

#### **Dayton Contest University**

May 14, 2015 Crowne Plaza Hotel Dayton, Ohio



#### **Extended Phone Hours** Sales: 1-800-777-0703

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The RPA-1 is the best low-noise preamp available. It's better than most radio front-ends, using an advanced push-pull design to eliminate harmonic distortion. The preamp also has a high quiescent current to help handle strong signals without overloading. It covers 300 kHz-35 MHz, and offers the best results for HF DXing or Contesting.



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Proper grounding is crucial in a high-performance contest station. First of all, it helps reduce the risk of damage to your sensitive gear. Plus, creating a single-point ground can also help mitigate the effects of unwanted RFI coming from inside your shack.

DX Engineering carries products from Erico, including grounding rods, copper strap and the revolutionary CADWELD system.





#### **ARRL Contest University Textbooks**

If you missed any earlier Contest University events, you can still get the slides. These paperback books are similar to the one you're holding right now, and serve as standalone guides to becoming a better contester. Read up, and discover even more helpful tips and pointers on mode-specific contesting, rules and ethics, propagation, and station setup.



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Built to withstand the wrath of Mother Nature, JK Antennas' time-tested Yagi designs are an excellent foundation for your high performance HF/VHF station. JK Antennas has several models to choose from, each delivering a perfect fusion of reliability, price and results. Visit DXEngineering.com to see the antennas available exclusively from DX Engineering.





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## Contesting made easy



IC-7600 HF / 50MHz Transceiver



IC-7700 HF / 50MHz Transceiver

IC-7851 HF / 50MHz Transceiver



### Heard it... Worked it... LOGGED IT











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The **World Wide Radio Operators Foundation** was created in 2009 by a group of experienced radio operators who saw a need for an independent organization devoted to the skill and art of radio operating. Until now, many of the elements of modern radio contest operating such as log-checking software, log submission robots, etc., have been developed and supported by volunteers. Who will organize and fund the enhancement of these tools into the future? The **World Wide Radio Operators Foundation** was created to help fill that need.

WWROF is dedicated to improving the skills of amateur radio operators around the world, utilizing education, competition, advancement of technology and scientific research, promoting international friendship and goodwill, and preparing them to better serve society in times of communication need.

#### **WWROF Programs**

- Webinar series on contesting and operating topics
- Stewards of the Cabrillo log file standard
- Log submission and processing infrastructure
- Contest award management including certificate and plaque distribution
- Support of Contest University and WRTC
- Other projects that support contesting

#### **WWROF Contester's Code of Ethics**

- I will learn and obey the rules of any contest I enter, including the rules of my entry category.
- I will obey the rules for amateur radio in my country.
- I will not modify my log after the contest by using additional data sources to correct callsign/exchange errors.
- I will accept the judging and scoring decisions of the contest sponsor as final.
- I will adhere to the DX Code of Conduct in my operating style.
- I will yield my frequency to any emergency communications activity.
- I will operate my transmitter with sufficient signal quality to minimize interference to others.

#### Leadership

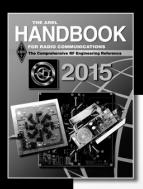
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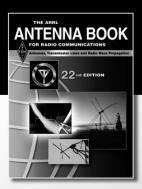
#### **Donate**

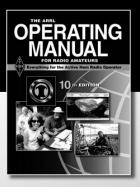
Can you imagine contesting without electronic logs? Sophisticated log checking software? Certificates for winners? The World Wide Radio Operators Foundation is completely dependent on contributions for our funding. We welcome donations of any amount to help us fund our projects.

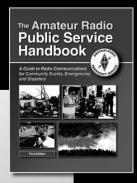
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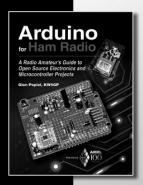
Learn more. Visit wwrof.org











# Stay in the Know!



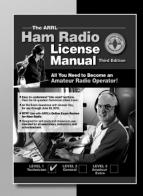


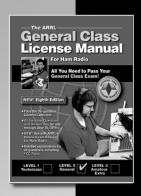


**Devoted entirely to Amateur Radio** 















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May 14, 2015 Crowne Plaza Hotel Dayton, Ohio USA

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First Edition

#### Welcome

On behalf of the CTU Board of Directors K1DG, N9JA and K1AR, K8MNJ and the 11 Professors of Dayton Contest University 2015, we are pleased you are here and we extend a warm welcome to you!

This is the 27th Contest University in nine years. Nine have been held here in Dayton, two in South America (Brazil), fourteen in Europe (England, Germany, Finland and Italy), one in Australia, and one in Puerto Rico.

Over 20 presentations are available here at Dayton Contest University 2015. They are the work product of many hours of hard effort by your Professors and the CTU staff (special thanks to K8MNJ, N9RV and K1SO).

Icom America has led the way by sponsoring this event from the start in 2007. Contest University would not be possible without the support of Ray Novak, N9JA and Icom, DX Engineering, CQ Magazine, ARRL, Remote Ham Radio and INRAD all have contributed their help and guidance in making this CTU the best ever. Please support these vendors who have given back to our RadioSport hobby.

Contest University is a platform for sharing ideas and learning new ways to enjoy Amateur Radio Contesting. e hope you will enjoy and share what you learn here today.

Finally, while we have tried to make everything as perfect as possible for you here at CTU, this is a work in process for all of us. I ask for your patience as we work out any problems. Your on going support for CTU is critical as we move forward to more Contest University's in the future.

Always – Share, Learn, Enjoy and Encourage!

Very 73!

Tim Duffy, K3LR CTU Chairman

#### 2015 Dayton Contest University "CTU" - COURSE OUTLINE - 7:00 AM to 5:00 PM

7:00 ALL SALON A & B – Student Registration and Contest Buffet Breakfast – ALL – 60 minutes 8:00 ALL SALON A & B – Welcome to CTU 2015 – K3LR – ALL – 10 minutes 8:10 ALL SALON A & B – Play by the Rules – Your Most Important Skill – NØAX – ALL 40 minutes

#### 9:00 CONTEST TOPIC SESSION #1 - attend ONE of 4 sessions - 60 minutes

SALON A – Practical upgrades for your 40 through 10 meter antennas – W3LPL SALON B – CW and RTTY Skimmers and the Reverse Beacon Network – N6TV SALON C/D – Why Cabrillo is Important to You – K5ZD HARDING – Getting the most out of your VHF Contest Experience– W5ZN

#### 10:00 ALL - \*CONTEST SNACK\* - 15 minutes

#### 10:15 CONTEST TOPIC SESSION #2 - attend ONE of 4 sessions - 60 minutes

SALON A – Practical upgrades for your 160 and 80 meter transmit/receive antennas – W3LPL SALON B – Ten Ways to Increase your Contest Score – K1DG SALON C/D – Strategies on Improving Your USA Contest Scores – K5ZD HARDING – 2015 RTTY Contesting Essentials – WØYK

#### 11:20 CONTEST TOPIC SESSION #3 - attend ONE of 4 sessions - 55 minutes

SALON A – 2015-2016 Propagation Update – W3LPL SALON B – Enhancing Contest Station Audio – K9EID SALON C/D – How to Use Waterfall Displays While Contesting and DXing – N6TV HARDING – Advanced RTTY Topics – WØYK

#### 12:15 ALL SALON A & B - \*CONTEST LUNCH\* - ALL - 35 minutes

12:50 ALL SALON A & B – 2015 Eye Ball Sprint Contest "**LIVE**" – K1DG – ALL – 10 minutes 1:00-1:35 ALL SALON A & B – Radio Contesting's Future, How Can you Help – K3LR

#### \*1:45 CONTEST TOPIC SESSION by REQUEST to RERUN - 50 minutes

\*SALON A – As determined by \*vote 1
\*SALON B – As determined by \*vote 2
\*SALON C/D – As determined by \*vote 3
\*HARDING – As determined by \*vote 4

#### 2:40 CONTEST OPEN DISCUSSION Q&A GROUPS Attend ONE of 4 sessions - 30 minutes

SALON A – Antennas & Propagation – W3LPL SALON B – CQ Worldwide Contests – K5ZD SALON C/D – Reverse Beacon Network, Skimmers, Waterfall, Displays, and Wintest – N6TV HARDING – Towers and Antennas – W3YQ

#### 3:15 CONTEST OPEN DISCUSSION Q&A GROUPS Attend ONE of 4 sessions - 30 minutes

SALON A – USA Contest Tips Q&A – N6TR SALON B – Contesting Hints & Kinks Q&A – W3LPL SALON C/D – Shack Design Q&A – K1DG HARDING – RTTY Q&A – WØYK

#### 3:45 ALL - \*CONTEST SNACK\* - 15 minutes

4:00 ALL SALON A & B – 2015 Contest Radio Performance – NCØB – ALL – 50 minutes 4:50 ALL SALON A & B – 2015 CTU Survey, K1DG Eye Ball Winner – K3LR – ALL – 10 minutes

#### \* 1:45 PM CONTEST SESSION by REQUEST vote to RERUN

CTU students will vote for 4 topics/classes that they missed and would like to have presented again – the top 4 WANTED by vote – will RERUN in this time slot

#### **Contest University Professor Bios**

#### Frank Donovan, W3LPL

Frank's contesting career began as a twelve year old at the Providence Radio Assn. 1959 ARRL Field Day, W1OP/1, two miles from his home in Providence, Rhode Island. Soon afterwards he began to slowly build his own small contest station on 1/10<sup>th</sup> acre in a densely populated urban neighborhood.

17 year old K1LPL finished first place USA in the 1964 ARRL CW DX Contest low power category. In 1968 he led the W1OP/1 Field Day that finished in first place in the Field Day 4A category. Immediately after college, 2<sup>nd</sup> Lieutenant Frank Donovan's first military assignment was in the Washington D.C. area where he worked for PVRC member W3GN and with his multi-multi mentor W4BVV.

Frank finished first place USA single operator in four CQ WW CW and four ARRL CW DX contests from 1973-78. His first multi-multi experience was with the world high scoring 1974 PJ9JT CQ WW CW team. W3LPL multi-multi teams started with a small entry in the 1978 CQ WW Phone DX Contest. Less than four years later, two incredible long nights of 10 meter JA runs unexpectedly produced the team's first USA multi-multi win in the 1982 ARRL Phone DX Contest.

W3LPL multi-multi teams have completed nearly one million QSOs and achieved 45 first place USA finishes out of more than 150 entries in the CQ WW and ARRL DX contests. Frank is a member of the prestigious CQ Contest Hall of Fame and is a regular presenter at Contest University. Frank retired as a Chief Engineer at General Dynamics Corporation after a 45 year career in electronics and systems engineering.

#### Tim Duffy, K3LR

Tim has been an active contest operator for over 42 years. He has hosted 130 different operators as part of the 88 K3LR Multi-Multi DX contest efforts since 1992. Tim served on the ARRL Contest Advisory Committee as a member and multi-year Chairman. K3LR has been an active member of the CQ Contest Committee for 25 years. Tim was the Atlantic Division Technical Achievement award winner in 1998. He was moderator of the Dayton Contest Forum for 10 years and has been moderator of the Hamvention Antenna forum for 32 years. He is a founding member and President of the North Coast Contesters, K3LR serves as founder and chairman of Contest University (9 years) and the Dayton Contest Dinner (23 years), chairman of the Top Band Dinner (4 years) - as well as coordinator of the Contest Super Suite (30 years) in Dayton. He is founder and moderator of the popular RFI Reflector (RFI@contesting.com). He has been a guest on Ham Nation ten times. Tim was a member of Team USA at WRTC - four times. Tim serves on the board of directors of the World Wide Radio Operators Foundation (WWROF) as Vice Chairman. He is Executive Vice President of The Radio Club of America (RCA). Tim is President of the Mercer County Amateur Radio Club -W3LIF (14 years). K3LR was elected to the CQ Contesting Hall of Fame in 2006. He was honored with the prestigious Barry Goldwater Amateur Radio service award by RCA in 2010. Tim was elected ARRL Section Manager for Western Pennsylvania in 2015 and is the 2015 Amateur of the Year as awarded by the Dayton Amateur Radio Association which runs the Dayton Hamvention®. Tim is the Chief Operating Officer and General Manager at DX Engineering.

#### Doug Grant, K1DG

Doug has been licensed since 1967. Over the years, he has managed to collect plaques for first-place scores in single-op, single-op-assisted, multi-single, multi-2 and multi-multi categories from his own station and numerous host stations. In addition, he was a competitor in 5 WRTC events, winning one gold and two bronze medals.

Doug is a past president of the Yankee Clipper Contest Club, past member and Chairman of the ARRL Contest Advisory Committee, member of the CQWW Contest Committee and has chaired the Dayton Hamvention Contest Forum for over 10 years. He is a Director of Contest University and the World Wide Radio Operators Foundation, and was Chairman of the WRTC2014 Organizing Committee.

#### Bob Heil, K9EID

Bob Heil, licensed in 1956 as KN9EID became an avid experimenter and builder of VHF equipment. Bob built a serious moonbounce station and was one of the first SSB stations on 6 and 2 meters in 1958. As a professional theatre pipe organist, Heil was also learning to voice and tune large Wurlitzer theatre pipe organs which taught him how to listen. In 1966 he started a retail music store and through his intense ham radio background and listening abilities, Heil was able to repair guitar amplifiers and build massive arena sound systems for some of the world's top performers. He invented the first high powered 'Talk Box' for Joe Walsh and Peter Frampton. His invite from the WHO to design and build the first quadraphonic PA made rock history. It was some of that equipment that landed Heil Sound in the Rock and Roll Hall of Fame, the only manufacturer honored to do so. Heil continues to build high quality microphones for amateur radio and well as professional musicians, recording studios and commercial broadcast stations. You can find him on many of the ham radio frequencies – many times operating some of his original 1956 AM and early SSB equipment from his station lab. Heil continues to bring new technologies constantly designing new and exciting audio products for his beloved ham radio friends. HEIL SOUND, Ltd. <a href="https://www.heilsound.com">www.heilsound.com</a> 618 257 3000

#### Tim Jellison, W3YQ/KL7WV

Tim was licensed in 1973 at 13 years of age. He achieved 5BDXCC then went on to confirm 100+ countries on 160. He no longer chases DX, but is a regular participant in CW DX contests, these days primarily as an operator at the K8AZ multi-op station.

Professionally, he took a job managing a satellite communication facility following his graduation from Penn State, then changed career paths in 1999 and accepted a position running a cellular network in the state of Alaska. He retired from corporate life in 2012 and now assists Radio Amateurs with their towers/antennas.

Tim has been a technician and a technical manager all of his adult life. He's been involved in all aspects of electronics, radio, towers, and antennas. He holds a valid FCC Radiotelephone License and is Comtrain certified as an Authorized Climber/Rescuer.

#### Joel Harrison, W5ZN

Joel was first licensed as WN5IGF in 1972. His first contest was the old ARRL CD Party in 1973. His interests later turned to VHF contesting, finally breaking into the top 10 in the ARRL June VHF contest in 1993. In June 1996 he won first place in the single op category setting a new world record under the call sign WB5IGF. In 1998 he returned to the June contest as W5ZN, once again winning first place and breaking his previous 1996 record. In 2001 he won first place single op in the ARRL UHF Contest and in 2011 the W5ZN team won first place in the Limited Multiop category of the ARRL June VHF Contest. W5ZN was a team member of the record setting WA8WZG contest team in 1999 and 2000 and the K1WHS team that finished first in the multiop category of the 2010 ARRL September VHF contest outing multi-year winner W2SZ. W5ZN is also active in HF contests. In the 2006 ARRL DX Contest he set a new 80 meter CW record for the W5 call area that held until 2009. In 2011 he reclaimed that record that still holds today. Joel holds 10 band DXCC and 11 band VUCC, is an A-1 Operator and served as ARRL President from 2006 until 2010 when he retired from ARRL elected service after 27 years. He has published many antenna articles in VHF/UHF/Microwave Conference proceedings including co-author of the W1GHZ Microwave Antenna Book and "Design, Construction & Evaluation of the 8 Vertical Circle Array for Low Band Receiving" in the March/April 2010 issue of QEX. In 2014 he was awarded the ARRL Medal of Honor for outstanding service to amateur radio.

#### Ed Muns, WØYK

Ed, WØYK, entered CW and SSB DX contests initially in the early 1970s as a way to work new band/mode-countries for DXCC. His interest rapidly evolved from DXing to contesting as his early learning came from multi-multi experience at KØRF. Today, CW and RTTY contesting dominate Ed's operating time. His local contest club, the Northern California Contest Club (NCCC), mounted an effort for the club competition gavel first offered in the 2004 ARRL RTTY Round-Up where Ed reluctantly (kicking and screaming) learned how to setup RTTY and ultimately won the Pacific Division SOHP plaque. He ironically enjoyed that induction into RTTY so much that he now includes all the major RTTY contests in his contesting schedule. With his P49X call sign, Ed holds the world SOHP record in ARRL RTTY Round-Up, having broken the record eight times, and the world SOHP record in CQ WPX RTTY, having broken that record seven times and set a world SOHP record in the 2010 CQ WW RTTY. Ed is the contest manager for the NCJ NA RTTY Sprint and the contest director for the two CQ RTTY contests, CQ WW RTTY and CQ WPX RTTY. He and Don, AA5AU, sponsor the Ten-Meter RTTY Contest which they initiated in December 2011 with nearly 700 logs submitted. He was inducted into the CQ Contest Hall of Fame in May 2014. This is his eighth year at CTU delivering the two RTTY presentations and Q&A.

#### Rob Sherwood, NCØB

Bob was an early adopter of the Perseus SDR and CW Skimmer, and has recently been analyzing signal reports using data from the Reverse Beacon Network (RBN). He voluntarily supports Win-Test users via the Win-Test Reflector, and also helps update the documentation. He joined K2KW's original "Team Vertical" group (6Y4A, 4M7X), and has been a member of the multi-op teams at HC8N, K3LR, and W7RN (K5RC). Bob finished first in the 2013 ARRL CW Sweepstakes Contest, and second in 2014, operating from W7RN.

Ham radio began for me in 1961 in Cincinnati, Ohio, as both a novice and general-class operator. After graduating college in 1969 with a degree in physics, I moved to Denver and worked for KOA radio as an engineer until 1987. While at KOA, I maintained their 50 KW AM and FM transmitters, microwave links and studio equipment.

1974 saw the beginning of Sherwood Engineering, offering roofing filters and upgrade kits for the Drake R-4C. In 1976 I started measuring receiver performance on dozens of radios, since reviews in QST did not correlate with actual on-air observations at crunch time in CW contests. In 1977 "ham radio magazine" published the first of several of my articles on receiver problems and cures, vertical antenna ground systems and mobile antenna efficiency. Those articles are available on my web site as PDF files. Receiver test data is now web based with over 100 transceivers included at www.nc0b.com/table.html.

