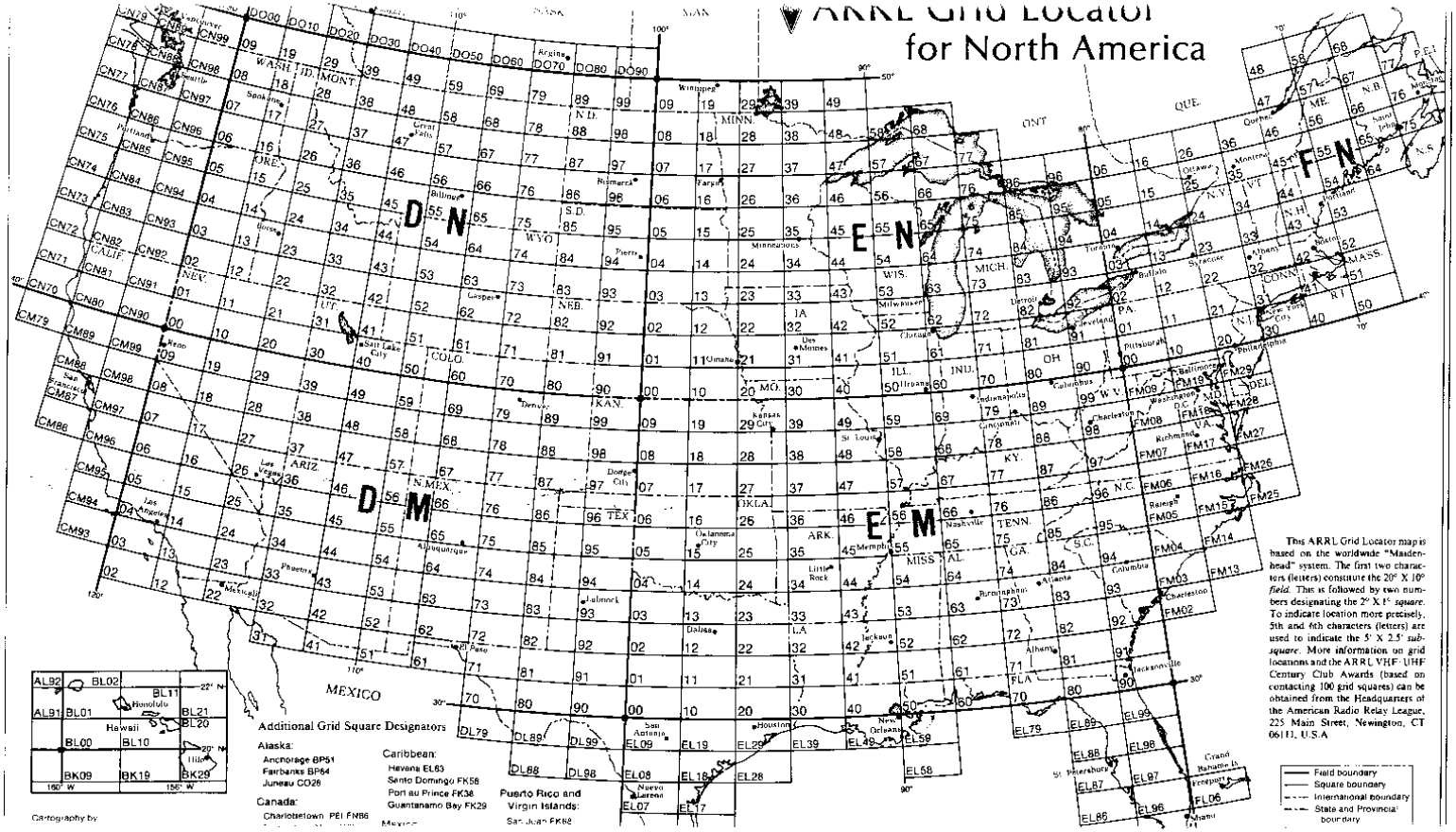
What Contests are Available?

- **ARRL**
  - January
  - June
  - September
- **CQ**
  - July
- **Many others throughout the year**

Categories

- **Standard**
  - Single OP
  - Multi Op
- ***Unique***
  - Rover
  - Single Op 3 Band (50, 144 and 432 MHz)
  - FM Only

Contest Exchange Grid Squares



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Station Basics

- **6 Meters**
  - Radio or transverter is fine
  - 50 watts is great, 100 watt is outstanding
  - 3 element antenna at 30 ft is good
- **2 Meters**
  - Radio or transverter is fine
  - >50 watts
  - 13 element beam @ ~50 ft

Station Basics

- **222 – 432 MHz**
  - >50 watts
  - 16 element & 25 element @ ~50 ft
  - Boom length
- **902 MHz & Up**
  - >10 watts
  - Loop yagis & parabolic (dish) antennas

Station Basics - Noise

The Grim Reaper of noise is *not* your friend!!

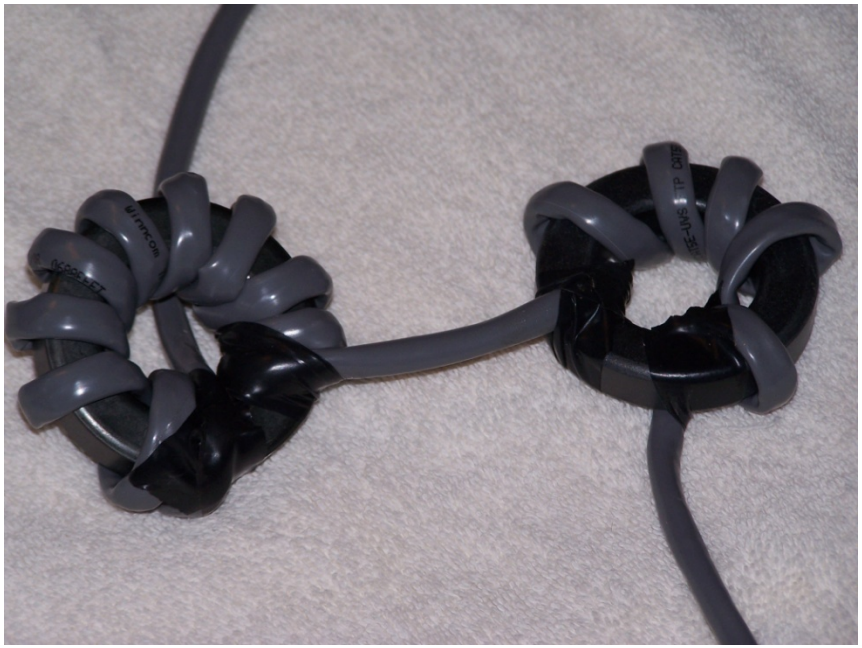
- Sky Noise
- Atmospheric Noise
- Line Noise
- Other man-made noise

Station Basics - Noise

- **Internet Routers can be a significant noise source at 50 MHz that will populate the band, especially the DX Window**
  - Multiple carriers of relatively constant amplitude but with modulation (Birdies)
    - 50.044, 50.058, 50.105, 50.120, 50.148, 50.166
  - Broadband trash
- ***Get your own station "clean" first!***

Station Basics - Noise

Internet Router noise can be significantly reduced or eliminated.



Also utilize shielded CAT5 cable and connectors

Station Basics - Noise

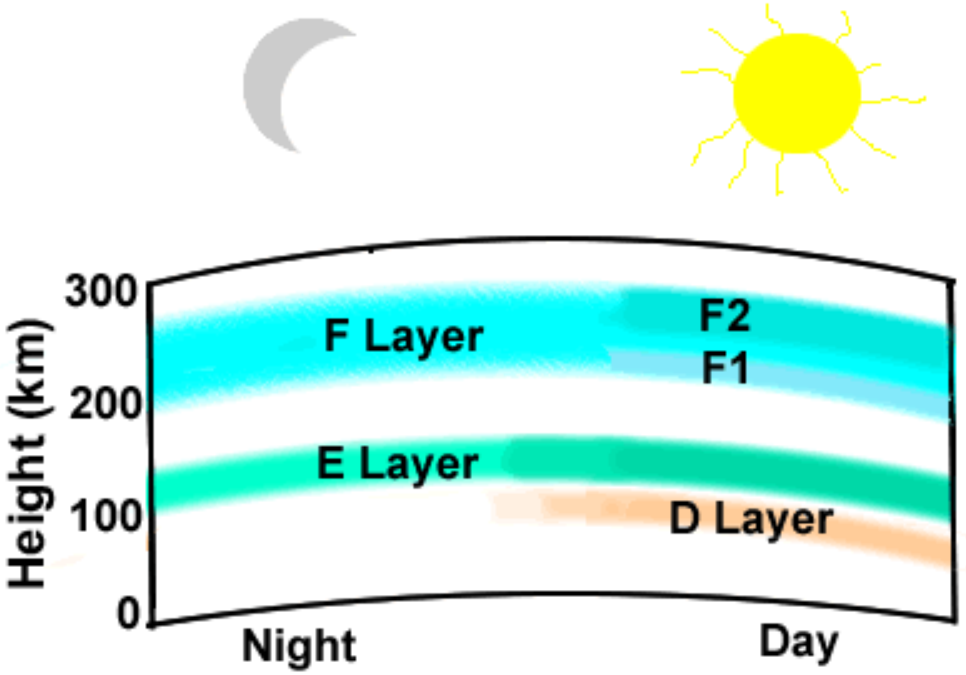
- **Some Actual Results**
  - All “birdies” are gone
  - Noise floor dropped 8 dBm !!!
- **More technical info:**
  - A Ham’s Guide to RFI, Ferrites, Baluns and Audio Interfacing - Jim Brown, K9YC
    - http://audiosystemsgroup.com

Propagation – What can I Expect

- Sporadic E – “Es”
- Tropospheric Ducting – “Tropo”
- Meteor Scatter – “MS”
- Even EME!!!!!

Propagation

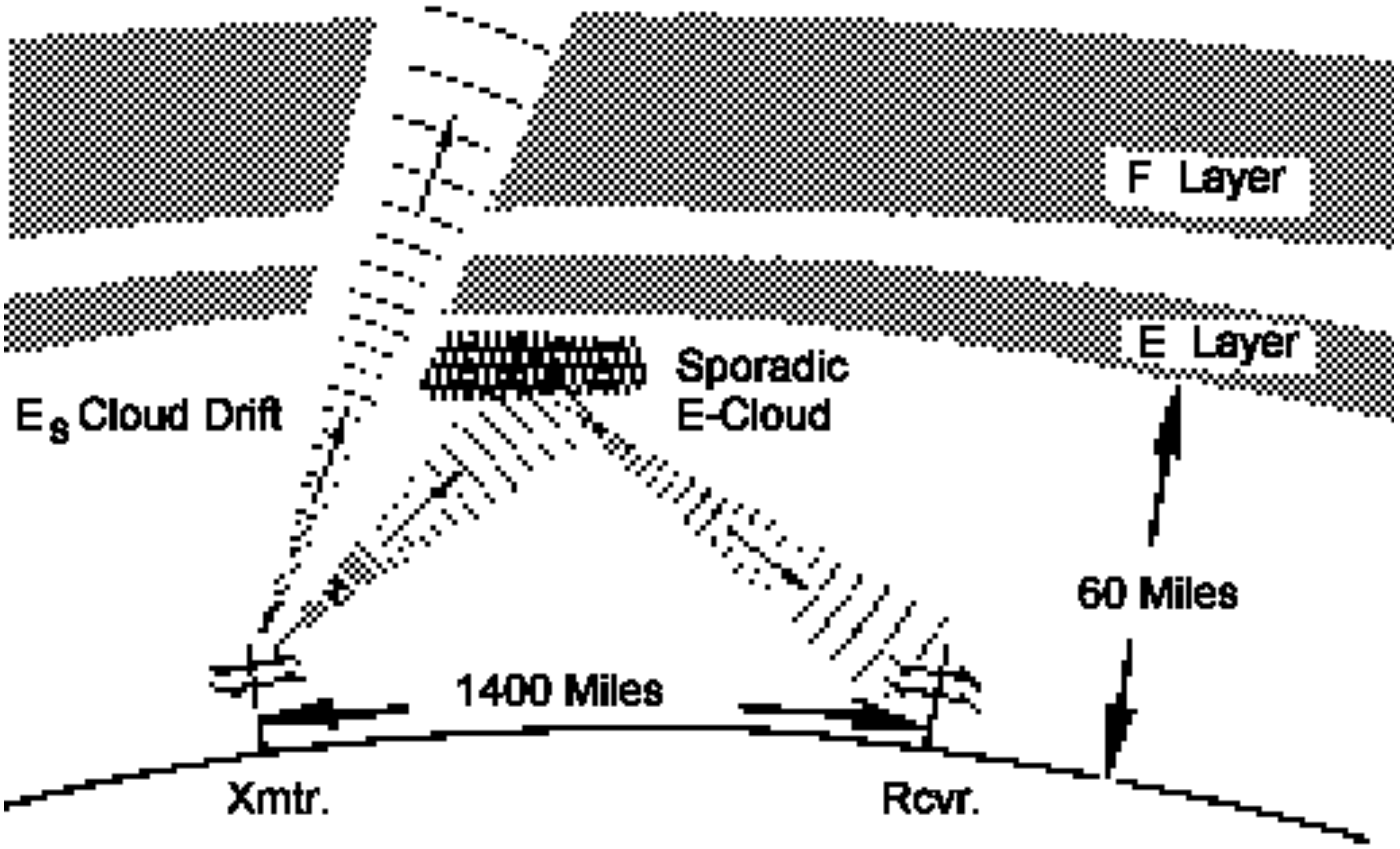
At night the E layer and F layers are present. During the day, a D layer forms and the E and F layers become much stronger. Often during the day the F layer will divide into F1 and F2 layers.