In the 80s I was invited to be a forum speaker at the Dayton Hamvention on several occasions, discussing both receiver and antenna performance issues. In 2004 I returned to the Dayton Contest Forum, giving a talk on the status of receivers both old and new, with special emphasis on the Orion and the Icom 7800. In 2007 the Drake Forum had me present a talk on the pros and cons of the new batch of DSP transceivers. In 2009 I made a presentation at the Dayton Hamvention Antenna Forum on ground systems for vertical antennas.

Speaking invitations at ham events have included WØDXCC, W9DXCC, W4DXCC, YCCC, New Orleans, Austin, Huntsville and Albuquerque hamfests. Locally around Colorado I have discussed receiver performance at the Boulder Amateur Radio, Northern Colorado Amateur Radio, Colorado QRP & 285 TechConnect Radio Clubs. 2015 is my eight year to have the privilege of making the wrap-up presentation at Contest University.

Eight years ago, my XYL encouraged me to build my dream contest station on 10 acres east of Ft. Collins, Colorado. This has made it possible to evaluate top transceivers in major contests in a real-world environment to augment my laboratory data. This rural setting has allowed me to focus my interest on effective antennas. Six towers support nine mono-band yagis and several wire antennas from 160 - 2 meters.

#### Ward Silver, NØAX

Ward has been an active contester since before his Novice days began in 1972, participating with high school club friends as WAØWBJ and WBØDQI. He credits contesting and later DXing with guiding his early interests n harm radio, propelling him to major in ham radio at the Missouri University of Science and Technology as WØEEE with a minor in electrical engineering and miraculously, a career.

After twenty years of developing industrial and medical products, Ward is now the Lead Editor of the ARRL Handbook and the ARRL Antenna Book. In 2003 he received the second Bill Orr Technical Writing Award from the ARRL. Finally, he is the author all three ARRL License Manuals and Q&A Study Guide, working closely with the ARRL and the NCVEC Question Pool Committee to develop appropriate and useful exam questions. Being entrusted with this set of documents that affects so many amateurs is the pinnacle of his amateur radio experiences.

He was a founder of the World Radiosport Team Championships (WRTC) in 1990 and is currently Secretary of the WRTC Sanctioning Committee. In 2013 he was elected President of the Yasme Foundation which supports amateur radio activities around the world. In 1982, he helped found the Mississippi Valley DX and Contest Club and later filled various offices of the Western Washington DX Club for more than a decade. He has been honored to be a lecturer for the Contest University programs on multiple occasions.

His list of contest operating spans four continents and includes a variety of good scores from home and multioperator stations such as HC8N, PH4Q, KH6RS/NH6T, K3LR K9CT, W7RM, KL7RA, W5ZN, and W1AW. He considers himself fortunate to have a few top finish plaques on the wall of the radio room but the best part is participating in record-setting team efforts with friends from coast-to-coast.

Rarely far from the keyboard, Ward is also a Contributing Editor to the ARRL Publications Department and represents the League at hamfests and club meetings across the country. He edited the popular biweekly "ARRL Contest Update" newsletter for 13 years and "Contest Corral" for 20 years, while consulting on a variety of projects and programs in the ARRL Contest Branch, including the monthly QST column "Hands-On Radio" and is the Managing Editor for all ARRL contest results articles.

You will also find his byline in the popular Wiley "for Dummies" series; Ham Radio for Dummies – now in its second edition – Two-Way Radios and Scanners for Dummies, and Circuit building Do-It-Yourself for Dummies. He recently published a ham radio detective novelette, "Ray Tracy – Zone of Iniquity". Other titles include books on antenna modeling and testing, chapters of the ARRL Operating Manual on DXing and Contesting, and for the ARRL's Centennial celebration, the History of QST's volume on amateur radio technology. He has been known to amuse his fellow amateurs by "hamifying" popular songs and performing them publicly with the Spurious Emissions (Out of the) Band.

Outside of ham radio, Ward plays the mandolin, dabbles in digital photography, enjoys camping, canoeing, kayaking, and continues to not act his age by playing Ultimate Frisbee.

#### Randy Thompson, K5ZD

Randy has been licensed and active in contesting since 1973 at the age of 13. He is an accomplished contester, having multiple single-operator wins in the ARRL Sweepstakes, CQ World Wide DX Contest, and the CQ WPX Contest, among others. Randy is a past editor of the "National Contest Journal" (a post he has held three separate times) and a co-founder of the eHam.net website. Randy was the Director of the CQ WPX Contest from 2008 until 2013, and is currently the Director of the CQ World Wide DX Contest. He is a member of the CQ Magazine Contest Hall of Fame. He has competed in five World Radiosport Team Championships and was Co-Chairman of the WRTC2014 organizing committee. When not in front of a radio, Randy is in sales for a software company involved in the Internet of Things.

#### Larry Tryee, N6TR

Tree was first licensed in 1967 and has been operating domestic contests since that time. He is a member of CQ Contest hall of Fame and competed in WRTC-1996. He holds numerous domestic contest records including the highest score ever in a CD Party and the QSO record in the CW Sprint. Tree is the author for the TR Log Logging software and is responsible for log checking for most of the domestic contests.

#### Robert Wilson, N6TV

"TV Bob" is an active CW contester and Win-Test supporter. Licensed for over 40 years, Bob competed at the World Radiosport Team Championship (WRTC) in San Francisco (1996), Slovenia (2000), and Moscow (2010). He earned numerous Top Ten finishes in the CW NA Sprints from his home station in Silicon Valley, a small suburban lot with a single tower loaded with monobanders. He finished first in the September 2014 CW NA Sprint.

#### 2015 Contesting Related Events

#### May 13<sup>th</sup> – Wednesday night

- 7 PM Contest Super Suite at the Crowne Plaza opens for the first of 4 nights in the Harding, Harrison and McKinley Ballrooms. Hosted by Contest University 2015.
- 8 PM to 10 PM CTU 2015 Registration
- 10:30 PM Pizza Party sponsored by Contest University 2015 http://contestsupersuite.com

#### May 14<sup>th</sup> – Thursday all day

7 AM CTU Registration opens. Must sign up in advance – http://www.contestuniversity.com 8 AM – 5 PM Dayton Contest University 2015 at the Crowne Plaza – 2<sup>nd</sup> floor.

#### May 14<sup>th</sup> - Thursday night

- 7 PM Contest Super Suite at the Crowne Plaza hosted by the Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and the North Coast Contesters (NCC).
- 7:15 PM 2<sup>nd</sup> Annual RTTY Contest Dinner at the Crowne Plaza Presidential Ballroom. Speaker is Ralph Fedor, KØIR. Tickets in advance from http://rttycontestdinner.com
- 10:30 PM QSL Wings and Pizza Party in the Harding, Harrison and McKinley Ballrooms sponsored by K8CC, K3WW and K3LR. http://www.contestsupersuite.com
- **May 15<sup>th</sup> Friday** Antenna Forum at HARA Arena 2:30 p.m. 4:45 p.pm. Room 1 Moderator: Tim Duffy, K3LR.
- "A behind the Scenes Tour The World's Largest Antenna at Arecibo" Angel Vazquez, WP3R
- "A Look at Antenna Analyzers" Joel R. Hallas, W1ZR
- "The Science of Predicting Space Weather and How it Affects Propagation" Dr. Tamitha Skov
- "Quadcopter Drone Assisted Real World Antenna Pattern Measurements" Greg Ordy, W8WWV

#### May 15<sup>th</sup> – Friday night

- 7 PM Contest Super Suite at the Crowne Plaza hosted by The Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and North Coast Contesters (NCC).
- 7:30 PM 25<sup>th</sup> Annual top Band Dinner at the Crowne Plaza Presidential Ballroom. Speaker is Bob Allphin, K4UEE. Tickets in advance from http://topbanddinner.com.
- 10:00 PM "Spurious Emission Band" Live in its NEW location the Presidential Ballroom.
- 11 PM Pizza Party sponsored by the Potomac Valley Radio Club (PVRC). http://contestsupersuite.com.
- **May 16<sup>th</sup> Saturday** Contest Forum at HARA Arena 12:30 p.m. 2:30 p.m. Room 1 Moderator: Doug Grant, K1DG.
- "WRTC2014 Documentary Video excerpts with Chairman's Commentary" Doug Grant, K1DG
- "Preparations for WRTC2018" Michael Hoeding, DL6MHW and Sandy Raeker, DL1QQ
- "The K3TN Zero-operator, Multi-transmitter Operation at K4VV in ARRL DX CW" John Pescatore, K3TN
- "Is Remote Contesting ready for Prime Time?" Larry "Tree" Tyree, N6TR

#### May 16<sup>th</sup> - Saturday evening

- 6:30 PM 23<sup>rd</sup> Annual Dayton Contest Dinner hosted by North Coast Contesters at the Crowne Plaza Presidential Ballroom. Dinner speaker is ARRL President, Kay Craigie, N3KN. Space is limited. Details and tickets in advance are available at http://www.contestdinner.com.
- 7 PM Contest Super Suite at the Crowne Plaza hosted by The Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and North Coast Contesters (NCC).
- 11 PM Pizza Party sponsored by the Yankee Clipper Contest Club (YCCC). http://contestsupersuite.com. Harding, Harrison, and McKinley Ballrooms.

# World Wide Radio Operators Foundation



#### **Contester's Code of Ethics**

- I will learn and obey the rules of any contest I enter, including the rules of my entry category
- I will obey the rules for amateur radio in my country.
- I will not modify my log after the contest by using additional data sources to correct callsign/exchange errors.
- I will accept the judging and scoring decisions of the contest sponsor as final.
- I will adhere to the DX Code of Conduct in my operating style.
- I will yield my frequency to any emergency communications activity.
- I will operate my transmitter with sufficient signal quality to minimize interference to others.

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#### **CTU Presents**

# Play by the Rules – Your Most Important Operating Skill Ward Silver, NØAX







#### **Purpose of this Session**



- Discussion of what ethical behavior is in radio contesting
- Understand the impact of unethical behavior
- Encourage participants to take ownership of their own behavior and encourage others to do the same





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#### Why do we play games?



- What is a game?
  - A contest with rules to determine a winner
  - An amusement or pastime
- Games provide players with
  - A means of exploring one's own capabilities
  - An opportunity to look at, understand, and experience things
  - Lessons about themselves and possibly the world.





#### An unusual game



- Entrants keep their own score
- Complex rules govern scoring
- Individuals and "team" entries permitted
- Some events include off-times
- Winners of the top-level event often invest \$50k
   or more and travel to favorable locations
- An on-line network helps participants increase their scores
- Spectators don't find it particularly interesting





#### Is this Radio Contesting?







#### **Is this Radio Contesting?**



## No! Its Birdwatching!

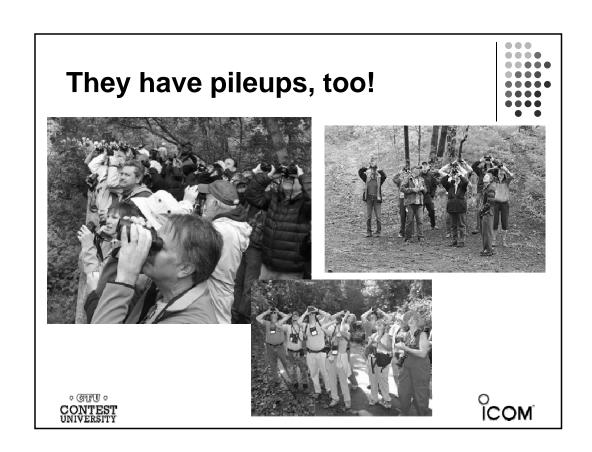
Birders keep track of "life lists" of bird species seen ("DXCC")

Audubon started the "Christmas Day Bird Count" in 1900.

Competition got serious after an innocent comment in the book <u>Wild America</u>, when Roger Tory Peterson wrote: "My year's list at the end of 1953 was 573 species"







#### **Radiosport vs Birding**

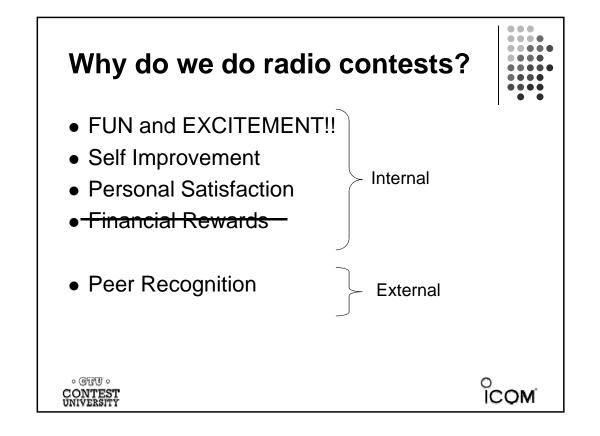


	Contesting	Birding	
Premier Event	CQWW, WRTC	Big Year	
Smaller event	Sprint	Big Day	
Spotting	DX Cluster	Birdingonthe.net	
Travel	Zone 9, 10, 33	Migratory paths	
Book/Movie	"To Win the World"	"The Big Year"	
Conventions	Dayton, Visalia	Annual, moves around	

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# Why do we do games? • FUN and EXCITEMENT!!! • Self Improvement • Personal Satisfaction • Financial Rewards • Peer Recognition External



#### What is this peer recognition?



- You are recognized by your achievements and how you went about achieving those results
- Your recognition is strongly influenced by what other people say about you





# **Negative Peer Recognition Examples**



- That station was too loud in the NAQP.
- That guy uses a pair of 8877s and has remote receivers in Europe.
- Joe uses spots but enters as unassisted.
- Ken had a second operator help him.
- Larry operated with a broad signal to push away nearby stations and keep his channel clear.

While most of these examples can not be proven – they are often based upon something not being quite right about an entry.





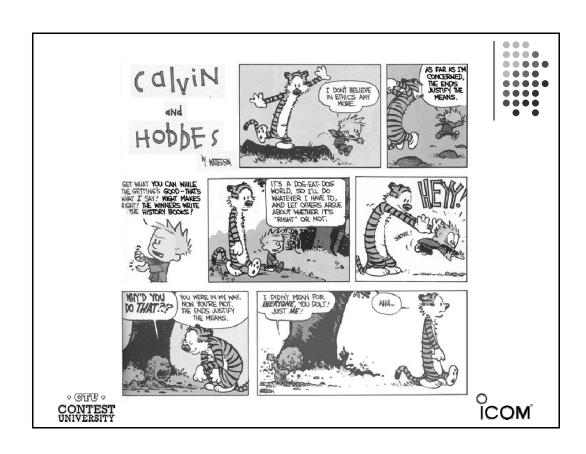
#### **Ethics and Respect**



- Ethics comes from respect...
- Respect for *others*
- Respect for *the game*
- Respect for yourself







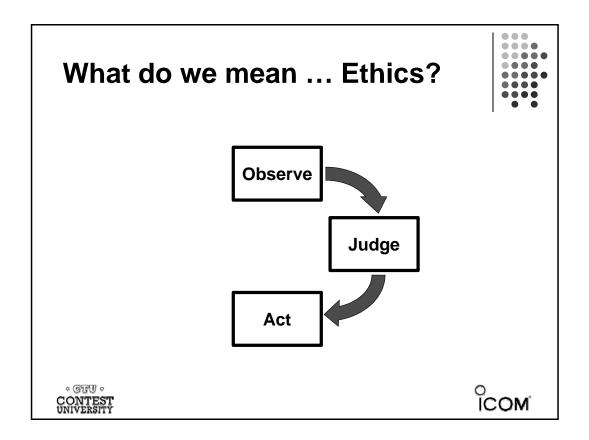
#### **Ethics and Respect**

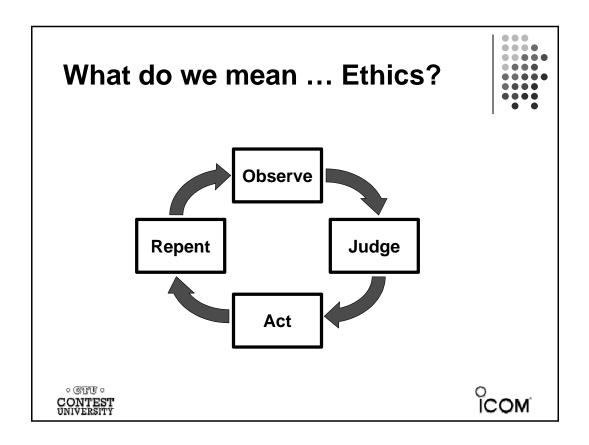


- Ethics comes from respect
- Respect for *others*
- Respect for *the game*
- Respect for *yourself*
- To *get* respect, you have to *give* respect



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#### What do we mean ... Ethics?



- Ethics denote the theory of right and wrong actions
  - Written and unwritten codes of principles and values that govern decisions and actions
- Morals indicate their practice within guidelines
  - Standards for determining the difference between good and bad decision making and behavior
- Ethics are...knowing the difference between right and wrong and choosing to do what is right.



#### **Ethics in Contesting**

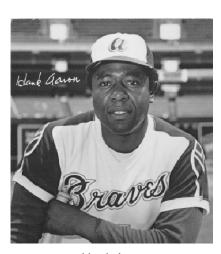
- Choosing to do the right thing even when no one is looking
- With SDR technology, people \*are\* looking at what happens on the air
- Unobservable rules require participants to apply ethics



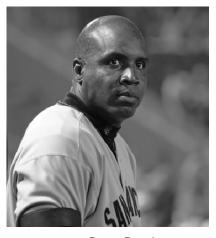
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#### Why do ethics matter?



Hank Aaron 755 Home Runs



Barry Bonds 762 Home Runs

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#### Why do ethics matter?



# Without ethics and respect – we have NOTHING

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# **Explaining Radio Contesting to a non-ham (or non-contester)**



"We operate for 4/24/48 hours, log all the stations we contact, and see who can make the most contacts in the most states, countries"

"How do you know who won?"

"We send our logs to the sponsor, and they check them"

"How do you prevent cheating?"



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#### How do we know what to do?



- Written Rules
  - Specified by the contest sponsor in writing
  - Black and white
  - May, can, should, must...
- Unwritten Rules
  - Expectations about behavior
  - Interpreted norms
  - Gray areas





# Some written rules are very clear (some people break these anyway)



- "A. Single Operator categories: For all single operator categories, only one person (the operator) can contribute to the final score during the official contest period."
- "Total output power per band must not exceed 1500 watts or the output power regulations of the country in which the entrant is operating, whichever is less."





#### **Play Fair**



- Do not exceed power limits for your category
- Just because the knobs go to 11...



See also: "headroom," "smoke," "gas," "soup," "smash," "Eimac antenna tuner". . .





#### **More Examples of Written Rules**



- Off times must be a minimum of 60 minutes in length.
- The log MUST show the correct serial number sent and received for each contact.
- The exchange consists of signal report and serial number. Serial numbers sent must be progressive, starting with 001.
- Self-spotting or asking other stations to spot you is not allowed.