Propagation – Es

- **Sporadic ionization of the E-Layer**
  - Peaks May–July, Possibly generated by lightning
- **50 & 144 MHz, possibly 222 MHz**
  - Single-hop optimum range 900-1300 miles, maximum range 1350-1500 miles
  - Double-hop optimum range 2000-2600 miles, maximum range 2750-3100 miles
- **Peak time during daylight hours & early evening**

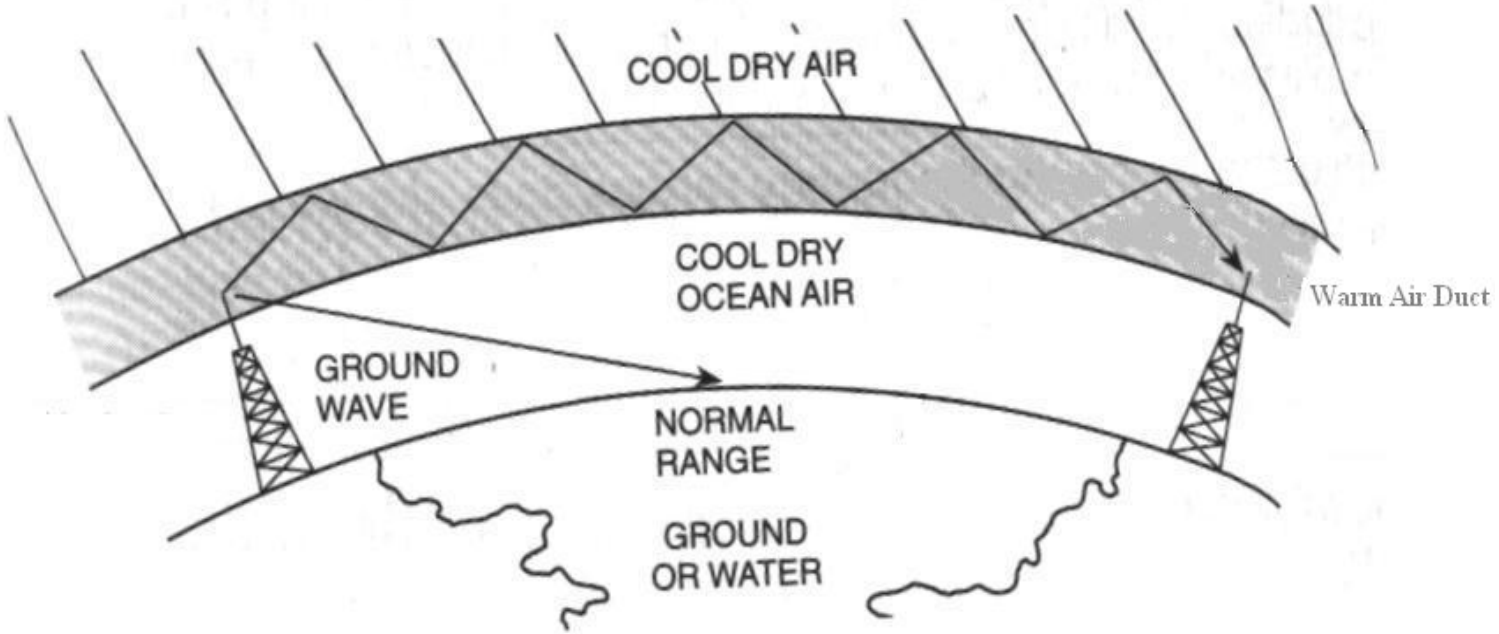
Propagation – Es



Propagation - Tropo

- **Natural atmospheric ducts that form due to temperature inversion and can shuffle VHF and UHF radio waves long distances**
  - All bands
  - Any time, but mostly warm weather months

Propagation - Tropo

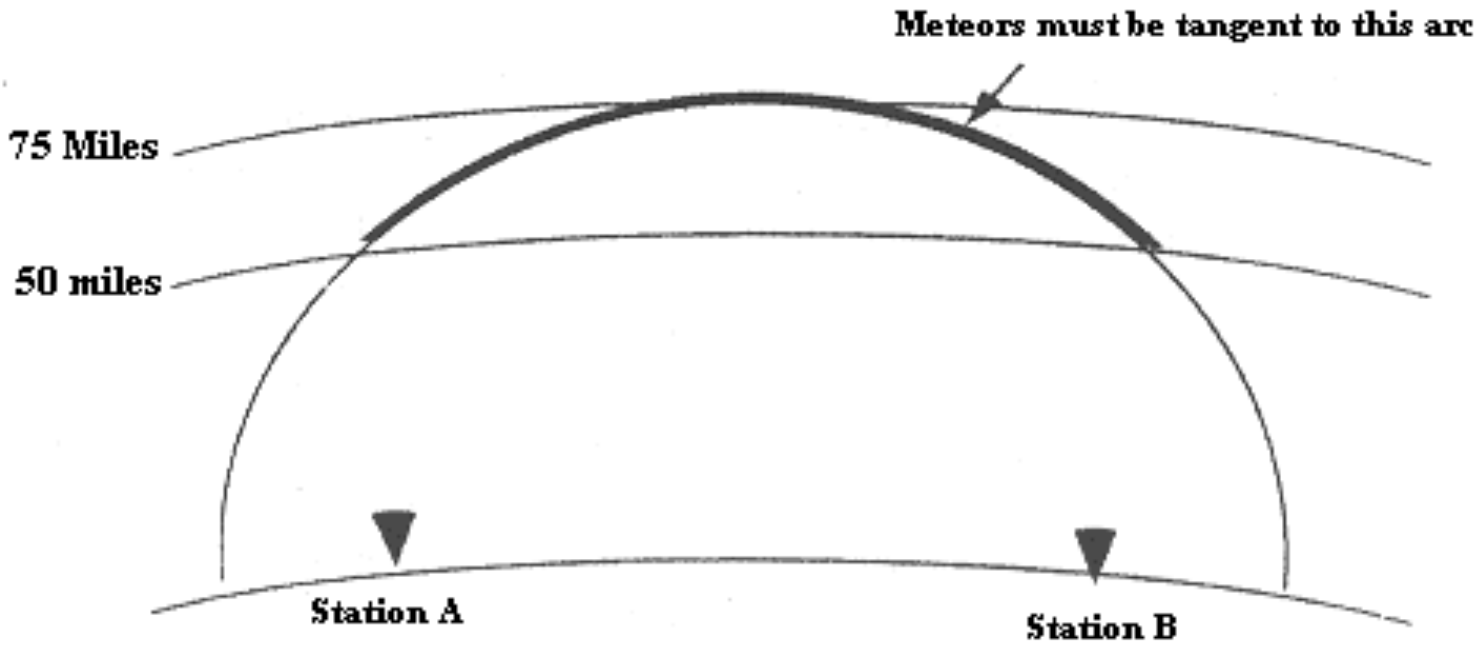


Propagation – MS

- Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.
- Meteors burn up in the upper atmosphere at a height of around 65 miles.
- This may be used to make QSOs up to about 1400 miles

Propagation – MS

Reflection will occur when the trail is oriented as shown



Propagation – MS

- **Excellent for 50 & 144 MHz, possible at 222 MHz**
- **Very Predictable Paths**
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

Equipment

- Antennas
- Receive Preamplifiers
- Amplifiers

Equipment - Antennas

- VHF antennas are small in comparison to HF antennas
- Boom lengths can be large, 30’ to 50’, but elements length & diameter is much smaller
- Antenna stacking for added gain is much easier at VHF

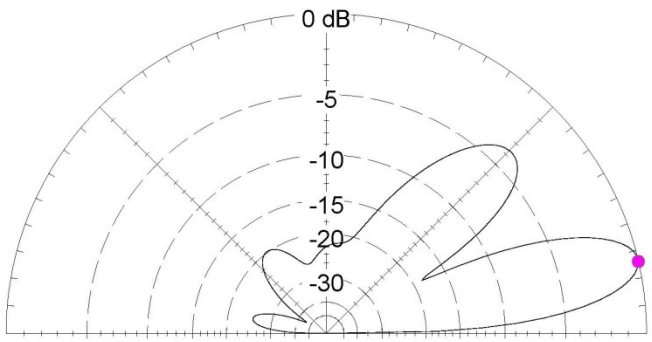
Equipment - Antennas

- **What is the best height for my antenna?**
  - You will always have dead zones and nulls regardless of height
  - Get your antennas as high as you reasonable can
- ***Antenna Rule of Thumb #1***

  Get your VHF antennas above the tree line

Equipment - Antennas

Total Field EZNEC+

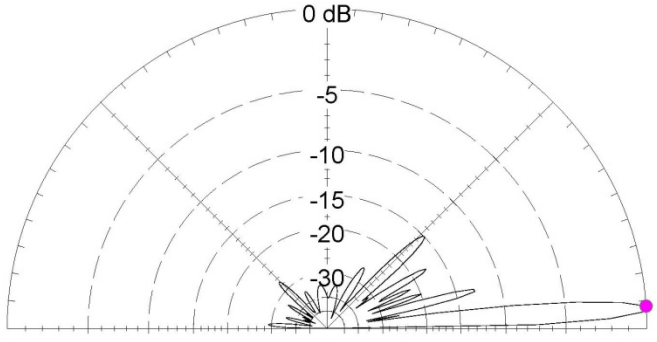


50 MHz - Three Element Yagi 50.1 MHz

Elevation Plot		Cursor Elev	13.0 deg.
Azimuth Angle	0.0 deg.	Gain	13.53 dBi
Outer Ring	13.53 dBi		0.0 dBmax
Slice Max Gain	13.53 dBi @ Elev Angle = 13.0 deg.		
Beamwidth	14.3 deg.; -3dB @ 6.6, 20.9 deg.		
Sidelobe Gain	9.89 dBi @ Elev Angle = 44.0 deg.		
Front/Sidelobe	3.64 dB		

Single 3 element @ 20ft

Total Field EZNEC+



7x7x7x7 Array 50.1 MHz

Elevation Plot		Cursor Elev	4.0 deg.
Azimuth Angle	0.0 deg.	Gain	22.84 dBi
Outer Ring	22.84 dBi		0.0 dBmax
Slice Max Gain	22.84 dBi @ Elev Angle = 4.0 deg.		
Beamwidth	3.8 deg.; -3dB @ 1.8, 5.6 deg.		
Sidelobe Gain	10.1 dBi @ Elev Angle = 14.0 deg.		
Front/Sidelobe	12.74 dB		

7x7x7x7 Array

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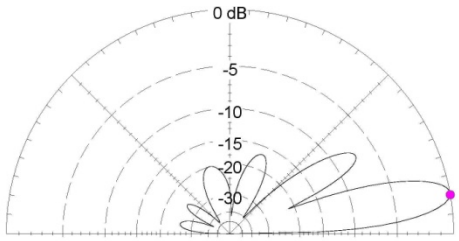
Equipment - Antennas

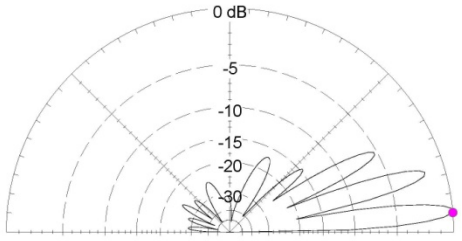
Total Field EZNEC+



7 Element Yagi @ 25 FT 50.1 MHz

Elevation Plot		Cursor Elev	10.0 deg.
Azimuth Angle	0.0 deg.	Gain	17.98 dBi
Outer Ring	17.98 dBi		0.0 dBmax
Slice Max Gain	17.98 dBi @ Elev Angle = 10.0 deg.		
Beamwidth	11.1 deg.; -3dB @ 5.1, 16.2 deg.		
Sidelobe Gain	10.86 dBi @ Elev Angle = 32.0 deg.		
Front/Sidelobe	7.12 dB		

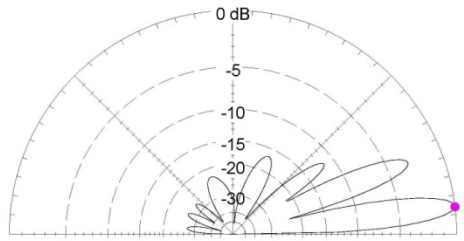
Total Field EZNEC+



7 Element Yagi @ 50 FT 50.1 MHz

Elevation Plot		Cursor Elev	5.0 deg.
Azimuth Angle	0.0 deg.	Gain	18.53 dBi
Outer Ring	18.53 dBi		0.0 dBmax
Slice Max Gain	18.53 dBi @ Elev Angle = 5.0 deg.		
Beamwidth	5.6 deg.; -3dB @ 2.7, 8.3 deg.		
Sidelobe Gain	16.95 dBi @ Elev Angle = 17.0 deg.		
Front/Sidelobe	1.58 dB		

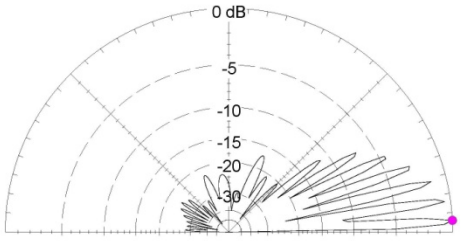
Total Field EZNEC+



7 Element Yagi @ 37.5 FT 50.1 MHz

Elevation Plot		Cursor Elev	7.0 deg.
Azimuth Angle	0.0 deg.	Gain	18.42 dBi
Outer Ring	18.42 dBi		0.0 dBmax
Slice Max Gain	18.42 dBi @ Elev Angle = 7.0 deg.		
Beamwidth	7.4 deg.; -3dB @ 3.6, 11.0 deg.		
Sidelobe Gain	15.52 dBi @ Elev Angle = 22.0 deg.		
Front/Sidelobe	2.9 dB		

Total Field EZNEC+



7 Element Yagi @ 100 FT 50.1 MHz

Elevation Plot		Cursor Elev	3.0 deg.
Azimuth Angle	0.0 deg.	Gain	18.72 dBi
Outer Ring	18.72 dBi		0.0 dBmax
Slice Max Gain	18.72 dBi @ Elev Angle = 3.0 deg.		
Beamwidth	2.6 deg.; -3dB @ 1.5, 4.1 deg.		
Sidelobe Gain	18.23 dBi @ Elev Angle = 8.0 deg.		
Front/Sidelobe	0.49 dB		

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Equipment - Antennas

HFTA

- **Terrain analysis works for 50 MHz**
- **Elevation angle statistics may not be accurate**
  - Based on IONCAP/VOACAP which are only accurate up to 30 MHz

Equipment - Antennas

Aiming

- Pointing your antenna in right direction is MUCH more critical than on HF
- Unless two stations are aimed very close at each other you most likely will fail.