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#### **Essence of Unwritten Rules**



- "Can" is not the same as "Should"
- Just because it's not specifically prohibited by written rules doesn't mean you should do it!
- Keep the contest on the radio and within the contest period
- Don't give or take unfair advantage of others
- Learn and follow the spirit of the rules



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#### **Examples of Unwritten "Rules"**



- Do not make pre-arranged schedules
- Do identify frequently
- Do not ask friends to work you ... only
- Do encourage club members work everyone
- Do not work friends with multiple calls
- Do work and spot stations equally



#### **Examples of Unwritten "Rules"**



- Do not call or text message multipliers
- Do make an effort to help casual callers enjoy the contest and make a contact
- **Do not** let others "help" your single-op effort

See the ARRL's "HF Contesting - Good Practices, Interpretations & Suggestions"



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#### No "Log Washing"



- Using QRZ.com, spot history, 3830 reports, LoTW, club databases
- Using utilities to analyze and correct the log
- Replaying the contest to change the log
- Asking others who they worked or if a call sign is correct
- "Fixing" off times or band changes
- It's over when the 2359 rolls over to 0000



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# How do people justify cheating?



- Everybody does it
- I like being an outlaw
- It was exciting to push the limits
- Nobody was getting hurt
- Nobody was watching
- Rules don't mean much to me, I'm bigger than that
- It doesn't make a difference anyway

- Little to lose and much to gain by it
- It helped me overcome my unfair disadvantage
- I had to do it to win!
- The rules weren't clear but it seemed to me it might be OK
- The rule I broke was unfair anyway

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Hat tip: AB7E



# "All the guys at the top are cheating"



- No, they are not
  - There are a few bad apples this is true in any sport
  - They don't last long
- This belief the primary reason for cheating in virtually every sport studied!
- This mindset is a contagious malady don't let it get a foothold with your peers



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# "I'm not a big gun...it doesn't matter if I cut corners a bit"



- Yes it does!
- Bad habits early on become seriously bad habits later
- Your reputation is established early
- Dealing with temptation is hard..."It's easy to just give in! And it keeps getting easier."





#### **Technology - A Game Changer**



- More options
  - More rules
    - More decisions
      - More bad decisions
        - More bad outcomes
          - Etc
- Ethics is more important than ever
- Respect is more important than ever
- Figure out where your "good arrow" points and let it be your guide when making decisions





#### **Honor Code**



- You are responsible for your own reputation
  - Follow the rules!
  - Don't participate with people who cheat you will be known by the company you keep
- Lead by example
  - You never know who is listening or watching
  - Don't do anything you would not want to be made public
- Be vocal
  - Confront cheating when you see it
  - Every incident is an opportunity to teach proper behavior





#### **Peer Pressure**



- Social pressure by members of one's peer group to take a certain action, adopt certain values, or otherwise conform in order to be accepted.
- Good
  - Encourage others to follow the rules
  - People respect those who are true to their beliefs
- Bad
  - Letting others influence you into not doing the right thing
  - "everyone else is doing it."





# From "The Code of Birding Ethics"



 If you witness unethical birding behavior, assess the situation, and intervene if you think it prudent. When interceding, inform the person(s) of the inappropriate action, and attempt, within reason, to have it stopped. If the behavior continues, document it, and notify appropriate individuals or organizations.





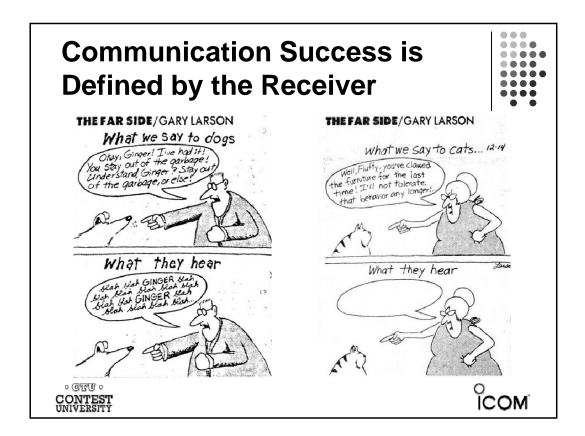
# **Applying Positive Peer Pressure**



- Be aware of your motives
  - Is it personal?
  - If necessary, enlist others to help deliver the message
- Give the benefit of the doubt
  - They may not realize what they are doing is against the rules
  - Take the opportunity to encourage taking the right path
- Choose the right time and place
  - Can they listen without feeling attacked?
- Don't be angry or accusatory
  - Treat the issue as a mistake, not a crime
  - Focus on actions, not character
- Be there
  - People cheat because they see others get away with it
  - Not confronting the problem hurts everyone







#### Scenario 1



- You discover a local contester uses cluster spotting and enters an unassisted category. What do you do?
  - She doesn't win anything so assume it doesn't matter
  - Avoid speaking to her ever again
  - Publicly call her a cheater at the next club meeting
  - Send a letter to the contest sponsor
  - Call her up and ask if she is aware of the rules about using spotting information



#### Scenario 2



- You are invited to a multi-op and upon arrival, you discover they are running 2.5 kW. What do you do?
  - You are there, loud is good, operate anyway
  - Turn the power down to 1500 W when you're operating
  - Loudly encourage the other ops to follow your example
  - Quietly ask the owner if he always runs excess power
  - Leave
  - Send a note to the contest sponsor and FCC





#### Scenario 3



- A local contester has key clicks that wipe out large chunks of the band. What do you do?
  - Sharpen up YOUR keying and give him a dose of his own medicine!
  - Send "KLIX" on his frequency anonymously
  - Call him, tell him he has key clicks, and sign your call
  - Contact him after the contest, explain the problem, and ask to help fix the problem
  - Notify the contest sponsor and his rig's manufacturer





# The Contest Code of Ethics www.wwrof.org



- 1. I will learn and obey the rules of any contest I enter, including the rules of my entry category.
- 2. I will obey the rules for amateur radio in my country.
- 3. I will not modify my log after the contest by using additional data sources to correct call sign/exchange errors.
- 4. I will accept the judging and scoring decisions of the contest sponsor as final.
- 5. I will adhere to the DX Code of Conduct in my operating style (see dx-code.org).
- 6. I will yield my frequency to any emergency communications activity.
- 7. I will operate my transmitter with sufficient signal quality to minimize interference to others.

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#### **WWROF Contest Code of Ethics**



1. I will learn and obey the rules of any contest I enter, including the rules of my entry category.

No spotting if not permitted, no second op or skimmer for single ops, off-times per rules, correct output power

- 2. I will obey the rules for amateur radio in my country. Power, frequencies, licensing – wherever you transmit
- 3. I will not modify my log after the contest by using additional data sources to correct call sign/exchange errors.

When it's over, it's over





### **Contest Code of Ethics, expanded**



4. I will accept the judging and scoring decisions of the contest sponsor as final.

No whining, no lawsuits, no threats or defamation of any sort

5. I will adhere to the DX Code of Conduct in my operating style (see dx-code.org).

Listen, listen, listen; only call when you can hear the station; never trust the cluster (copy the call!)...

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#### **Contest Code of Ethics, expanded**



6. I will yield my frequency to any emergency communications activity.

Contesting is a game. Emergencies are real life.

7. I will operate my transmitter with sufficient signal quality to minimize interference to others.

Mic gain set properly; amp not overdriven; no splatter!

www.wwrof.org



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### The RIGHT Way



- Play fair
  - Obey the rules, remember this presentation
- Try to do better next time
  - Improve your skills, station
- Make your enjoyment of contesting be about the journey, not the destination



### Who are you?



- What does winning the contest mean to you?
- How important is your radio identity to you?





### Who is the final judge?



• The person in the mirror



Your peers

"Yeah, I know that guy. He cheats."
- Anonymous Contester





### **Final Thought**



 Do unto others as you would have them do unto you – nothing else matters.





### **Acknowledgments**



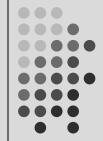
- This presentation draws on material developed by Ken Adams, K5KA (SK), Randy Thompson, K5ZD, Doug Grant K1DG, Larry Tyree N6TR, and Dave McCarty K5GN
- Analogies with birding originally developed by Dick Norton, N6AA





# Practical Upgrades for your 40 through 10 Meter Antennas

- > Horizontally polarized antennas
- Single Yagi stations
- > Single tower stations
- Stacked Yagis
- Care and feeding of coaxial cables







Dayton 2015

1

#### 6 dB of "Free" Ground Gain



- A horizontally polarized dipole, Yagi or quad easily provides 6 dB of useful ground gain
  - · but only if you install it an appropriate height
  - vertical antennas can achieve equivalent ground gain only over highly conductive soil such as a salt marsh
- Stacked HF Yagis achieve higher gain mainly by suppressing undesired high angle radiation and redistributing the power into the main low angle beam
  - stacked Yagis must be installed at appropriate heights to achieve the expected results

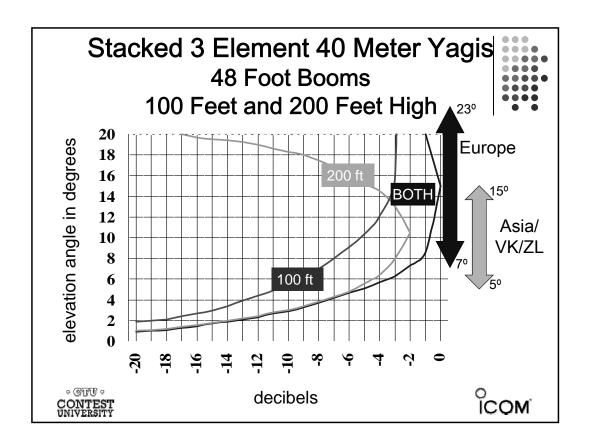


## High Performance Antennas for 40 Meters



- High horizontal dipole at least 70 feet high for DX contests
  - otherwise use a four-square vertical array with 30-60 radials
  - use a dipole at 40-50 feet high for Sweepstakes and Field Day
- Higher gain: 2 element Yagi at 70-100 feet high
  - significant improvement over a simple horizontal dipole for DX
  - a Cushcraft XM-240 at 70-100 feet high is very cost effective
- Highest gain: full size 3 element Yagi at 100-140 feet high
  - but don't underestimate the high cost and complexity of the effort!
- High performance 40 meter receiving antennas
  - 200 foot Beverages
  - · arrays of 14 foot verticals

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## 4-Square Vertical Array for 40 Meters



- A 4-square vertical array is good alternative to a Yagi if you cannot install it at least 70 feet high.
  - install a 4-square at least 40 feet from all other towers
    - more spacing will significantly improve its performance
  - at least 30-60 slightly buried 35 foot radials under each vertical
- A 4-square is an excellent receiving antenna

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# The Comtek 4-Square Controller





www.dxengineering.com/search/brand/comtek

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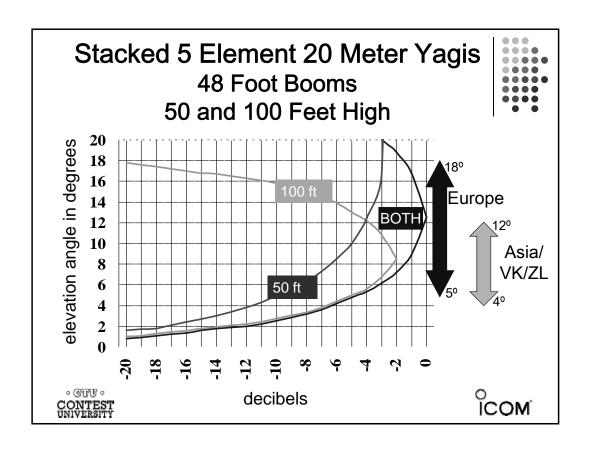
## High Performance Antennas for 20 Meters



- A horizontal Yagi or quad is always the best choice
  - if you can install your antenna at 35 feet high or higher
  - otherwise use a four-square vertical array with 30-60 radials
- Moderate gain: small tri-band Yagi, Hex-beam or quad
  - a small Yagi at 50-70 feet high will produce good DX results
  - a small Yagi at 35-50 feet high for Sweepstakes and Field Day
- High gain: full size tri-band Yagi, small monoband Yagi or quad at 70-100 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 100-140 foot tower (170-200 feet high for three stacked Yagis)
  - stack switching (a "stackmatch") provides high payoff at low cost



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## The Array Solutions Stack Match





www.arraysolutions.com/Products/stackmatch.htm





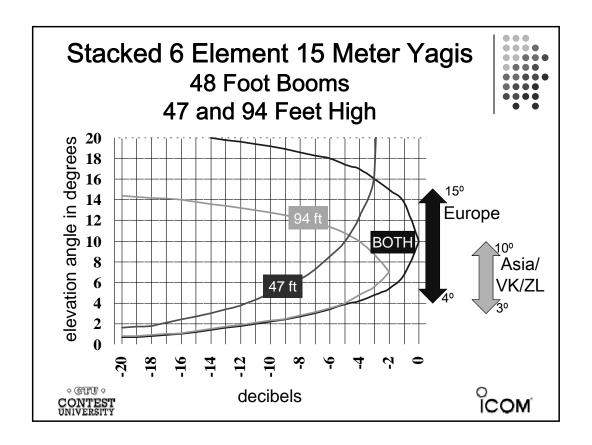
## High Performance Antennas for 15 Meters



- Horizontal polarization is always the best choice
  - if you can install your antenna 35 feet high or higher
  - otherwise use a four-square vertical array with 30-60 radials
- Moderate gain: small tri-bander Yagi, Hex-beam or quad
  - a small Yagi at 40-50 feet high will produce good DX results
  - a small Yagi at 30-50 feet high for Sweepstakes and Field Day
- High gain: a full size tri-band Yagi, small monoband Yagi or quad at 70-90 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 80-100 foot tower (120-140 feet high for three stacked Yagis)
  - stack switching ( a "stackmatch") provides high payoff at low cost







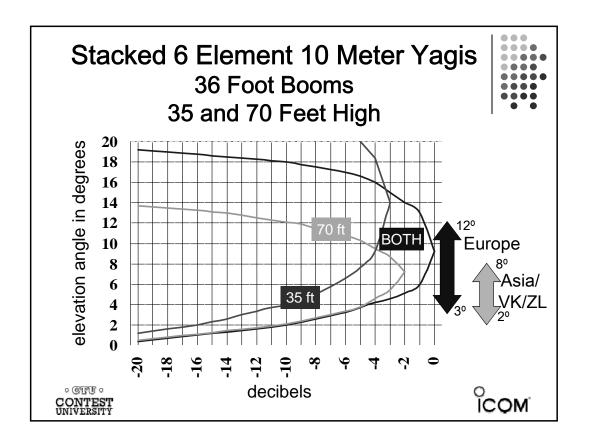
## High Performance Antennas for 10 Meters



- Horizontal polarization is always your best choice
  - if you can install your antenna only 25 feet high or higher
  - otherwise use a four-square vertical array with 30-60 radials
- Moderate gain: small tri-band Yagi, Hex-beam or quad
  - a small Yagi 25-50 feet high will produce good results
  - a small Yagi at 25-40 feet high for Sweepstakes and Field Day
- High gain: a full size tri-band Yagi, small monoband Yagi or quad, at 50-70 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 60-70 foot tower (90-120 feet high for three stacked Yagis)
  - stack switching ( a "stackmatch") provides high payoff at low cost







# Competitive One Tower Antenna Systems



- 50-60 foot tower and a small rotator (e.g., HyGain Ham-IV)
  - small tri-band Yagi, Hex-beam or quad
  - 40 and 80 meter dipoles and a 160 meter inverted-L
- 70-80 foot tower and a medium rotator (e.g. HyGain T2X)
  - Cushcraft XM-240 two element 40 meter Yagi
  - large tri-band Yagi such as the DX Engineering Skyhawk
  - 80 meter dipole and a 160 meter inverted-L
- 100-140 foot tower and a large rotator (e.g., M2 Orion)
  - Cushcraft XM-240 two element 40 meter Yagi
  - monoband Yagis such as the Hy-Gain LJ series on ring rotators
  - 80 meter dipole and a 160 meter inverted-L





## **Achieving and Maintaining Low Loss Coaxial Cables**



- Select appropriate low loss coaxial cables for each antenna
- Preserve your investment
  - water and moisture entry is a persistent, serious threat to your station
- Hard-line (e.g., Heliax or 75 ohm CATV) coaxial cables are the best choice for cable runs longer than 100 feet
  - RG-213 and all other flexible jacket coaxial cables are very susceptible to physical damage and water entry
    - a pin hole in the jacket can quickly cause a high loss cable
    - · carefully protect your coax cables from physical damage and water entry
- Assure long term performance
  - test and inspect your cables and connectors at least annually





# **Coaxial Cable Monetary Considerations**



- The selection, installation and maintenance of coaxial cables and connectors should be among your most important investments when building and improving your competitive station
  - Is the proper grade of coaxial cable worth your additional cost?
  - Is attention to the many details of installation worth your extra effort?
  - Is annual inspection to preserve your investment worth your effort?
- Yes
  - If you want trouble-free low loss coax cables for 25 years or longer
- No
  - If you don't mind the high cost and disappointment of catastrophic failure when you least expect it





## Coaxial Cable Environmental Considerations



- Constant exposure to wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes
- Flexible jackets of RG-213 and LMR-400 flexible coaxial cables are easily damaged during feedline installation, antenna installation, tower maintenance, wind, ice and lightning strikes
  - Never use 9913 or similar "water hose"
  - Never use air or foam dielectric flexible coaxial cable outdoors
    - except Davis RF Bury-Flex
- Heliax and jacketed CATV hardline are highly resistant to environmental damage and provide 25 years of service
  - If no installation errors are made
  - if you perform annual inspections

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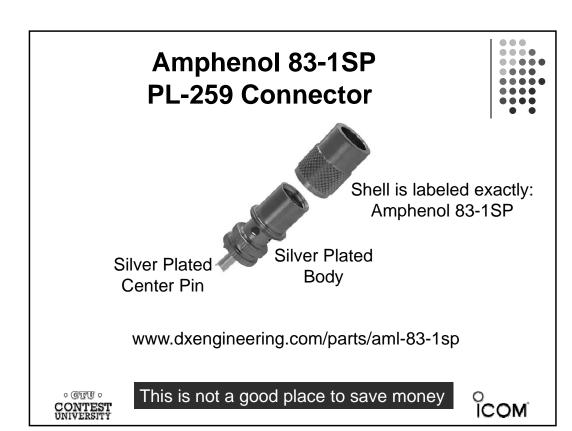
#### **UHF Coaxial Cable Connectors**



- N and UHF connectors are the most commonly used
  - both have insignificant loss at HF
- High quality silver plated UHF connectors provide much more center pin mating force than any N connector
  - eliminates cross-station interference and N connector failures from:
    - unreliable center pin mating force and common pin alignment failures
    - installation errors (e.g., incorrect pin depth, misalignment and pullback)
- Avoid using adapters as much as possible
  - but if necessary use only name-brand silver plated adapters, not nickel plated
  - never use cheap import "no name" adapters and connectors
- Wrench tighten your all of your UHF connectors (1/4 turn)

。 ©TU。 CONTEST UNIVERSITY Avoid saving a few dollars on cheap unbranded connectors and adapters