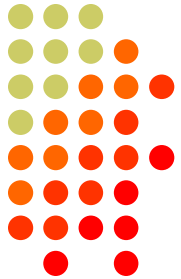
Equipment - Receive Preamps

- **Preamp may not be needed unless your receiver has a really bad noise figure**
- **What is a "bad" noise figure??**
  - Total system noise figure depends more on antenna & sky temperature – they will dominate & you can't change them
- **At VHF and above, gain is NOT as important as a low noise figure**

Equipment - Receive Preamps

- **Assume T_{ant} = 3000°K**
- **If RX nf is 20 dB and you add a preamp with only 12 dB gain but it's nf is 2 dB you will improve your system nf by 10 dB!**
- **If RX nf is 10 db and you add a preamp with 25 dB gain but it's nf is 10 dB you will improve by 0 dB and cause other problems.**

Equipment - Receive Preamps



RX Noise figure (nf) to Noise Factor (NF)

$$\frac{\text{nf (db)}}{10} \text{ Inv Log}$$

Noise Factor to Temp (K) = NF - 1 x 290

Total System Temp = TANT + TRX

Improvement (dB) = 10 log $\frac{\text{Temp 1}}{\text{Temp 2}}$

Equipment - Receive Preamps

The Simple Bottom Line on Preamps

- ***Preamp Rule of Thumb #1***
  - Approx 90% of the entire receive system noise figure is determined by the NF of the first stage after the antenna. If that first stage is “passive coax” then the coax loss determines 90% of your entire system NF

Equipment - Receive Preamps

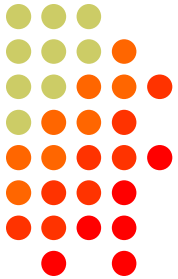
- ***Preamp Rule of Thumb #2***

  Every time you cut your system noise figure in half you gain approx 3 dB in signal to noise ratio until you are limited by sky/antenna noise temperature

- ***Preamp Rule of Thumb #3***

  Mast mounting a preamp is like bringing the RX front end right up to the top of the tower.

Equipment - Receive Preamps



- **50 MHz**
  - Not needed unless your radio is really deaf
    - Most new radios do need a preamp!!!!!
- **144 MHz**
  - Recommended for radios, DEMI xvtrs are FB
- **222 & 432 MHz**
  - STRONGLY recommended
- **902 & Above**
  - ***Mandatory!***

Equipment - Amplifiers

- Before you sink a lot of money into a high power amplifier, learn the real facts about “gain”!
- Only needed if you want to enter the high power category
- There are no “multiband VHF/UHF amplifiers
- Outstanding gain can be achieved by stacking antennas

Contest Strategy

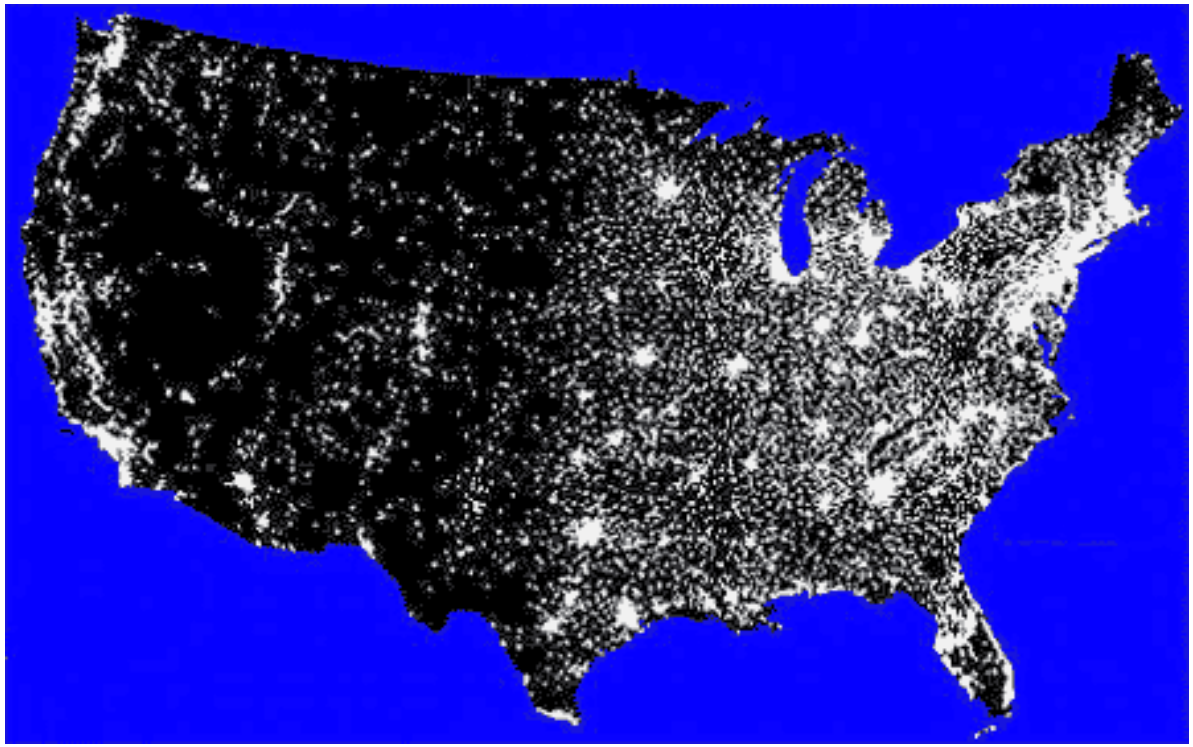
- **Once you decide what you want to do, you must fully understand what will be required to achieve that objective.**
  - How many points do I need?
    - How many Q's? How many grids (multipliers) ?
  - What equipment do I need.
  - When are the prime propagation times to particular areas

Contest Strategy

- **Determine what others are accomplishing**
  - Evaluate top 10 scores for past 10 years
- **Its not all about making the most QSO's**
  - Maximize grid multipliers