### Coaxial Cables 83-1SP Connector Installation





http://wwwww.k3lr.com/engineering/pl259

CONTEST

An unconventional but superb method

COM,

### **Connector Waterproofing**



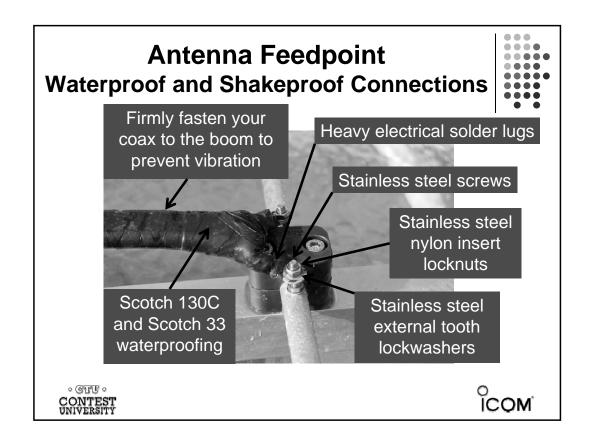




Cover your connectors with two 50% overlapped layers of Scotch 130C stretched to 50% of its original width, sticky side facing out

Cover the Scotch 130C with two 50% overlapped layers of Scotch 33+ or Scotch 88

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# Coaxial Cables Can Make or Break Your Competitive Performance



- How well you select, install, waterproof, inspect and maintain your coaxial feed lines and connectors can make or break the competitive performance of your contest station
- Cross-station interference in multi-operator and SO2R stations is often caused by
  - inappropriate or failing outdoor coaxial cables
  - inappropriate connectors (never use N connectors)
  - cheap low quality imported connectors and adapters
  - improper installation practices
  - failure to perform annual inspections and regular maintenance





## Low Loss Coaxial Cables for Single Operator Stations



- Coaxial cable loss, proper installation and annual inspections are the most important concerns for single operator stations
  - Andrew LDF4-50A 50 ohm Heliax and connectors are commonly available at hamfests and eBay for ~ \$1.00/foot
    - Less than 1 dB of loss on 10 meters for lengths up to 300 feet
  - If you must use flexible coaxial cable on your tower,
     Davis RF Bury-Flex is an acceptable alternative for single operator stations only, at about the same price.
    - Never use any other type of foam dielectric flexible coaxial cable
  - Non-flooded coax such as RG-213 and LMR-400 has short service life in the harsh environment on a tower
    - especially the rotating cable loop above a rotator
    - Never direct bury RG-213 or LMR-400 or lay it on wet ground



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## Low Loss Coaxial Cables for Multi-Op and SO2R Stations



- Andrew LDF4-50A Heliax is an ideal choice for lengths up to:
  - 300 feet on 10 meters
  - 400 feet on 20 meters
  - 600 feet on 40 meters
- Eliminate common cross-station RFI sources:
  - Use Heliax to avoid RFI caused by corrosion of dissimilar metals in aluminum foil and tinned braid shields of Davis RF Bury-Flex cable
  - Signal coupling between RG-213 single braid shielded coaxial feed lines when they are bundled or run together in conduits
  - Never use nickel plated or cheap no-name connectors and adapters
  - Minimize the use of connectors and adapters as much as possible
    - Use only brand name silver plated connectors and adapters





### Low Loss Coaxial Cables for Multi-tower Stations



- Multi-tower stations often use coax cables longer than 300 ft
- Andrew LDF5-50A Heliax is an ideal choice for lengths up to
  - 500 feet on 10 meters
  - 600 feet on 15 meters
  - 750 feet on 20 meters
  - 1000 feet on 40 meters
- Be cautious of the windload and weight (including ice load) of large Heliax cables mounted on light duty towers such as Rohn 25 and 45





# Coaxial Cable Installation on your Tower



- Wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes are important concerns
  - If any of these conditions are unusually severe in your environment, implement additional protective measures
- Heliax and CATV hardline must be firmly fastened to the tower at least every to five feet to protect them from wind and ice damage
- Flexible coaxial cables (e.g. RG-213) should be firmly attached to the tower at least every two or three feet to protect them from wind and ice damage
- Use electrical tape to protect plastic tie-wraps from ultraviolet radiation

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# Coaxial Cable Interface to the Top of your Tower



- Coaxial cables must be bonded ("grounded") to the top of your tower to prevent the coaxial cable jacket from developing pinholes caused by cable-to-tower arcing during lightning strikes
- Connectors must be carefully placed and waterproofed so that water cannot not flow down the outside of the coaxial cables then into your connectors





# Coaxial Cable Interface to the Bottom of your Tower



- Tower mounted coaxial cables must be bonded ("grounded") to your tower base to prevent the coaxial cable jacket from developing pinholes caused by cable-totower arcing during lightning strikes
- An effective ground system must be connected to your tower base to strip lightning currents from your cables before they flow down the cable shields into your station
  - A minimum of three 8-foot galvanized ground rods
  - spaced at eight feet from each other and from the tower base
- Connectors must be carefully placed and waterproofed so that water cannot not flow down the outside of the coaxial cables then into your connectors





#### **Buried Coaxial Cables**



- Direct Burial
  - Use only coaxial cable that is rated for direct burial
    - Andrew Heliax, jacketed CATV cable or Davis RF Bury-Flex
  - PVC jacketed coaxial cable should never be direct buried
- PVC conduit
  - Use oversized conduit with plenty of room for pulling cables
  - Use sweeps, not sharp right angle PVC connectors
  - Use appropriate methods to drain moisture from the conduit
  - Prevent water and vermin entry into conduit entrances
  - Use only Heliax cables in multi-op or SO2R stations
    - bundled single shielded coax can cause cross-station RFI





#### **Antenna Rotation Coax**



- Your antenna rotation coaxial cable is exposed to the most extreme environmental conditions in your station
- Carefully avoid allowing the coax to rub or pull against the tower or any other objects that could damage it
  - Rotators with more than 360 degrees of rotation make this extremely difficult to achieve
- Name brand, high quality, new RG-213 is an excellent choice
  - 95% shield, stranded center conductor, solid dielectric, black UV-resistant jacket
- Replace the coaxial cable whenever you discover abrasion, damage or degradation during annual inspections
- Replace at least once every ten years



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## Single Point Ground at the Cable Entry into your Station



- Your station cable entry interface should establish a single point ground as close as possible to the outside wall of your building
  - Install a minimum of three 8-foot ground rods
  - spaced at least eight feet from each other in undisturbed soil
- Your single point ground strips lightning currents off of the coaxial cable shields before they enter your station
- Lightning protectors should be installed at the station single point ground
  - never install lightning protectors at your tower base





# Coaxial Cables Inside your Station



- RG-213 is much more practical than Heliax cable
  - RG-223 and RG-400 are excellent choices for small diameter coax
- Eliminating cable, connector and adapter related crossstation interference in SO2R and multi-operator stations
  - Never bundle single shielded coaxial cables
    - avoids cross-cable signal coupling in single shield coaxial cables
    - use double shielded coax if you must bundle your coaxial cables
  - Use UHF connectors and never N connectors for much better center pin contact pressure and reliability
    - Use only high quality Amphenol 83-1SP silver plated connectors
  - To minimize signal radiation, use K3LR'a PL-259 installation technique and avoid nickel plated adapters



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# Annual Coaxial Cable Inspections



- Inspect all indoor and outdoor coaxial cables, connectors and waterproofing for evidence of damage, cuts, cracks, moisture intrusion and improper installation
  - Antenna feed point connection (wear and water intrusion)
  - Antenna rotation coaxial cable (chaffing and wear)
  - Tower top connectors and bonding to tower
  - Tower base connectors and bonding to tower
  - All coaxial cable connectors and adapters in your station
  - All SO-239 chassis connectors on your station equipment
  - If in doubt, remove the connector for detailed inspection
  - · Verify that all indoor and outdoor connectors are wrench tight
    - ¼ turn

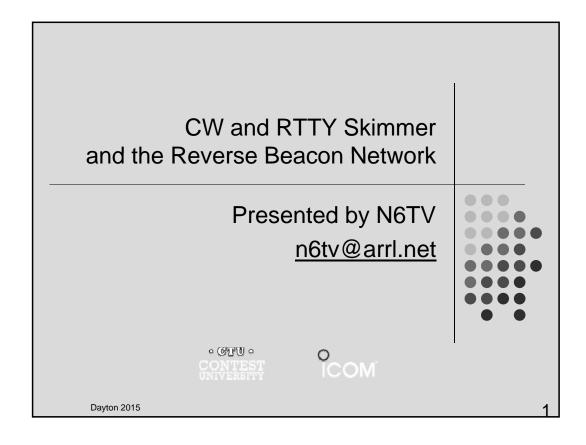


## Coaxial Cable Measurements Inside Your Shack



- Make a record of the following measurements at the ham shack end of every coaxial cable:
  - VSWR across the entire band(s)
  - · Center conductor to shield resistance
    - typically either a fraction of one ohm or many megohms
  - TDR and/or VNA plots
    - serious station builders should own (and use!) a TDR and a VNA
- Well before your next competitive contest, verify that all measurements have not changed and are not erratic
  - any change (better or worse) requires detailed investigation
- Use a digital wattmeter in your station to allow you to quickly detect and diagnose abnormal operation





#### **Overview**



- What is CW Skimmer and RTTY Skimmer?
- What is the Reverse Beacon Network?
- How does it work?
- What can the RBN do for me?
- How can I use it?
- How can I help?
- What's new?

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### It all starts with one developer



Alex Shovkoplyas, VE3NEA
 (b. 1965, ex-UR5EMI, in Canada since 1998)



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#### What is CW Skimmer?



 Hardware: PC + Software Defined Radio (SDR)







### **SDR Antenna**



2. Wideband RX Antenna, 1.8-30 MHz

InLogis (formerly Pixel Loop) RF Pro-1B:



DX Engineering Active Horizontal: ARAH3-1P:



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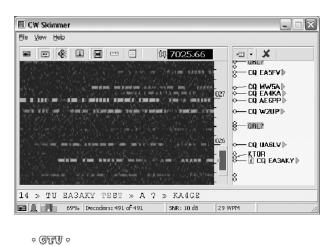
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#### **Software**



3. CW (or RTTY) Skimmer or Skimmer Server

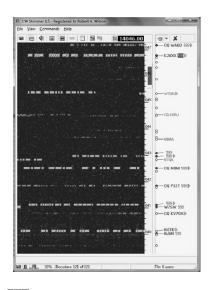




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### **CW Skimmer by VE3NEA**





- Works with many SDRs
- Decodes multiple CW signals in real time
- Can monitor entire CW band
- Waterfall Display
- Band Scope
- Uses MASTER.DTA
- Telnet Server (emulates a DX Cluster)

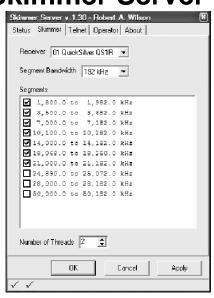
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### **Skimmer Server by VE3NEA**



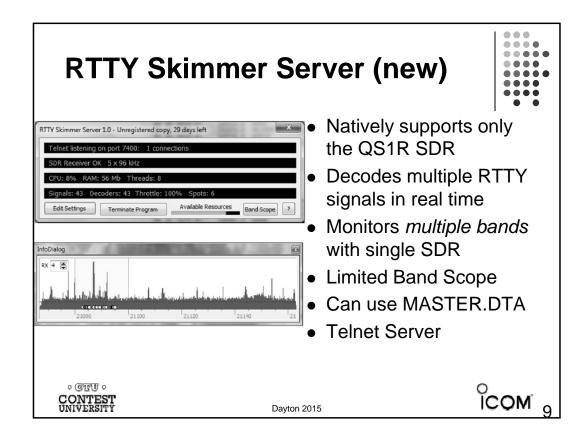


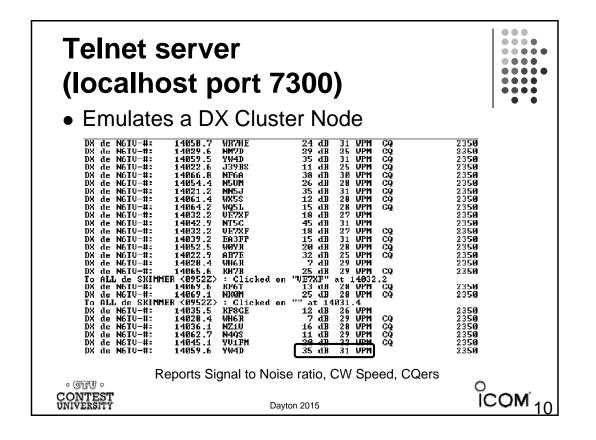
- Natively supports only the QS1R SDR
- Decodes multiple CW signals in real time
- Monitors multiple bands with single SDR
- No Waterfall Display
- No Band Scope
- No MASTER.DTA
- Telnet Server

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# What is the Reverse Beacon Network (RBN)?



- Uses any CW or RTTY signal as a beacon
- Multiple Skimmers world-wide record signal strength (S/N ratio in dB) and CW speed (WPM)
- A free "Aggregator" program forwards
   Skimmer spots to a central server
- Central server distributes spots via web page and public telnet servers
- You don't need to have an SDR to use it

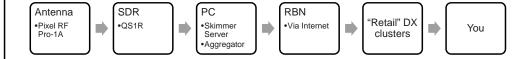


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### How do spots get to you?





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### **Acknowledgements**



- RBN web site and first aggregator originated by PY1NB (similar to his other web site, www.dxwatch.com). Felipe pays all the bills.
- Lots of code by W3OA (aggregator), F5VIH (Spots analysis tool)
- CW Skimmer evangelized and tested by N4ZR (also publishes <u>RBN blog</u>) – "RBN Chief Evangelist"
- Telnet server support by K5TR, W2QO, KM3T

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### Felipe Ceglia, PY1NB



- Created and maintains the Reverse Beacon Network
- Hosts dxwatch.com and reversebeacon.net



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### Dick Williams, W3OA

 Created the newest RBN Aggregator software; now adding enhancements.



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### Nick Sinanis, F5VIH

 Wrote the RBN Spots Analysis Tool



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### Pete Smith, N4ZR



- RBN Chief Evangelist
- Skimmertalk Reflector: <a href="http://dayton.contesting.com/">http://dayton.contesting.com/</a> mailman/listinfo/skimmertalk
- Yahoo Group: RBN-OPS
   https://groups.yahoo.com/neo/groups/RBN-OPS/info
   (130+ members)



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### What can the RBN do for me?



- It can improve your score
  - Fills spots in band map (SOA, Multi-op)
  - Spots you (very often, if you call CQ properly)
- Entering a contest?
  - Before: Check antenna F/B, signal strength
  - During: See where you are being heard, view skimmer-generated propagation maps
  - After: Compare signal strength with the competition

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## How can I use RBN to improve my score?



- Make sure the Skimmers find and spot you
- Access RBN via your favorite DX Cluster, for CW and RTTY contests (when allowed)
- RBN will post far more spots than DXers
  - With smaller pileups, less competition
- RBN quickly fills the band map in your logging software
- RBN helps locate clear spots to call CQ (between stations that you may not hear)

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## How can I use RBN to improve my score (cont'd):



- The RBN reveals band openings, shows where you are being heard
  - At K3LR, sunrise on 15m: "Spotted by S50ARX-#"
  - First EU answered our 15m CQs 25 minutes later



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## How do I CQ "properly"?



- Send everything at the same consistent speed
  - Never use >/< or +++/--- to change speed in messages
- Call CQ or TEST and send your call twice
  - CQ N6TV N6TV
  - TEST N6TV N6TV
  - CQ N6TV N6TV TEST
- Use proper spacing (let computer send)
  - Don't send with paddles and rusheverythingtogether
- Change your freq. slightly to get spotted again

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## What counts as "CQ"?



- Originally just: "CQ", "TEST", and "QRZ"
- VE3NEA Added: "FD", "SS", "NA" and "UP"
- Examples:
  - P5DX P5DX UP
  - SS N6TV N6TV
  - NA N6TV N6TV
  - FD N6TV N6TV FD
- Short calls like "W1F" should always be sent twice to help Skimmer identify it quickly

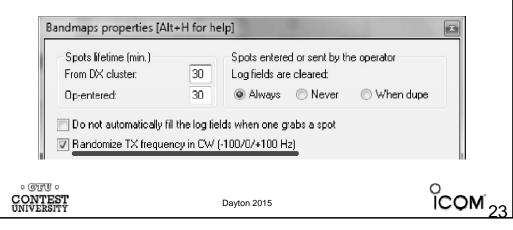


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## How to improve your chances in a Skimmer-generated pileup



 Use XIT or the "randomize TX" feature of your logging program to call a bit off frequency.



## How do I use the RBN to Check My Antennas?



- To test performance, just call CQ on CW, check RBN web site (turn beam, repeat)
- Use RBN web site's "Spots Analysis Tool" to compare your signal to the competition
- Download raw data files for deeper analysis
  - Every RBN spot posted since February, 2009 is archived on the RBN web site

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## Accessing the RBN (SOA, Multi)



- Many DX clusters combine RBN and human spots using AR-Cluster V6 (see www.dxcluster.info for address listing).
  - Some ARC V6 clusters offer CT1BOH spot quality filters (flags busts, uniques)
- dxc.ve7cc.net port 23
   CC Cluster software removes many bad spots (uniques) and dupes

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## Filtering Spots (old way)



- DXSpider
  - accept/spots by\_zone 1,3,4,6,7,31 and not by WZ7I or call N6TV
  - http://www.dxcluster.org/main/filtering\_en.html#toc1
- ARCluster V6
  - set dx filter call=N6TV or (unique>1 and (spotterstate=CA or spotterstate=NV or spotterstate=UT))
  - http://www.n8noe.us/ARC.html



## Filtering Spots (new way)



- Use CC User software by VE7CC to log in to dxc.ve7cc.net port 23
- CC User sets filters with a full-feature, Graphical User Interface (GUI)
- CC Cluster nodes automatically reject "unique" (busted) spots, eliminates dupes
- New AR-Cluster Client by AB5K
- Updated Tutorial:
  - http://reversebeacon.blogspot.com/2013/12/a-new-tutorial-onusing-rbn.html

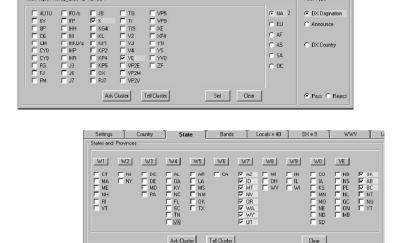
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## **CC User Filter Dialogs**

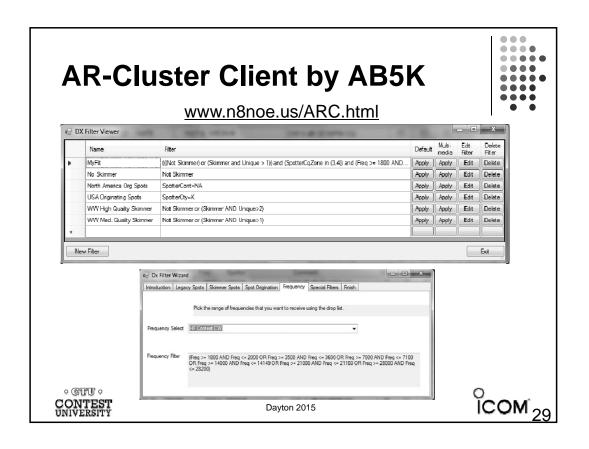


C DX Country



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## Many nodes combine RBN and "legacy" (human) spots



- dxc.ve7cc.net port 23 (CC Cluster, many filtering options, use CC User to set them)
- dxc.w9pa.net port 7373 (AR Cluster) set dx extension skimmerquality
- dxc.n7tr.com port 7373 (AR Cluster, but pre-filters to show only spots from Zones 3 and 4)

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## **Real-time propagation maps**

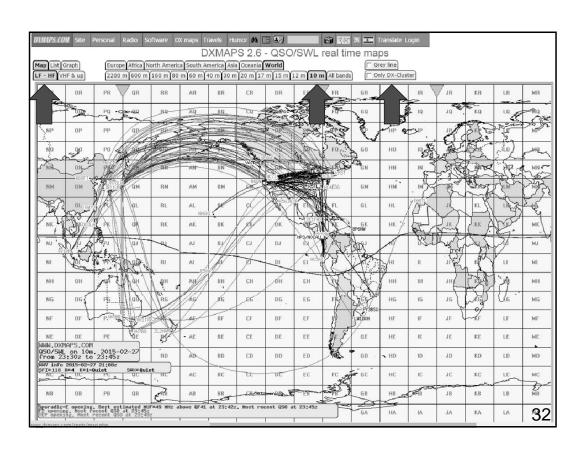


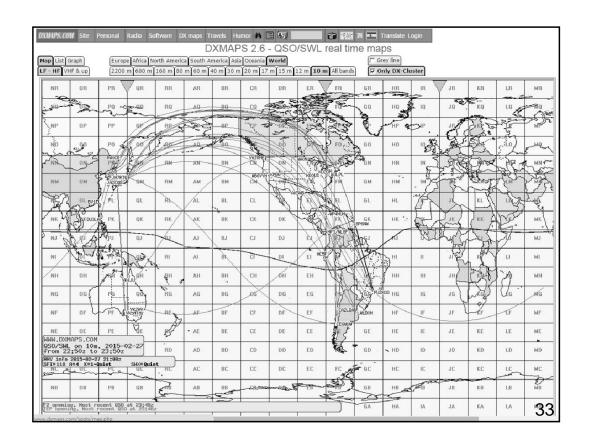
- http://www.dxmaps.com
- Click "HF" and band of interest
- Leave page open, it refreshes automatically



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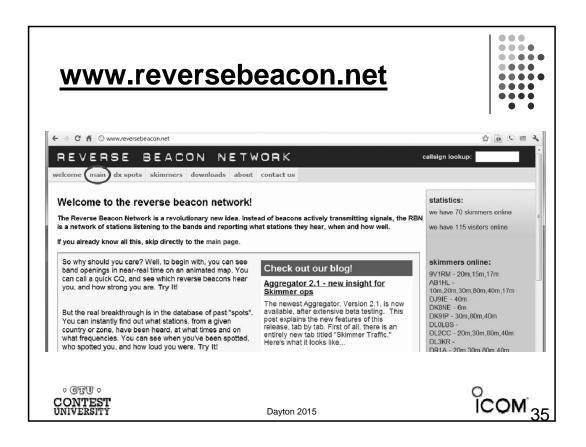
## Using www.reversebeacon.net



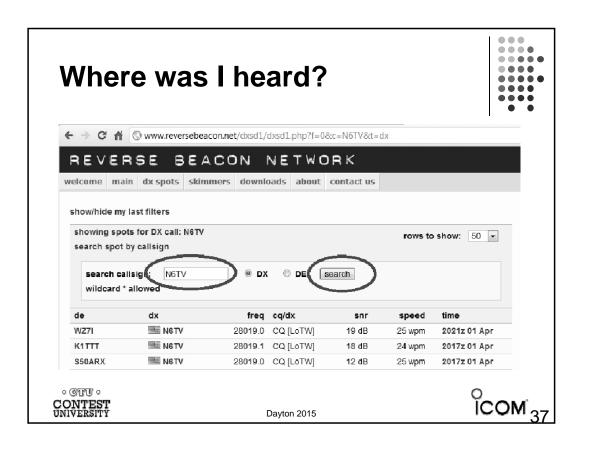
- Great for post-contest analysis
- Plot signal strengths
- Raw data files can be downloaded / analyzed
  - Millions of spots archived

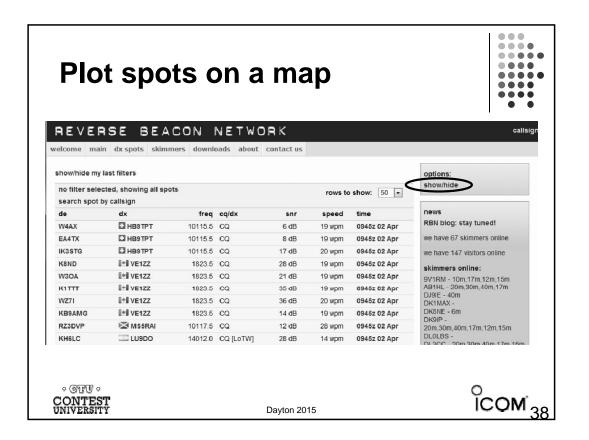


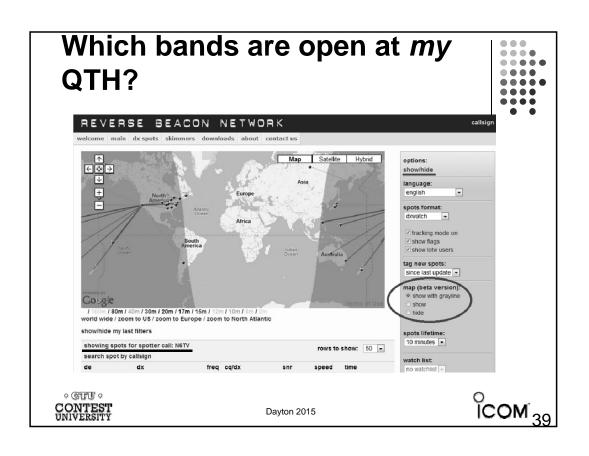
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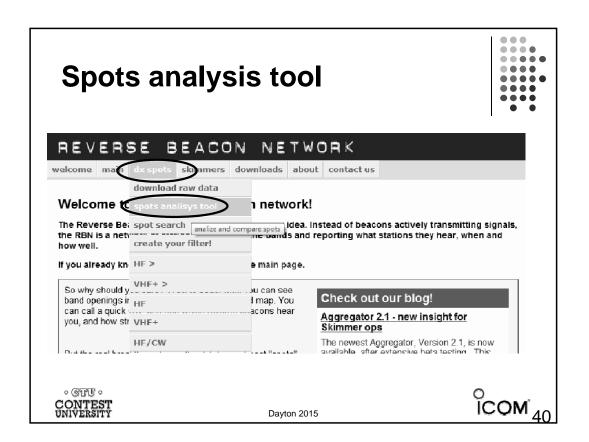


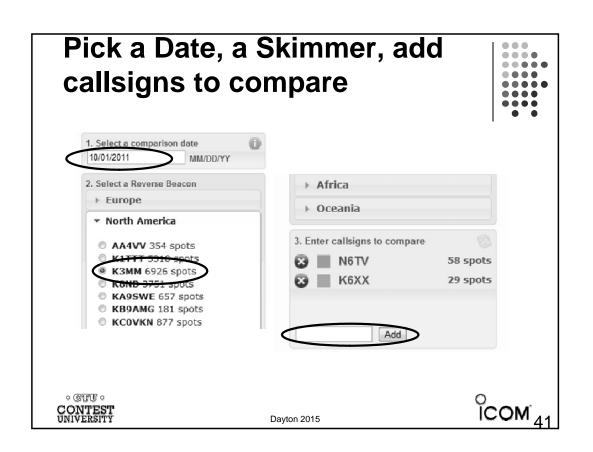


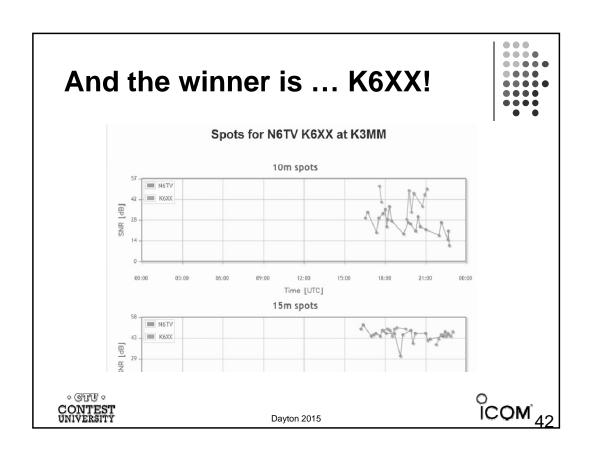


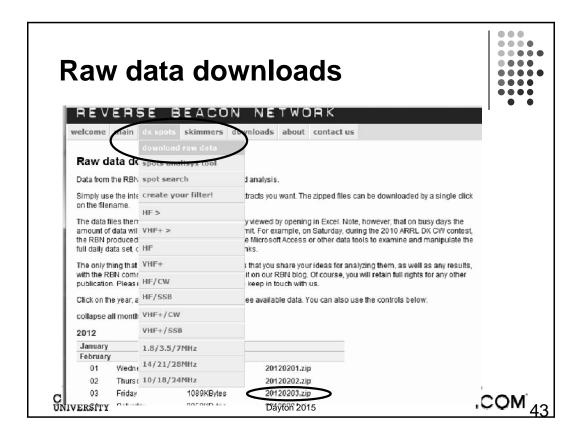












## Raw data is text file, Comma Separated Values



callsign, de\_pfx, de\_cont, freq, band, dx, dx\_pfx, dx\_cont, mode, db, date, **speed, tx\_mode**JE1SGH, JA, AS, 28032.6, 10m, K6UW, K, NA, CQ, 29, 2014-02-15 00:00:00, 32, CW
XV4Y, 3W, AS, 14041.1, 20m, PT5T, PY, SA, CQ, 22, 2014-02-15 00:00:00, 28, CW
XV4Y, 3W, AS, 14021, 20m, PX2F, PY, SA, CQ, 23, 2014-02-15 00:00:00, 23, CW
NC7J, K, NA, 28005.5, 10m, N2IC, K, NA, CQ, 11, 2014-02-15 00:00:00, 33, CW

### Total World-Wide RBN CW spots, CQ WW:

2012: 3,163,126 (18.3 spots per second)

2013: 5,743,545 (33.2 spots per second) – up 81.5% 2014: 6,200,340 (35.9 spots per second) – up 8.0%

#### ARRL DX CW:

2013: 3,937,108 (82,023 spots per hour)

2014: 4,146,399 (86,383 spots per hour) – up 5.3% 2015: 5,537,017 (115,354 spots per hour) – up 33.5%



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## What's the Average CW Speed?



• 2013 CQ WW CW: 30.6 WPM

• 2014 CQ WW CW: 30.8 WPM

• 2014 ARRL DX CW: 29.6 WPM

• 2015 ARRL DX CW: 30.1 WPM



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## How can I help?



- Set up an SDR, feed Skimmer Spots to the RBN, using the Aggregator program
  - More skimmers needed in Asia/Africa/South America
- Call a bit off frequency (Win-test and N1MM both provide automatic randomization if desired)



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## What's New?



- NCDXF and other HF Beacons can be spotted on RBN
  - reversebeacon.blogspot.com/2014/02/ncdxfbeacon-spotting-redux.html
- RTTY Skimmer Server 1.0
- CW Skimmer 1.83
- Aggregator v4.0

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### For more information



- http://www.reversebeacon.net
- http://www.dxmaps.com
- <a href="http://www.bcdxc.org/ve7cc/default.htm#download">http://www.bcdxc.org/ve7cc/default.htm#download</a>
- http://www.dxatlas.com/CwSkimmer
- <a href="http://www.dxatlas.com/SkimServer">http://www.dxatlas.com/SkimServer</a>
- <a href="http://www.srl-llc.com/">http://www.srl-llc.com/</a> (QS1R SDR)
- <a href="http://microtelecom.it/perseus/">http://microtelecom.it/perseus/</a> (Perseus SDR)
- <a href="http://www.dxengineering.com/parts/ins-rf-pro-1b">http://www.dxengineering.com/parts/ins-rf-pro-1b</a> (RF Pro-1B loop antenna)

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## For more information



- <a href="http://www.dxengineering.com/parts/dxe-arah3-1p">http://www.dxengineering.com/parts/dxe-arah3-1p</a> (Active Broadband Dipole antenna)
- http://www.pvrc.org/~n4zr/rbn.pdf
- <a href="http://reversebeacon.blogspot.com/2013/12/a-new-tutorial-on-using-rbn.html">http://reversebeacon.blogspot.com/2013/12/a-new-tutorial-on-using-rbn.html</a>
- <a href="http://reversebeacon.blogspot.com">http://reversebeacon.blogspot.com</a>
- http://www.ve7cc.net/
- <a href="http://www.grz.com/db/n6tv">http://www.grz.com/db/n6tv</a>

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## **Questions?**



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## Why Cabrillo is Important to You

Randy Thompson, K5ZD



• G.L.A.

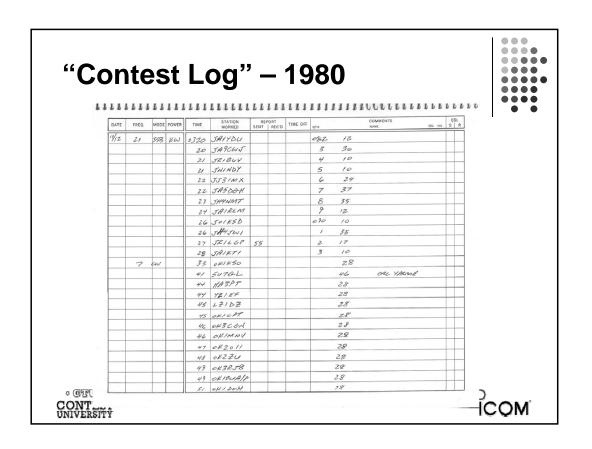


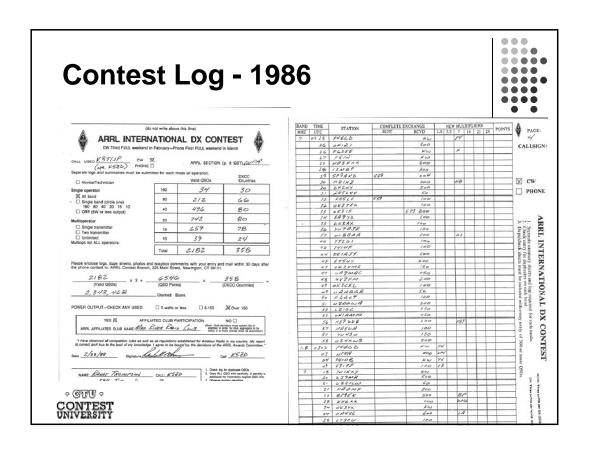
## **Purpose of this Session**



- History of the Cabrillo log specification
- Cabrillo log file basics
- How the log submission process works



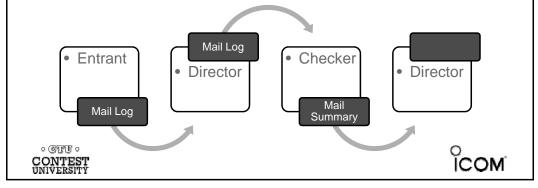




## **CQWW Paper Log Processing**



- Receive logs (4-8 weeks in mail)
- Divide logs by category
- Mail logs to log checker for that category
- Checker reviews logs and marks scoring changes on summary sheet
- Sends summary sheets back to Director



## **Paper Log Results**

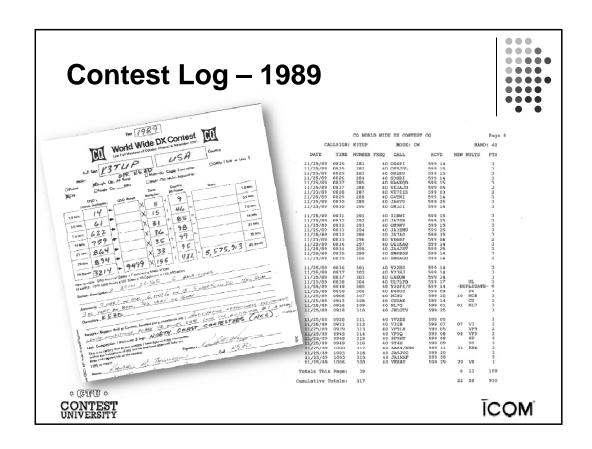


- Director collects all summary sheets
- Write correct line score info "above this line"-



- Store summary sheets in results order
- When final, deliver to typesetting department (in results order)







## Requirements



- What makes up a contest log?
- What data do we need for each QSO?
- What data is needed from the summary sheet?
- Formatting?
- Human readable?





## **QSO Data**



3/9	21	0050	JH3DPB	59	TX	59	KW
			JA7YAA				KW
			VS6BG				100
		55	KH6ND				KW
			ZL1ANJ				150
	28		HC8A				KW
			OA4ANR				100
		0100	KL7RA				KW
	14		VP2E				KW

• Easy for humans to understand, but not for computers





## **ARRL Format "V1" - 1993**



## ARRL Suggested Standard File Format For Submission of Contest Log Data

- All files must be in standard ASCII format.
- All files must be on an MS-DOS formatted disk, 3.5 inch (720-KB or 1.44-MB) or 5.25 inch (360-KB or 1.2-MB).
- The diskette label should clearly indicate the call sign used, contest name, entry class, and date of the contest.
- A paper summary sheet is required of all logs, either an official ARRL summary sheet or a close facsimile with a signed contest participation disclaimer.
- All diskettes become the property of the ARRL and are not returnable.
- All QSO data must appear in each line, aligned by columns...