Contest Strategy

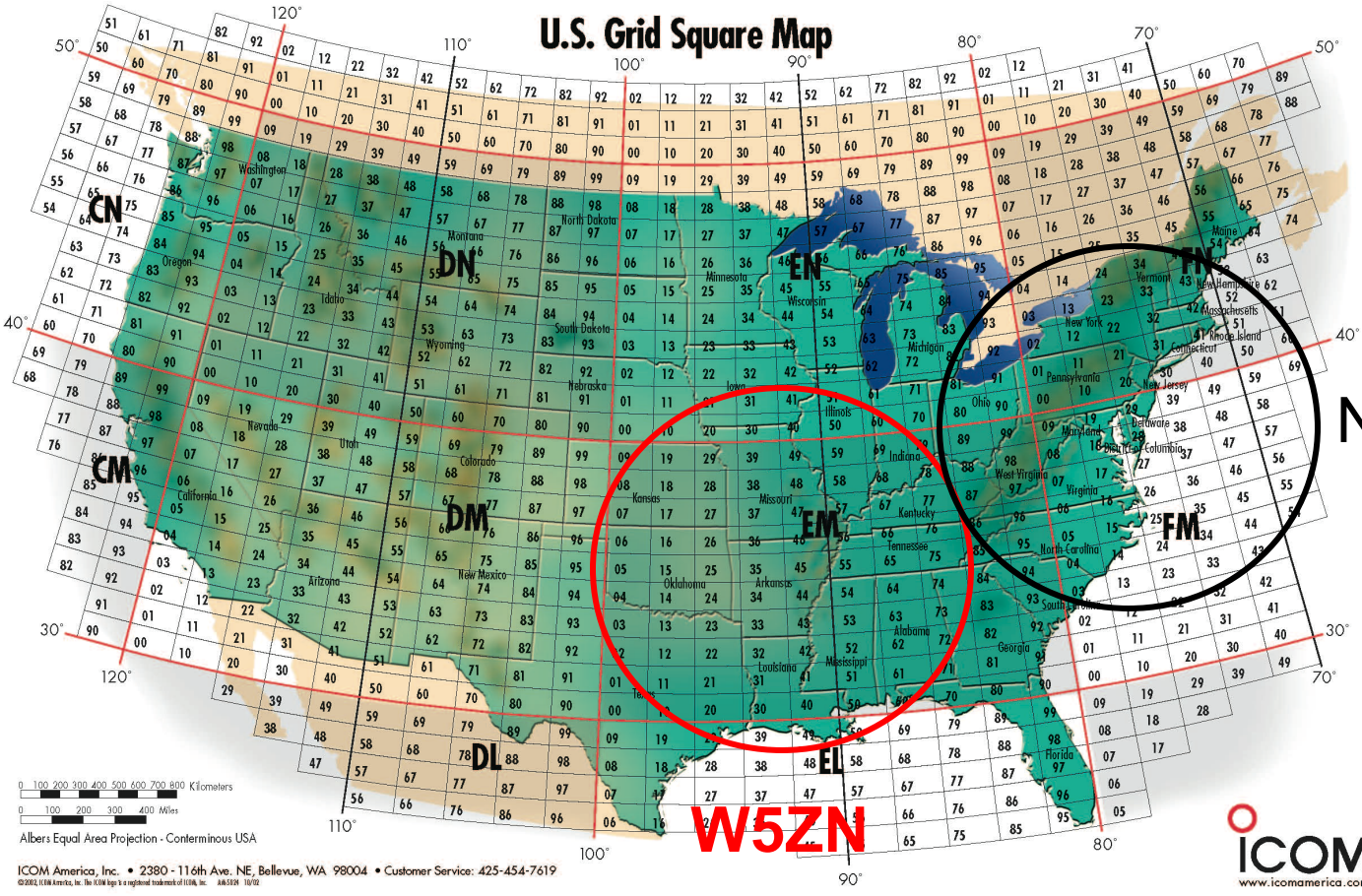
How To Maximize Your Score



Night time Satellite Photo Reveals Population Density

Contest Strategy

Grids Within 500 Mile Radius



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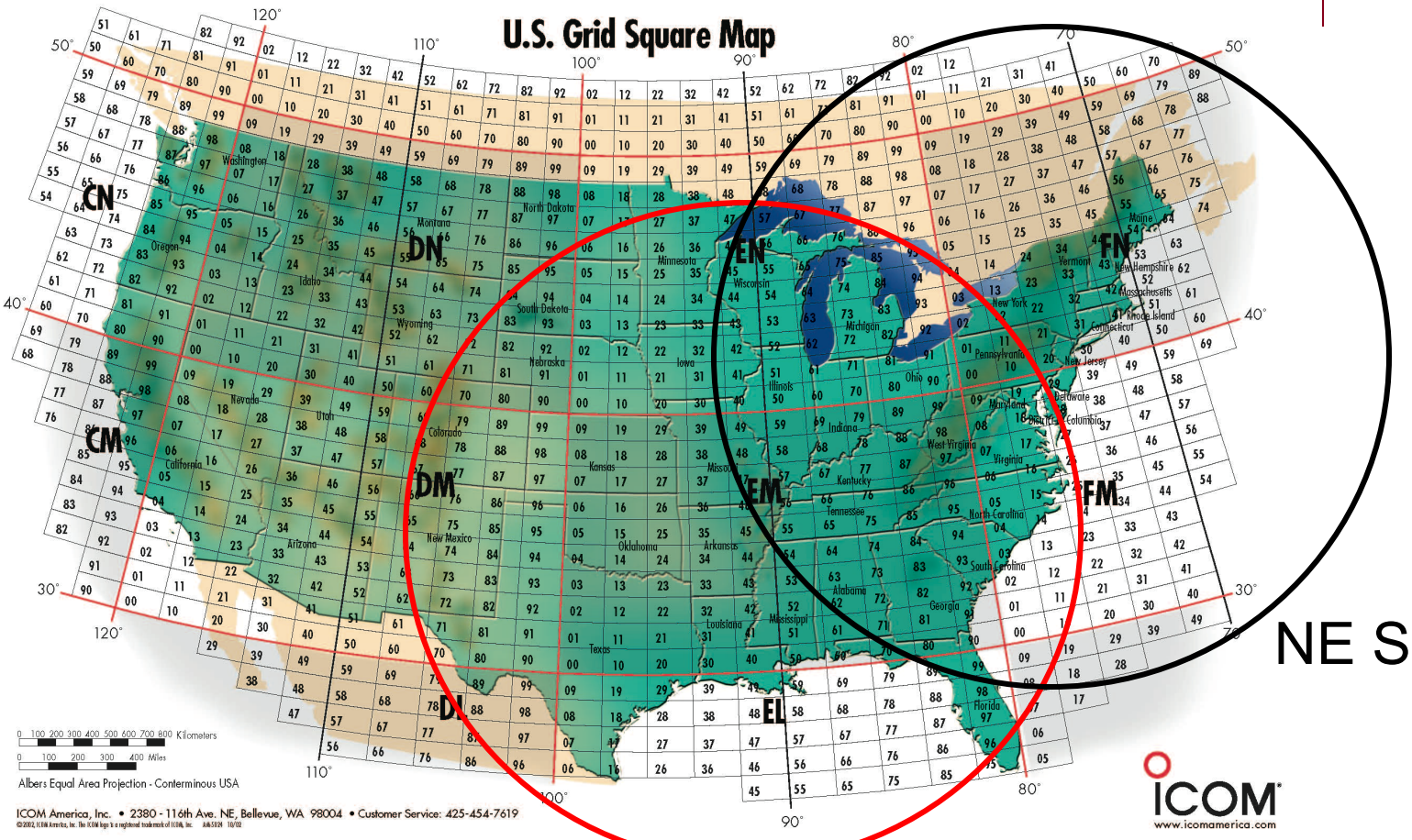
Contest Strategy

Sporadic E 1000 mi Radius



NE Stns

W5ZN

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Contest Strategy
How Can "Dead Grids" be Activated?

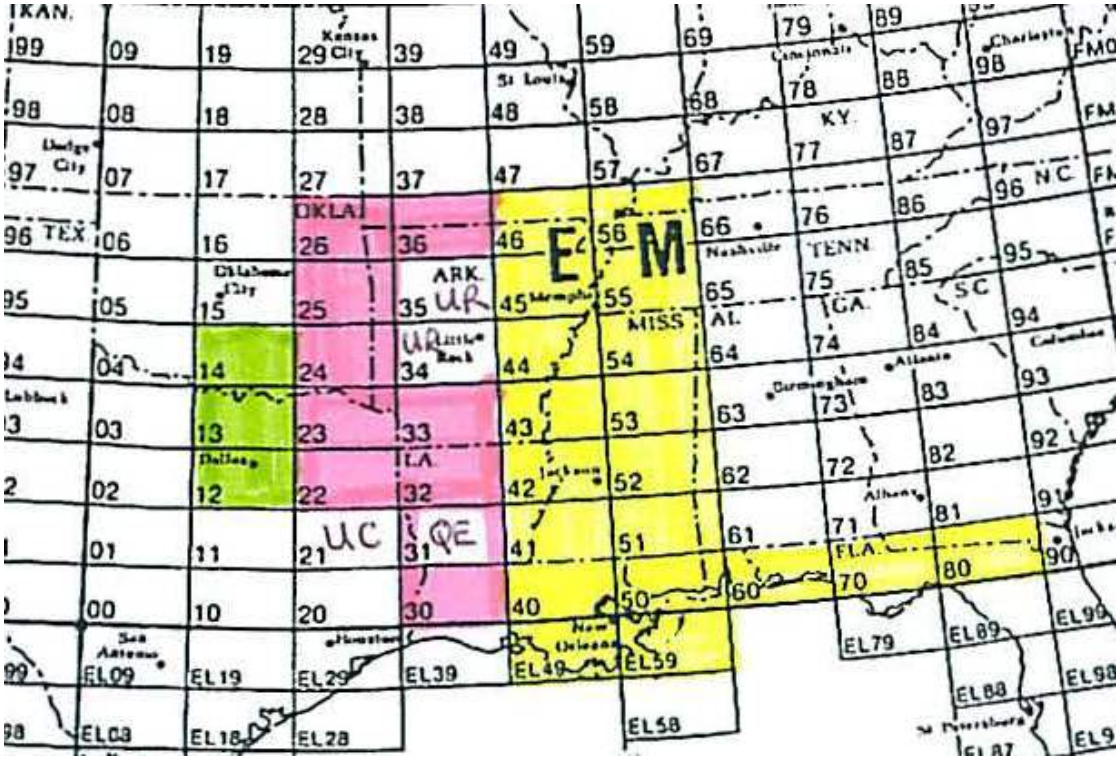
- **So you want to be a Rover?**
  - What route should I plan?
  - How do I know where I am when I get there?
  - What equipment do I need?
  - What else should I plan for?

Contest Strategy
Rovers

- **What route should I plan?**
  - 6 meters can open to just about anywhere no matter where you are.
  - For higher bands you should plan an approx 400 mile radius of other stations.
  - Use GPS (Smart Phone) to identify your exact location

Contest Strategy
Rovers

- **What route should I plan?**



Contest Strategy
Rovers

- **What equipment do I need?**
  - Multi-band VHF radios that cover 50 through 432 MHz are great!! (FT-847, FT-736, TS-2000)
  - Smaller antennas

Contest Strategy
Rovers

N2CEI / K4SME Rover Station

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Contest Strategy
Rovers

Contest Strategy
Rovers

N5AC Rover Station

W5ZN Rover Station

Contest Strategy
Rovers

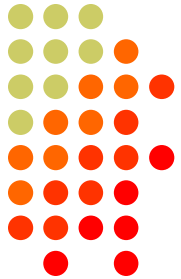
- **What else should I plan for?**
  - Bad weather
    - K4SME/N2CEI got in a tornado in 2011
  - Vehicle breakdown
  - Adequate rest over a 36 hour contest period
  - Emergency Medical Assistance

Contest Strategy
K1JT Digital Modes

- **Weak Signal Communication by K1JT (WSJT) offers specific digital protocols optimized for EME and meteor scatter at VHF/UHF**

- **Free open-source programs. Normal usage requires only a standard SSB transceiver and a personal computer with soundcard.**

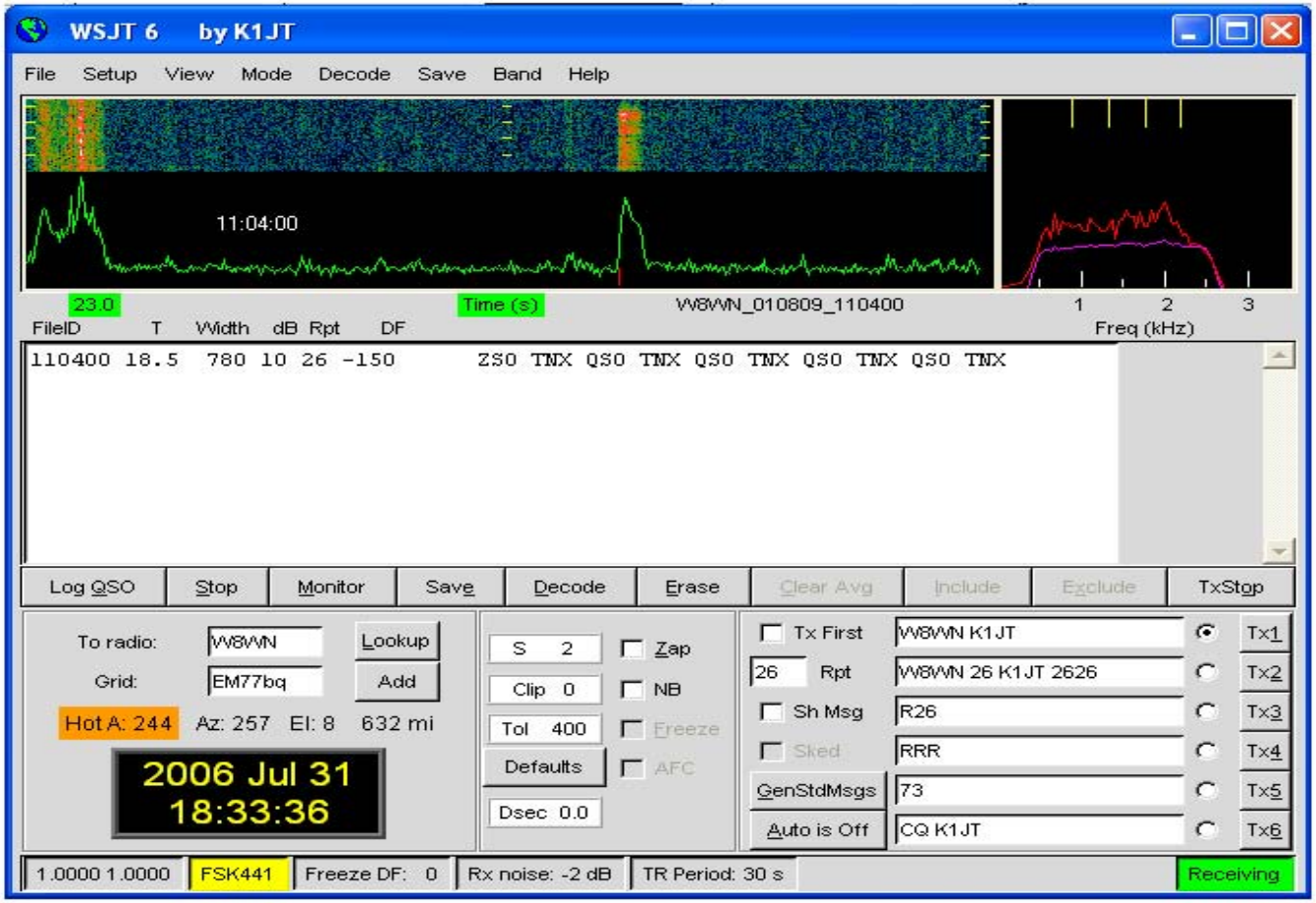
Contest Strategy
K1JT Digital Modes



- **Can Provide Outstanding access to new grid multipliers from moderate stations**
  - FSK441 for Meteor Scatter
  - JT65 for EME
- **EME for Single Yagi stations**