#### SAMPLE FILE:

```
20 CW 15/02/92 0001 UW9WA 599 MA 599 200 * 3 20 CW 15/02/92 0001 UZ1AWJ 599 MA 599 200 * 3 20 CW 15/02/92 0002 DZ1KW 599 MA 599 100 * 3 20 CW 15/02/92 0002 VUIGN 599 MA 599 100 * 3 20 CW 15/02/92 0003 UZ4WWA 599 MA 599 100 * 3 20 CW 15/02/92 0003 UZ4WWA 599 MA 599 200 * 3 20 CW 15/02/92 0003 UZ4WWA 599 MA 599 500 * 3 20 CW 15/02/92 0005 DK1ALW 599 MA 599 KW * 3 20 CW 15/02/92 0005 DK1ALW 599 MA 599 KW * 3 20 CW 15/02/92 0005 DF5UL 599 MA 599 KW * 3 20 CW 15/02/92 0005 DF5UL 599 MA 599 KW * 3 20 CW 15/02/92 0005 DF5UL 599 MA 599 KW * 3 20 CW 15/02/92 0006 RHDE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 RHDE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 RHDE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 RHDE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 SW * 3 20 CW 15/02/92 0006 FORE 599 MA 599 MA 590 MA 590
```



Source: http://lists.contesting.com/ cq-contest/1993-02/msq00078.html



## **Next Steps**



- Logging software authors had embraced ARRL Format V1
- But, floppy disks and paper summary sheets wasn't making things better
- In 1998 K5FUV at ARRL invited Trey, N5KO, to investigate electronic log submission



## **Other Possible Formats**



- ADIF
  - Late response from developers
- DARC Contest Data Exchange Format
   "STuetzerbach Format" STF
  - Discovered too late
- XML
  - Too new and not easy to read



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## ARRL Format V2



- Needed summary sheet data to put complete log submission in one file
- CQ Magazine would not accept file format with ARRL in the name



OCOM

## Cabrillo Log Format – 1999



- Name of Portuguese explorer whose name was popular near where Trey lived!
- 1999-08-16 Cabrillo V2.0 recognized by ARRL and CQ

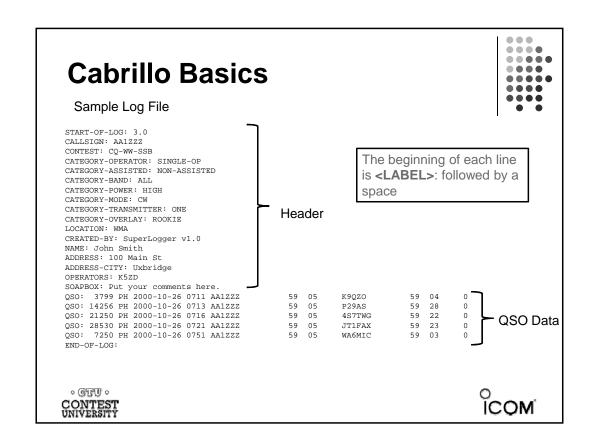


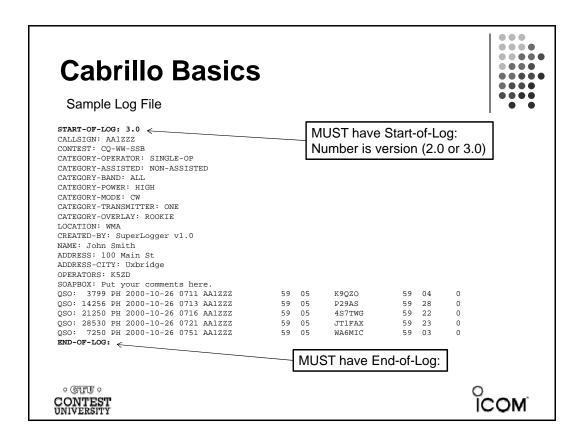


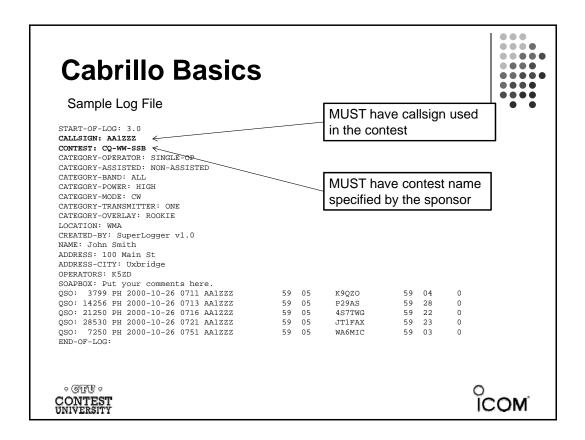












## **Category Information**



#### V3.0 (preferred)

- Each descriptor has its own line
- All lines must be included

CATEGORY-OPERATOR: SINGLE-OP CATEGORY-ASSISTED: NON-ASSISTED

CATEGORY-BAND: ALL CATEGORY-POWER: HIGH CATEGORY-MODE: CW

CATEGORY-TRANSMITTER: ONE CATEGORY-OVERLAY: ROOKIE

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#### **V2.0 (old)**

All descriptors on one line

CATEGORY: SINGLE-OP ALL HIGH CATEGORY-OVERLAY: ROOKIE



#### ... .... Other Header Fields Sample Log File START-OF-LOG: 3.0 CALLSIGN: AA1ZZZ CONTEST: CQ-WW-SSB CATEGORY-OPERATOR: SINGLE-OP CATEGORY-ASSISTED: NON-ASSISTED CATEGORY-BAND: ALL CATEGORY-POWER: HIGH LOCATION: used to determine CATEGORY-MODE: CW CATEGORY-TRANSMITTER: ONE section or call area where operation CATEGORY-OVERLAY: ROOKIE LOCATION: WMA occurred CREATED-BY: SuperLogger v1.0 NAME: John Smith Address is optional, used ADDRESS: 100 Main St ADDRESS-CITY: Uxbridge < to mail certificates OPERATORS: K5ZD SOAPBOX: Put your comments here. QSO: 3799 PH 2000-10-26 0711 AA1ZZZ QSO: 14256 PH 2000-10-26 0713 AA1ZZZ 59 05 P29AS 59 28 0 QSO: 21250 PH 2000-10-26 0716 AA1ZZZ QSO: 28530 PH 2000-10-26 0721 AA1ZZZ 59 22 59 23 59 05 4S7TWG 0 JT1FAX 59 05 0 QSO: 7250 PH 2000-10-26 0751 AA1ZZZ END-OF-LOG: • GLU •

## **Other Fields**



- OPERATORS:
  - Calls of all operators, use @ to show station used OPERATORS: K3EST @N6RO
- SOAPBOX:
  - Limit line to 75 characters, use multiple lines

SOAPBOX: The contest was great fun SOAPBOX: until my amplifier blew up!

- CREATED-BY:
  - Optional, sometimes helps us know which programs are not formatting correctly



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## **Other Fields**



- CLUB:
  - Single ops only one club name
  - Multi-ops may list multiple club names

CLUB: 1/3 Yankee Clipper Contest Club 2/3 North Coast Contesters

- Robot will give warning if multiple clubs, but can be ignored
- CLAIMED-SCORE:
  - Optional, not used



## **QSO Data**



QSO:	3799	PH	2000-10-26	0711	AA1ZZZ	59	05	K9QZO	59	04	0
QSO:	14256	PH	2000-10-26	0713	AA1ZZZ	59	05	P29AS	59	28	0
QSO:	21250	PH	2000-10-26	0716	AA1ZZZ	59	05	4S7TWG	59	22	0
QSO:	28530	PH	2000-10-26	0721	AA1ZZZ	59	05	JT1FAX	59	23	0
QSO:	7250	PH	2000-10-26	0751	AA1ZZZ	59	05	WA6MIC	59	03	0

					into s	o sent		into rcvd			
QSO:	freq	mo	date	time	call	rst	exch	call	rst	exch	t
QSO:	****	**	yyyy-mm-dd	nnnn	******	nnn	****	******	nnn	*****	n
oso:	3799	PH	2000-11-26	0711	N6TW	59	03	JT1Z	59	23	0

- QSO: indicates a QSO
- Each line contains all frequency, date, time, and sent/received info
- Every line must include all fields
- Use spaces or tabs between fields
- · Columns do not need to line up

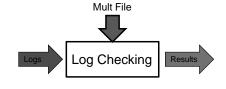
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## Why no Multipliers or QSO Points?



- Electronic logs enable fully computerized log checking
- All logs are scored in a consistent way without "interpretation" by the entrants
  - Common multiplier file and scoring algorithm
  - What country is TO2A? TX5K? GM4WXQ?



(FY, FO/c, GM/s)



## What about dupes?



- Submit all QSOs that you make
  - Even if you are single band
  - The Header tells us your category for scoring
- There is no penalty for logging duplicate contacts

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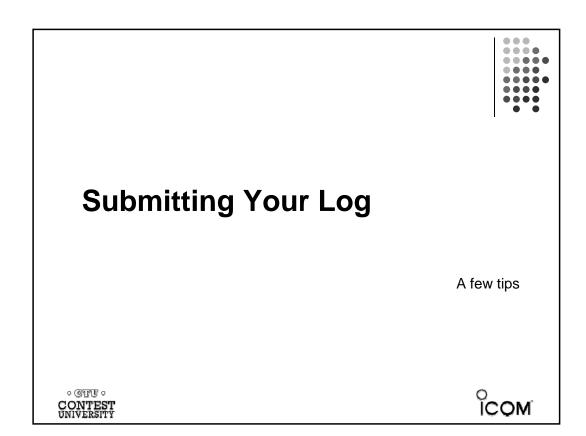
COM

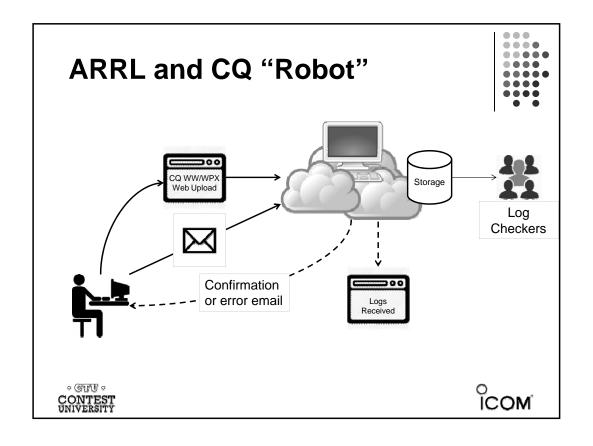
## **Cabrillo Notes**



- Must be ASCII text file
- You can edit with any text editor (such as Notepad or Wordpad)
- Please do not use special fonts to create slashed zeroes
- Use tabs or spaces between line items
  - Text columns do NOT need to line up
- ACCURATE DATE/TIME IS IMPORTANT!







## **Email Tips**



- Log can be an attachment or in the body of the email
  - Use <call>.cbr or <call>.log for file name
- Subject line should have only your callsign
  - Subject line must have less than 4 words (spam defense mechanism)
- READ THE CONFIRMATION EMAIL!
  - Your log may have errors or been rejected
- Each new log submitted <u>replaces</u> any previous one



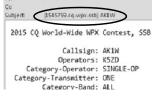


## **Final Confirmation**



 Your log is not officially received you receive an email confirmation with tracking number in subject line

 Contest Robot Current/Wide @ccqup.com>



- Check your category!!
  - The robot may enter a default if something is missing or invalid





## **Note**



Do not put any information about your entry in the email subject or body.

The log checkers only see the log file!

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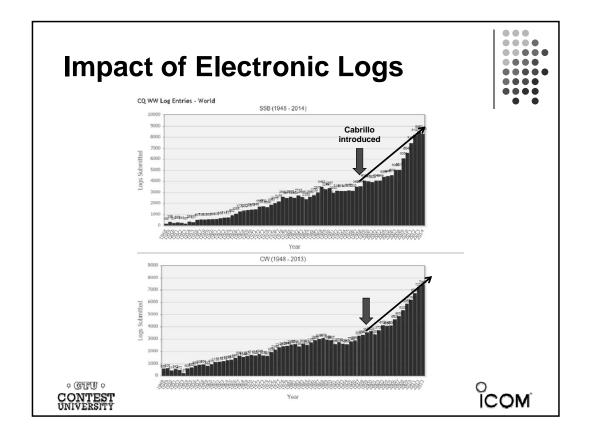
## **Log Submission Deadlines**



- See the contest rules for log deadline
  - For CQ Contests, it is 5 days
  - For ARRL Contests, it is ~15 days
- Robot accepts late logs
- If you need more time, request an extension

Why not just submit your log as soon as the contest is over?





## **World Wide Radio Operators Foundation**



- Non-profit corporation focused on support of radio contesting
- WWROF funds
  - CQWW infrastructure including the robot, web site, log checking software/hardware
  - Manages Cabrillo log format standard
  - Webinar series
  - Other projects that support contesting
- Learn more and donate at www.WWROF.org







## **Questions?**



Cabrillo Specification: <a href="http://wwrof.org/cabrillo/">http://wwrof.org/cabrillo/</a>

Questions or Change Requests: <a href="mailto:cabrillo@wwrof.org">cabrillo@wwrof.org</a>

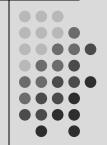
ARRL Article about Cabrillo: <a href="http://bit.ly/1FzgkM9">http://bit.ly/1FzgkM9</a>





## **CTU Presents**

# Getting the Most Out of Your VHF Contesting Experience



Joel Harrison, W5ZN





## **VHF Contesting – Expectations**



- Advanages
  - Magic Bands
  - Super Results from Average Stations
  - Great activity to obtain new operating awards
  - Intense excitement when bands open
- Disadvantage
  - QSO rates are not normally as continuous as HF on 2 meters & above





## **What Contests are Available?**



- ARRL
  - January
  - June
  - September
- CQ
  - July
- Many other smaller events throughout the year

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## **What Contests are Available?**



- ARRL June VHF Contest
  - The premier VHF contest of the year
  - Occurs during peak Sporadic E Season
  - Excellent weather condx for roving or mountain top operating

### What Bands are Important?



#### 6 Meters

- The major focus 50.125 is calling freq
- Spread out during contest. Stations will be on:
  - 50.080 50.105 CW (50.105 50.120 DX Reserved)
  - 50.125 50.200+ SSB
- Band can open unexpectedly with Es
  - Keep a dedicated radio here or monitor by other means
- Provides most Q's and Mult's





### **What Bands are Important?**



#### 2 Meters

- Second most important
  - 144.200 is center of activity but listen up and down 25 KHz or more in populated areas
- Es can extend to 2 meters





### What Bands are Important?



#### • 432 MHz

- Third most important band
  - 432.100 is center of activity and calling frequency
  - Stations will move 10 to 20 KHz up or down during heavy activity

#### • 222 MHz

- Not as populated as other three bands but plenty of activity in populated areas.
- 222.100 is activity center





### What Bands are Important?



#### Microwave Bands

- Not as much activity as in previous years
- Concentrated in populated areas
- Many rovers have these bands
- 902.100 (or 903 in some areas) 1296.100, 2304.100, 3456.100, 5760.100 & 10368.100 is center of activity and calling frequency
  - You normally won't hear stations calling CQ here but they will move stations here from the lower bands





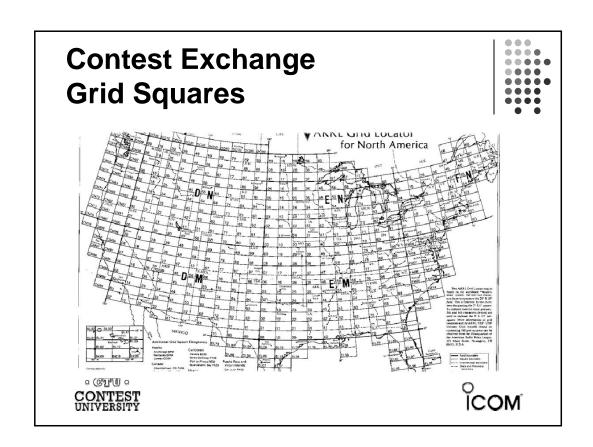
### **Categories**



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







### **Station Basics**



- 6 Meters
  - Radio or transverter is fine
  - 50 watts is great, 100 watt is outstanding
  - 3 element antenna up at least 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



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### **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**

reduced

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!!!!!



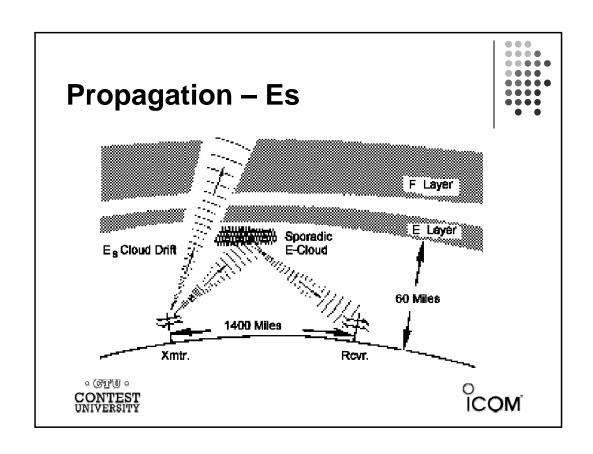
### **Propagation – Es**



- 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







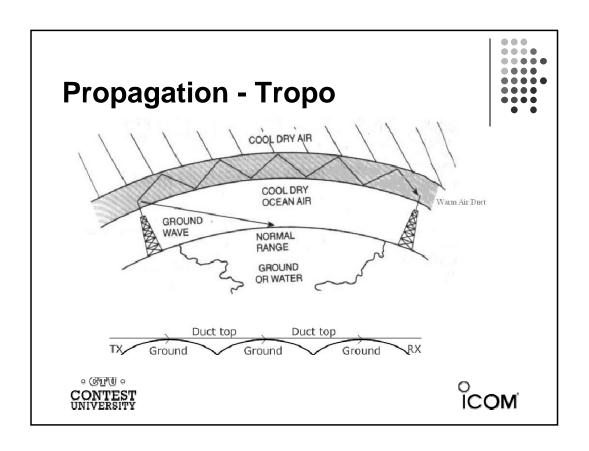
### **Propagation - Tropo**



- 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 – 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

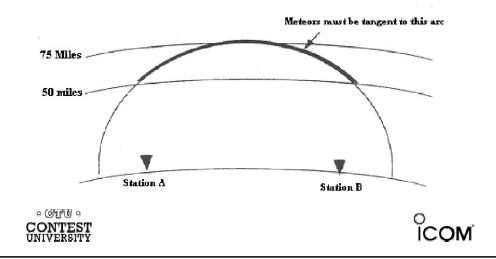




### **Propagation – MS**



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 <u>WSJT</u>





### **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 <u>Aiming</u>



- 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



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### **Equipment - Receive Preamps**



- Assume Tant = 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**



#### 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. Coax loss adds directly to the receiver NF and can determine up to 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







- 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





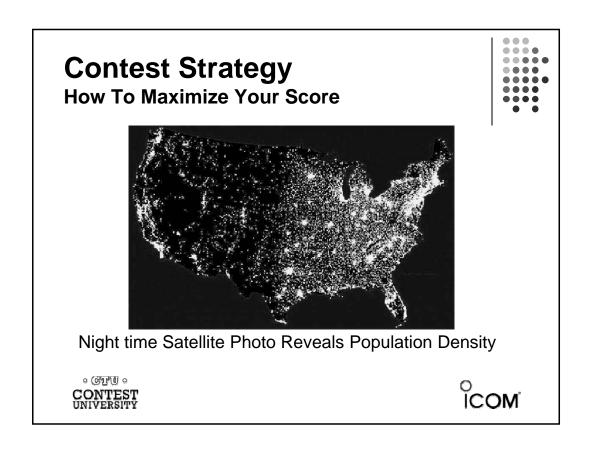
### **Contest Strategy**

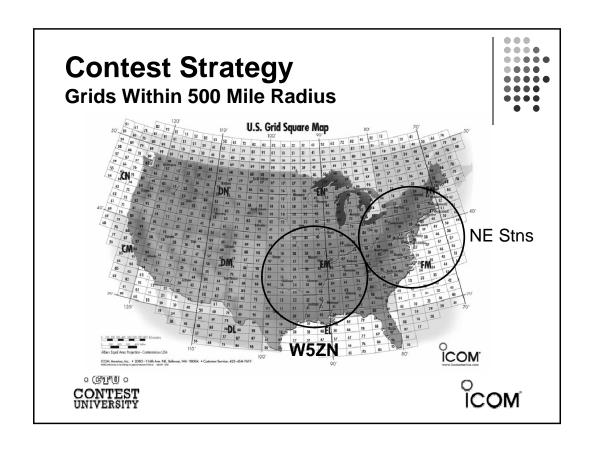


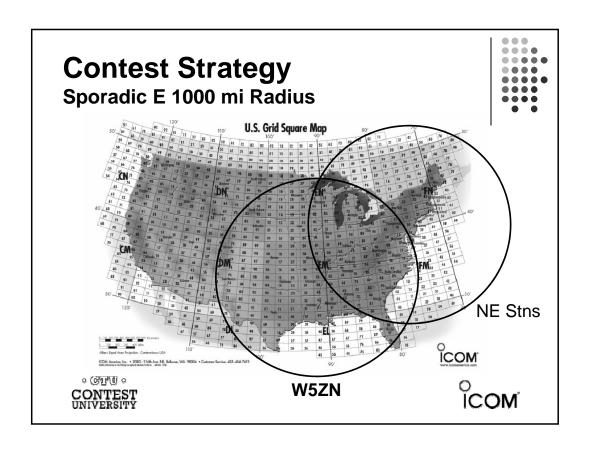
- Determine what others are accomplishing
  - Evaluate top 10 scores for past 10 years
- Its not all about making the most QSO's
  - Maximize grid multipliers











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?





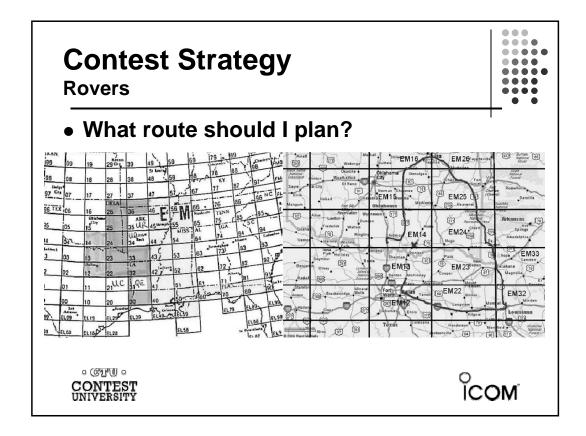
#### **Rovers**



- 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 equipment do I need?
  - Multi-band VHF radios that cover 50 through 432 MHz are great!! (FT-847, FT-736, TS-2000)
    - Can interface with transverters a plus!
  - Transverters for higher bands
  - Smaller antennas

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### **Contest Strategy**Rovers



W5LUA / WA8RJF Rover Antennas 50 – 432 MHz



W5LUA / WA8RJF Rover Equipment 50 – 432 MHz

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### **Contest Strategy**Rovers







N2CEI / K4SME Rover Station 50 MHz – 10 GHz

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### **Contest Strategy**Rovers







50 MHz - 432 MHz Rovers

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#### **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.





**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 – Meteor Scatter** ZSO TNX QSO TNX QSO TNX QSO TWX QSO TNX Tx2 Sh Msg R26 Tx3 T×4 RRR 2006 Jul 31 GenStdMsgs 73 T×5 Auto is Off CQ K1JT 0 **GLA**O 0 COM CONTEST UNIVERSITY

**K1JT Digital Modes – Meteor Scatter** 



- FSK441 Mode
  - Calling frequencies 50.260 & 144.140
  - Single Antenna & 100 W is outstanding
  - Antenna is pointed toward station worked
  - Run 30 second sequences
    - Normally eastern most station runs 1<sup>st</sup> 30 second period (0-30) and western station runs 2<sup>nd</sup> 30 second period (31-00).





### **Contest Strategy**

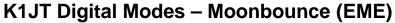
**K1JT Digital Modes – Meteor Scatter** 



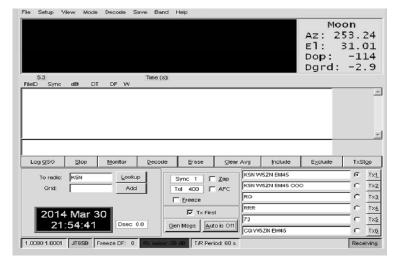
- FSK441 Mode (cont)
  - Once calls are received stations start sending report
  - Stations will be on after 0500z
  - Listen on 50.260 in "Monitor" mode for stations calling CQ
    - You may hear "CQ W5ZN EM45 U5" or "D10"
      - U5 means the CQ station is listening Up 5 KHz
      - Call there. When CQ station hears you he will begin transmitting Up 5 KHz.











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### **Contest Strategy**

**K1JT Digital Modes – Moonbounce (EME)** 



- JT-65B Mode
  - 144 MHz and 432 MHz
  - No Calling frequencies
  - Single antenna & 100 W can work big stations
    - More antennas + More power = More Success
    - 2 antennas & 300 400 watts is very good
  - Must aim antenna at the moon
    - If you can't elevate antennas then catch moon at horizon on "moonrise" or "moonset"









- JT-65B Mode (Cont)
  - Run 1 minute sequences
    - Normally eastern most station runs 1<sup>st</sup> "even" period (beginning at 0, 2, 4 etc min) and western station runs 2<sup>nd</sup> "odd" 1 minute period (1, 3, 5 tec min).
  - After calls are sent and received send report
    - Report is "OOO"
  - After report is received send "RO"
  - Complete with "R" and "73"



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### Contest Strategy K1JT Digital Modes



Kibi Digital Wodes

• 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



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### **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?



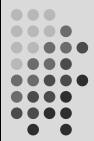
- VHF Conferences & Microwave Update
  - Central States VHF Society (CSVHFS)
  - Northeast Weak Signal Society (NEWS)
  - Southeast VHF Society (SEVHFS)
  - Western States Weak Signal Society (WSWSS)
  - Microwave Update Conference
  - Not "traditional" hamfests
  - Publish proceedings (compilation of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





## Practical upgrades for your 160 and 80 Meter Antennas

- Vertical polarization on 160 meters
- Horizontal polarization on 80 meters
- > Small receiving antennas
- High performance receiving antennas







Dayton 2015

# Vertical Polarization on 160 Meters almost always provides better DX performance than any horizontally polarized antenna



- Vertical, inverted-L, T, or umbrella transmitting antennas almost always outperform horizontally polarized antennas at distances beyond 1500 miles
- Nearby towers and antennas can significantly degrade the performance of vertical antennas
- Good radial systems are essential to achieving the full performance potential of vertical transmitting antennas





### Horizontal Polarization on 80 Meters provides 6 dB of "free" ground gain



- Horizontal dipole or inverted-V dipole 50-70 feet high
  - superb Sweepstakes and Field Day antenna
  - a good antenna for DXing at distances up to about 5000 miles
- Horizontal dipole or inverted-V dipole at least 70 feet high
  - outperforms a 65 foot vertical installed over all but the most conductive soils such as a salt marsh
- Use a vertically polarized antenna if you cannot install a dipole or inverted-V dipole at least 70 feet high
  - 65 foot vertical, inverted-L, T or umbrella with at least 30-60 radials
  - · corner fed delta loop
- A four-square vertical array with at least 30-60 radials
  - competitive with high horizontal arrays





### High Performance Transmitting Antennas for 160 Meter DX



- A 125 foot vertical is the gold standard 160 meter antenna
  - well spaced from all nearby tall towers and antennas
    - at least 140 feet from towers over 80 feet tall supporting large HF Yagis
    - optimum performance with spacing much greater than 140 feet
  - Install at least 30-60 shallow buried 125 foot radials
    - or at least two (preferably four or more) elevated 125 foot radials
      - but only if 30-60 shallow buried radials are impossible
    - or a reduced size counterpoise
- Inverted-L, T or umbrella antenna is a good alternative
  - as short as 50 feet (even shorter with reduced performance)
  - supported by a tower, mast or trees
- Vertically polarized corner fed delta loop





### High Performance Transmitting Antennas for 80 Meter DX



- Horizontal dipole at least 70 feet high
- 65 foot vertical
  - install at least 30-60 shallow buried 65 foot radials
    - or at least two (but preferably four or more) elevated 65 foot radials
      - only if buried radials are impossible
  - at least 70 feet from towers over 40 feet tall supporting a Yagi antenna
    - optimum performance with much more than 70 foot spacing
- Inverted-L, T or umbrella vertical is a good alternative
  - as little as 25 feet tall supported by a tower or trees
  - install at least 30-60 shallow buried 65 foot radials
    - or elevated radials
    - or a reduced size counterpoise
- Vertically polarized corner fed delta loop





### **The 4-Square Vertical Array**

an excellent alternative to very high 80 meter horizontal antennas



- A four square vertical array is very competitive with high horizontal Yagis and quads and is also an excellent receiving antenna
  - install at least 70 feet from all other towers
    - much greater than 70 feet will significantly improve its performance
  - at least 30-60 shallow buried 70 foot radials under each vertical





### **Comtek 4-Square Controller**





www.dxengineering.com/search/brand/comtek





### Why Receiving Antennas?



- Much better performance than most transmitting antennas
  - much lower cost
  - greatly reduced footprint
  - greatly reduced height (7 to 25 feet)
  - excellent directivity on less than an ¼ acre
  - superb directivity on less than 3/4 acre
  - greatly reduced mutual coupling between individual verticals
  - greatly reduced need for high efficiency matching and radial systems
- A large array performs equivalent to a 5 element Yagi!
- Combining two antennas with a variable phase controller
  - steerable nulls
  - optimize the front-to-back ratio of phased arrays of Beverages and verticals
- Diversity reception with dual phase locked receivers

。 ⑤宜世。 CONTEST UNIVERSITY All receiving antennas dimension are for 160 meters - simply scale them to 80 meters



### **Receiving Directivity Factor (RDF)**

- A proven measure of receiving antenna performance
  - forward gain at the desired azimuth and elevation angle compared to average gain over the entire hemisphere
- 4 dB: very small diameter "magnetic" loop
- 5 dB: single vertical antenna (short vertical or a 1/4 wavelength vertical)
- 4 6 dB: 250 400 foot Beverage
- 4 6 dB: 225 foot Beverage on Ground (BOG)
- 6 8 dB: small loop arrays (flag, pennant, EWE, K9AY, Shared Apex Loop Array)
- 9 dB: two element or triangle array of short verticals (80-120 foot spacing)
- 10 dB: 500 - 600 foot Beverage
- 11 dB: two or three close spaced 500 - 600 foot Beverages staggered 65 feet
- 12 dB: 4-square array of 20 foot verticals only 80 feet on a side (3/16 acre)
- 13.5 dB: four short verticals switchable in two directions (1/2 acre)
- 13.5 dB: steerable 8-circle array of short verticals (3/4 acre)
- broadside/end-fire 800 foot Beverages 14 dB

· CTT ·

Reradiation from nearby antennas and power lines can degrade actual RDF especially high RDF arrays



### **Popular Receiving Antennas**

- Small loops (good)
  - small diameter "magnetic" loop
  - fixed unidirectional terminated loop (e.g., flag, pennant, EWE, K9AY)
  - electrically steerable compact array of loops (e.g., K9AY, Shared Apex Loop Array)
  - mechanically rotatable unidirectional terminated loop (e.g., rotatable flag)
- Beverages (better)
  - single wire Beverage
  - Beverage on ground (BOG)
  - two wire bi-directional Beverage or BOG
  - arrays of two or three close spaced staggered Beverages or BOGs
- Arrays of short verticals (best)
  - active high impedance 20 foot verticals
    - · requires a high input impedance amplifier at the base of each vertical
  - passive low impedance 25 foot verticals
    - requires eight 70 foot or sixteen 35 foot radials at the base of each vertical
      - stabilizes feed point impedance in all weather and decouples the coax shield
    - four 25 foot umbrella wires
      - reduces the required height to 25 feet and increases the array bandwidth











### Small Diameter Loop Antenna The "Magnetic" Loop



- Excellent for nulling a single nearby RFI source
  - but a poor low angle DX receiving antenna
  - RFI must be vertically polarized and received at a low angle via ground wave
- Excellent for very accurately locating RFI sources
- Bi-directional figure-8 pattern 150 degree 3 dB beamwidth
  - omni-directional for skywave propagated signals
- Very deep nulls (2 degrees wide) off both ends of the loop
  - mechanically rotate the loop until the single local RFI source is nulled
  - no useful nulls for skywave propagated signals
- Small loop antennas produce very low signal levels
  - · requires a high gain, low noise preamplifier
- Decouple stray pickup from all attached cables
  - install chokes on the coaxial feed line shield and the DC power cable
  - bury cables about 12 inches deep for optimum null depth
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines



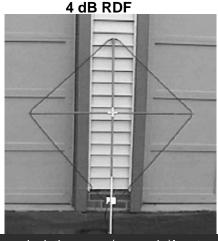
The "Magnetic" Loop is a Specialized Antenna



### **Small Diameter Loop Antenna**

inexpensive and very easy to build and use 8 foot diameter (4 foot diameter on 80 meters) Very deep, narrow beam width nulls for local RFI suppression bidirectional 150 degree 3 dB beam width





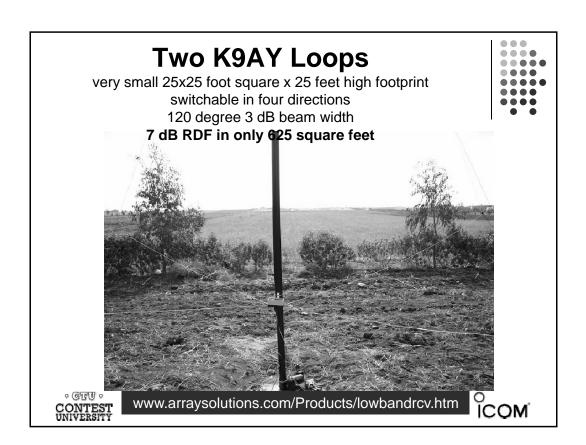
www.seedsolutions.com/gregordy/Amateur%20Radio/ Experimentation/160loop.htm

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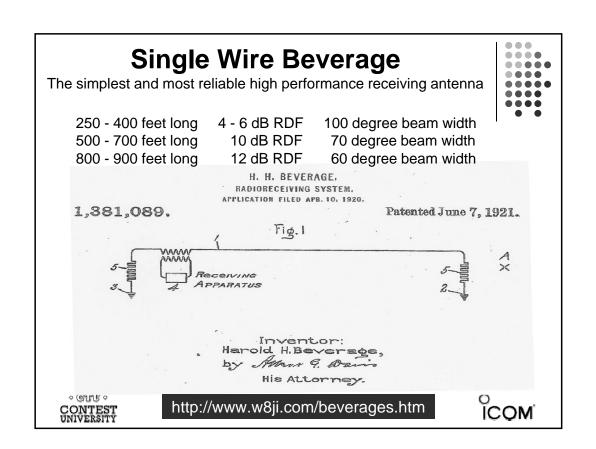
#### **Electrically Steerable Loop Arrays**

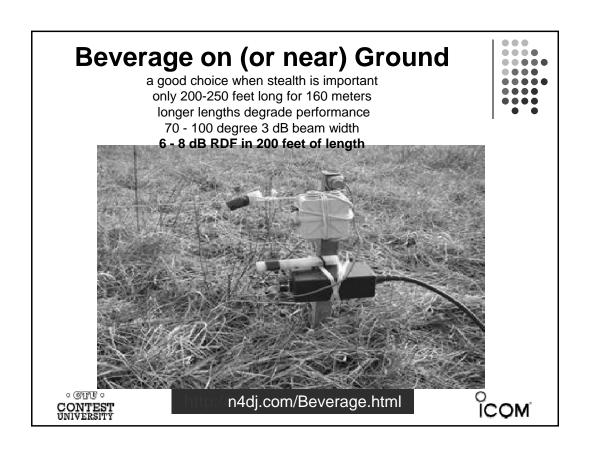
- Two K9AY loops
  - · switchable in four directions
  - footprint is only 25x25 feet and 25 feet tall
  - 120 degree 3 dB beam width
  - 7 dB RDF
- Shared Apex Loop Array
  - switchable in eight directions
  - footprint is only 50x50 feet and 25 feet tall
  - 75 degree 3 dB beam width
  - 8 dB RDF
- Loops produce very low signal levels
  - · a high gain, low noise preamplifier must be used
  - careful attention to stray signal pickup
    - decouple the coaxial feed line shield, control cable and DC power cable
    - · bury cables about 12 inches deep for best null depth
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