Contest Strategy

K1JT Digital Modes



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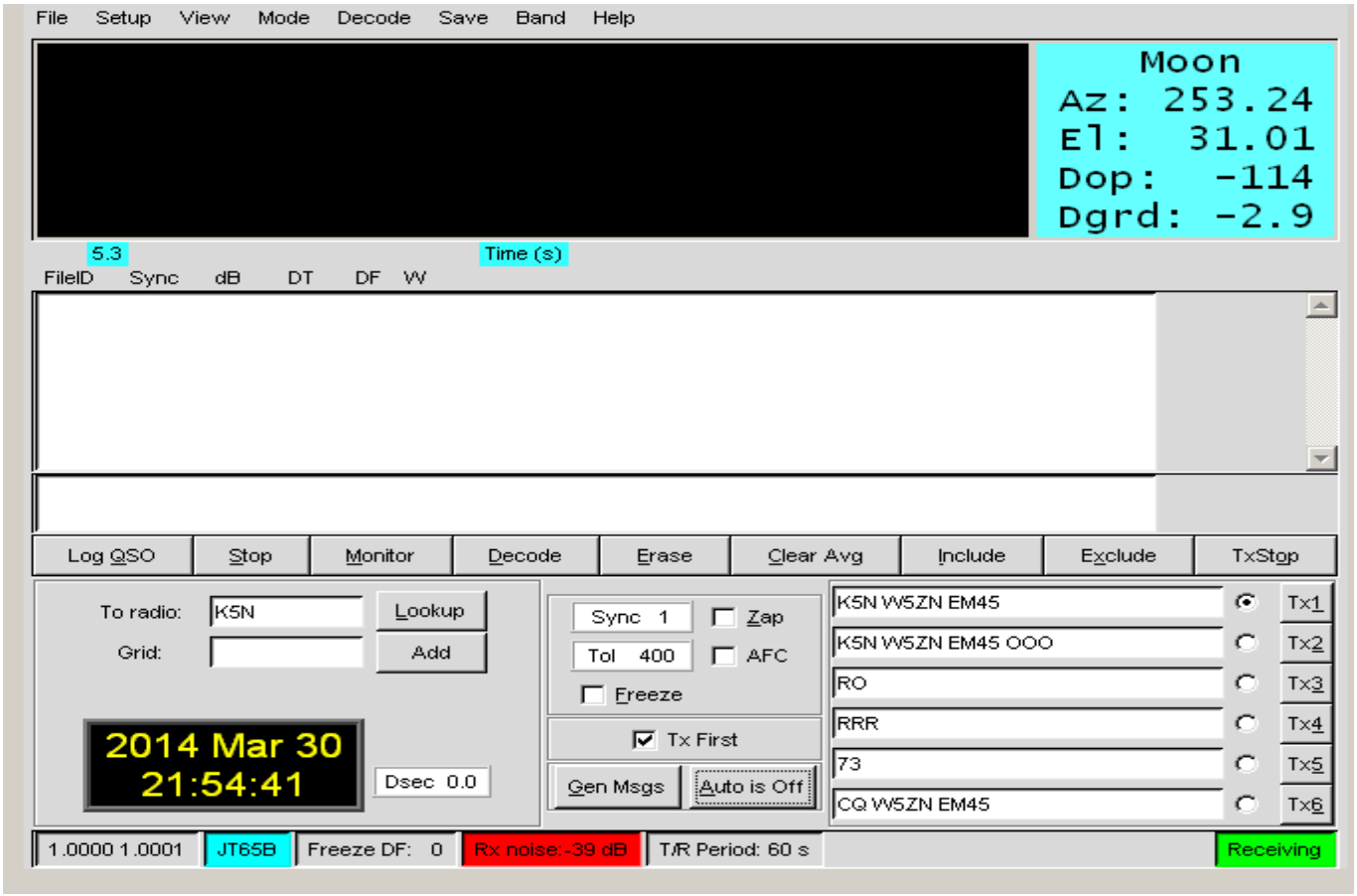
Contest Strategy

K1JT Digital Modes



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Contest Strategy
K1JT Digital Modes

- **Download Free Software at:**

  http://physics.princeton.edu/pulsar/K1JT/wsjt.html

  Download User's Guide at:

  http://physics.princeton.edu/pulsar/K1JT/WSJT_User_600.pdf

Operating Technique

- **How to monitor for an unpredictable band opening:**
  - Radio with Panadapter
  - CW Skimmer
  - ON4KST Region 2 - 50 MHz Chat
  - DX Sherlock
    - Based on Cluster spots & shows paths
  - DX Cluster
- **CAUTION!! Stay within the rules for your operating category when using the above!**

Operating Technique

- **READ THE RULES!!!!!!!!!!!!**
  - Different contests have different rules. Some allow assistance for single op and some don't. Do NOT assume they are all the same!
- **The band will not be open continuously or with any certainty**
  - Monitor & Listen!
  - Monitor & Listen some more!!

Operating Technique

- **6 Meters**
  - Daylight hours, early evening
  - ***PRIORITY band when it is open***
- **144 MHz & Up**
  - Anytime
- **Sunday Morning – DO NOT MISS**
- **Midnight to 5 AM – DEAD!!!**
  - Some Rovers may still be roaming
  - Meteors & EME with JT Modes

Operating Technique

- **2 Meter FM**
  - FM is NOT a four-letter word
  - The Q's count and can add up nicely
  - Excites the local club and introduces them to contesting
  - They get to be a part of the big winning team!
  - Give a presentation at the local club, most new hams have an HT.

Operating Technique

- **Call CQ in several directions**
  - Keep rotating the antennas every few minutes
  - Just because you heard nothing in one direction an hour ago doesn't mean no one is there. A station may now have their antennas your way and listening / CQ'ing
  - If you hear a weak partial move your antennas

Operating Technique

- **Keep Track of Grids Not Worked**
  - Keep track of grids not worked. If you know there are stations there keep going back to that beam heading and listen / call CQ.

- **Move Stations to Other Bands**
  - If you work a station on 2 meters (or 6 meters within range) ask them to move to another band for a quick QSO.

Other Important Points

- **The Same Principles for HF Apply to VHF**
  - Tower & Electrical Safety
  - Station Ergonomics
  - Physical Fitness
  - **ETHICS !!!**
    - A system of moral values and motivation based on right and wrong
      - "The rules are black and white, we make them gray!"
        K5ZD, CTU Dayton 2009

Where Can I Learn More?

- VHF Conferences & Microwave Update
  - Central States VHF Society (CSVHFS)
  - Northeast Weak Signal Society (NEWS)
  - Southeast VHF Society (SEVHFS)
  - Western States Weak Signal Society (WSWSS)
  - Microwave Update Conference
  - Not “traditional” hamfests
  - Publish proceedings (compilation of technical papers)