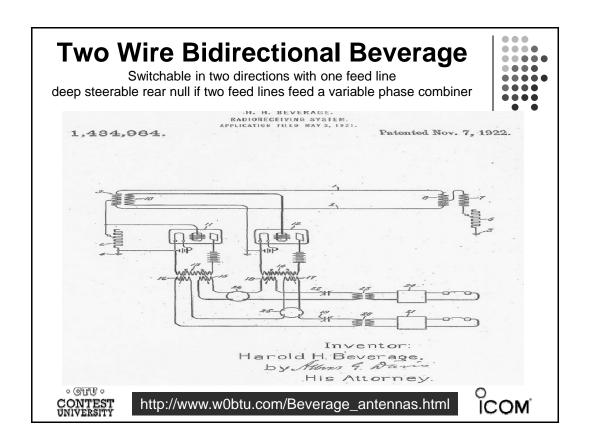


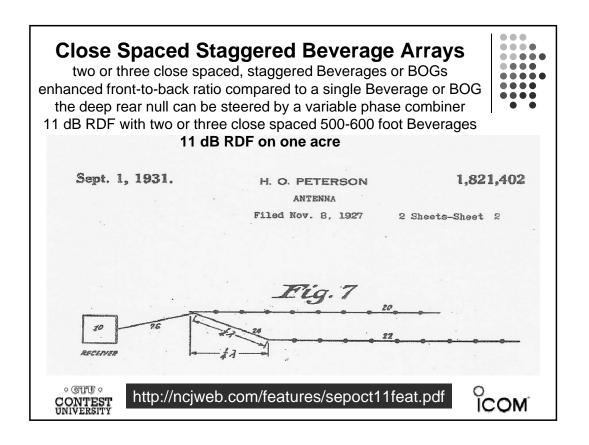


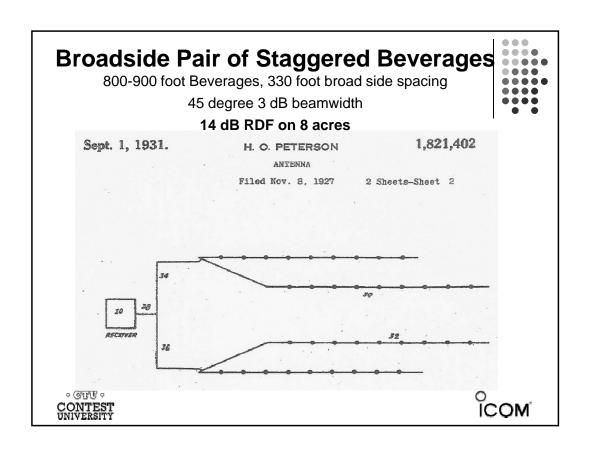












#### **Phased High Impedance Verticals**

#### Two or More 20 Foot Verticals

- No radials
- No umbrella wires
- Dual band operation with compromise 65 foot element spacing
- 80 foot element spacing for better 160 meter performance
  - even closer spacing is possible by using a variable phase combiner
- High input impedance amplifier at the feed point of each vertical
  - stray capacitance at the base of each vertical and at the input to each amplifier must be as low as possible
- Switchable in multiple directions
- Verticals cannot be installed within ten feet of nearby objects
  - trees or any conductive or partially conductive structure
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines



http://www.hizantennas.com



#### **Electrically Steerable 4-Square Vertical Array**

four <u>high impedance</u> 20 foot verticals
no umbrella wires and no radials
80x80 foot square x 20 foot high footprint
high input impedance amplifier at the base of each vertical
switchable in four directions
100 degree 3 dB beam width



12 dB RDF on less than 1/4 acre



http://www.dxengineering.com/parts/hiz-4-lv2-80

ĬCQMÎ

#### **Electrically Steerable 8-Circle Vertical Array**

eight high impedance 20 foot verticals no umbrella wires and no radials requires a high input impedance amplifier at the base of each vertical 200 foot diameter array with 106 degree phasing switchable in eight directions 50 degree 3 dB beam width, the performance of a 5 element Yagi



13.5 dB RDF on 34 acre



http://www.hizantennas.com/8\_element\_arrays.htm



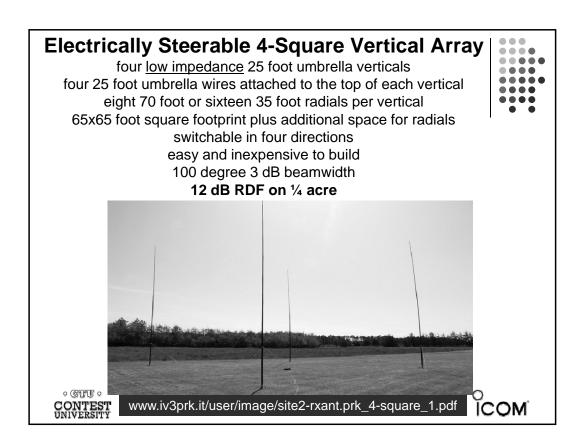
#### **Phased Low Impedance Verticals**

#### Two or More 25 Foot Umbrella Verticals

- Radials are required at the base of each vertical
  - eight 70 foot radials, sixteen 35 foot radials or chicken wire
  - randomly laid on the ground or shallow buried, symmetry is not important
- Four 25 foot umbrella wires attached to the top of each vertical
  - reduces the height and improves array bandwidth
  - or use 35 foot verticals with no umbrella wires.
- As little a 65 foot element spacing
  - its difficult to achieve good performance with smaller spacing
- Amplifiers are not needed at the base of each vertical
- Switchable in multiple directions
- Easy to homebrew your own antenna
  - large arrays are very tolerant of moderate amplitude and phase errors
- Low impedance verticals are tolerant of nearby objects
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines @TU •









# Receive Antenna Variable Phasing Controller DX Engineering NCC-1



#### Combines the inputs from two antennas

- creates a directional pattern with deep steerable nulls
- optimizes the performance of phased Beverages and phased verticals
- · very well engineered and very easy to use



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http://www.dxengineering.com/parts/dxe-ncc-1





# 

# Ten ways to improve your contest score



- 10. New radio
- 9. Amplifier
- 8. New antennas
- 7. Move
- 6. Second radio
- 5. Join a club
- 4. Go to a multiop
- 3. Use the Cluster
- 2. Go to Dayton/CTU
- 1. THE BIG SECRET

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# First cluster of improvements



- Tangible improvements
  - 10. New radio
  - 9. Amplifier
  - 8. New/better/more antennas
  - 7. New QTH
- All of these are ways to increase your score, but maybe not the way you think





#### 10. New Radio



- IMHO, this is the least useful improvement
- Most \$1000+ radios from the past 10 years provide adequate performance and features
  - IMD DR >70 dB SSB, >80dB CW sufficient (NCØB)
- Benefits of a new radio
  - It gets you more interested & on the air more
  - You enjoy it more & get on the air more



# 9. Amplifier 8. Antennas 7. QTH



- All are ways to "add dB"
- How much is 1 dB worth in score?
- How much does a dB cost?
  - Amplifier dB
  - Antenna dB
  - QTH dB
- If the goal is increasing score, where do you spend the money?

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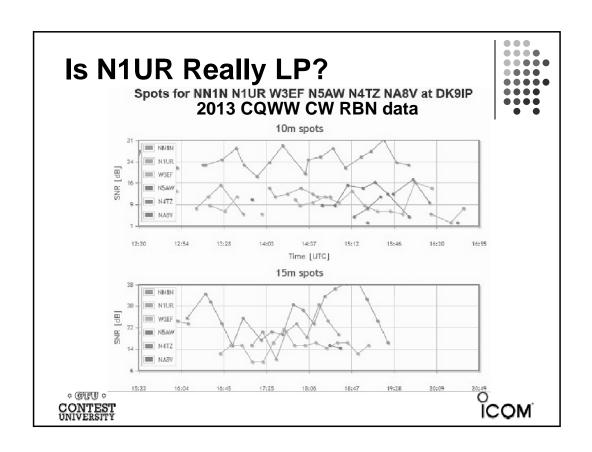
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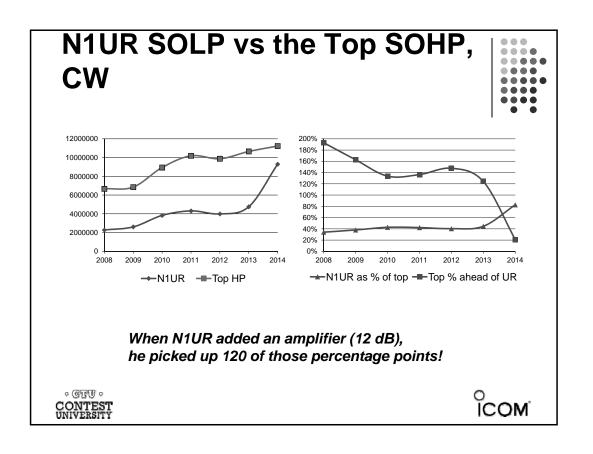
#### Score increase vs. dB

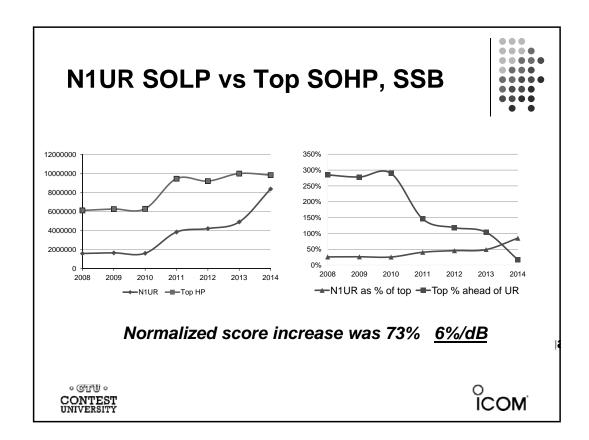


- Prior to 2014, N1UR always operated LP
- Good antennas, hillside W1 QTH
- Switched to HP in 2014
- Did it help his score?









# Does it hold for other LP-HP comparisons?



- Compared Top 5 QRP, LP vs top 5 HP
- Calculate % score increase vs. dB
  - For CW, ~12% per dB (range: 10.3-15.1)
  - For SSB, ~15% per dB (range: 11.3-17.7)
- May be closer to the 6%/dB figure, since many LP stations have lesser antennas than HP



#### From QRP to LP to HP...



- No RBN data (QRP guys don't call CQ!)
  - 5 spots total in DL for top 5 QRPs, all bands)
- HP scores typically 1000% (CW) to 1500% (SSB) higher than QRP
- 1500W is ~25dB above 5W
- Most QRP guys do not have big antennas...another 10dB of QRPness maybe?
- If linear, 30%(CW) to 40%(SSB) per dB increase



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## 9. Add an amplifier (LP guys only)



- Cost:
  - Used SB220 \$500
  - \$10k for auto-everything
  - Use \$2500
- 100W to 1500W is 11.6 dB
  - Cost per dB: \$200 (only \$43 with SB220)
- Score improvement should be ~80%; \$31 /%
- KPA500 vs. 1500W: 4.77 dB; ~30% score increase



#### For HP entrants...



- More than 1500 W is against the rules
- Adding 10 dB is very expensive...
  - Tubes >\$1000
  - Electrical service to the shack is expensive
  - Coax, connectors, filters... all get complicated
  - Damage to reputation
- Don't do it!





#### 8. Antennas



- A very mixed bag of bang-for-buck
  - Gain is expensive after a while
    - ¼-wave vertical: 1.77 dBi FS, 5.15 dBi over perfect ground,
       0 dBi over average ground
    - 40M dipole used on 15M: 2.8 dBi
    - 80M dipole used on 15M: 4.7 dBi
    - 3 element 15M beam: 7.44 dBi, \$500, 2.7m boom, 12 lb
    - 4 el: 9.01 dBi \$750, 5.4 m, 20 lb
    - 5 el: 9.1 dBi \$900, 6.2m, 25 lb
    - 5 el: long boom 10.1 dBi \$1050, 8.5m, 28 lb
    - 6 el: 10.9 dB \$1500, 11.3m, 51 lb
    - 7 el: 12 dBi \$2300, 17.6m, 78 lb



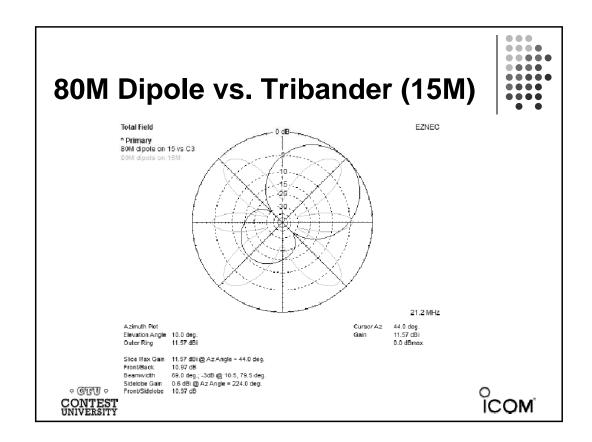


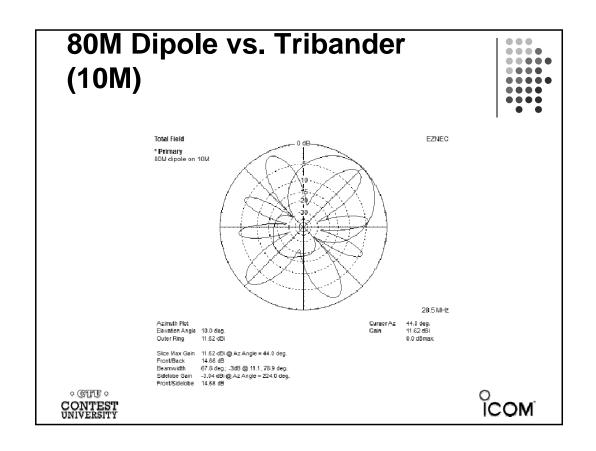
## The K1AR Story

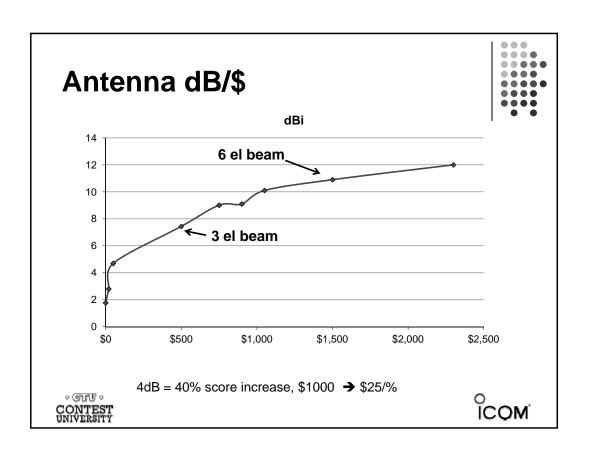


- Excellent scores with "just a dipole"
- AR is one of the best operators ever
- NH QTH
- 1500W output









# If you already have a beam...



- Assume starting point of 40-foot tower with 3element tribander
- Move to 80-foot tower, stack two 4-element beams
- Cost, comparison of patterns, gain





## Low band improvements are hard



- 40M
  - Start with inverted Vee at 60 feet
    - (1.6 dBi FS, 6 dB over real ground but very high angle)
  - Move to 2-el shorty beam at 60 feet
    - (\$1000 + rotator, gives 5-6 dBi gain in FS, 9-10 over real ground)
  - 4 dB for \$1000 = \$250/dB; 25% increase in score
    - · Probably much better due to lower angles
  - Vertical or sloper array
- 80M/160M
  - Start with inverted Vee at 60 feet
  - Consider half-sloper or vertical array
    - Verticals need lots of radials
    - Arrays need phasing boxes, build or buy
  - Adding a Beverage to receive better is <\$50</li>



#### Feedline improvement



- Assume a tribander at 60 feet, 140 feet from the shack, fed with RG8X
  - Loss of 200' of RG8X on 10M: 4 dB
  - Replace with 200' LMR400, loss: 1.6 dB
    - Gain 2.4 dB for \$180 = \$75/dB
    - Equivalent to raising power by 1.7x AND helps on receive
    - 24% score increase
  - Replace with surplus 3/4" CATV line, loss of 0.4 dB
  - Gain 3.6 dB for \$?
  - Equal to raising power by 2.2x OR...





#### Getting 3.6 dB additional gain on 10M



- 3-el 10M yagi: 7 ft boom, \$300, 7.5 dBi
- 6-el 10M yagi: 28 ft boom, \$1000, 11.1 dBi
- Spend \$180 (or scrounge) better coax or spend \$700 on a bigger beam
- If you already have a 6-element yagi, the next
   3 dB will cost a lot more!





#### 7. Move



- Complicated and expensive
- Can be effective
- Hilltop or oceanfront vs valley
- W1 vs. Black Hole
  - (NM/WTX/KP4 vs W1 for SS)



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#### 7a. "Virtual Move"



- Remote station
- This is now practical
- RHR, others...
- Roll your own



#### 6. Add a Second Radio



- "Don't try SO2R until you are really good at SO1R...please!" - K5ZD
- "SO2R station construction is harder than Multi-Multi" - KL7RA
- Adding a second radio only adds ~10% to a DX contest QSO total, maybe 20-30% to score
- It allows you to know what is happening on the other bands

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#### 5. Join a Club



- Chose the right club...or start one!
- Learn from the other guys
- Exchange rate sheets
- "Do for others and let others do for you"
   B. Dylan





# 4. Go to a Multiop



- Most multiops are well-equipped
- See what it is like to use the "Big Iron"
- See how other ops play the game
- Learn some best practices in station design and construction





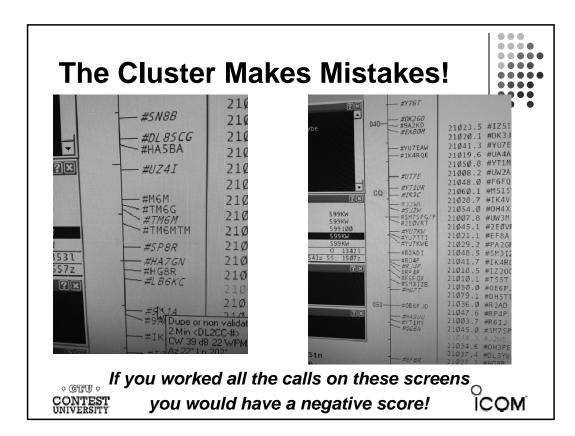
# 3. Use the Cluster (sigh)



- It will add 20-30% to your score...BUT...
- You will not learn anything if the Cluster does the work for you
- Don't let the Cluster distract you
- Don't believe all the spots...it can make your score go DOWN







# 2. Go to Dayton (and CTU)



- Meet people
- Learn from the pros
- Ask questions
- Pay attention





# AND THE NUMBER ONE WAY TO IMPROVE YOUR CONTEST SCORE...

>>>> THE BIG SECRET <<<<

○ ©TU ○ CONTEST UNIVERSITY



#### 1. There is no secret!



- Get on the air a lot
- Learn the bands and your station capability
- Practice calling in pileups to hone your timing
- LISTEN!
- Run any time you can...get familiar with callsigns (improve your "vocabulary")



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# The Big Myth



- "I yam what I yam, and that's all what I yam"
  - Popeye the Sailor
- "Can't run, can't jump."
  - scouting report on Larry Bird
- "Can't sing. Can't act. Balding. Can dance a little."
  - RKO screen test of Fred Astaire



## "Outliers" (Malcolm Gladwell book)



- Cites Ericssons' "10,000 hour rule"
  - Beatles (1200 live performances in Hamburg 1960-64),
  - Bill Gates (had access to a computer at age 13)
- 10,000 hours of "deliberate practice" required for mastery
  - "Deliberate practice is not always enjoyable"
- The top contest operators don't have bigger or more sensitive ears, springier fingers, ...





# How did the top operators get there?



 "Giftedness researchers have long debated whether there is empirical evidence to support a distinction between giftedness and attained level of achievement. With the exception of fixed genetic factors determining body size and height, we were unable to find evidence for innate constraints to the attainment of elite achievement for healthy individuals."

K. A. Ericsson et al, "Giftedness and evidence for reproducibly superior performance: an account based on the expert performance framework", *High Ability Studies Vol. 18, No. 1, June 2007, pp. 3–56,* 





# Two more factors, from recent research



- Starting young
  - All other factors being equal, those who started younger were higher achievers <u>at the elite level</u>
  - Probably related to development of working memory capacity, the ability to remember a set of objects while engaged in another task
- "Grit"
  - The unique blend of IQ and EI that results in persistence
  - "The desire and passion to get better drives the willingness to spend so many hours practicing a skill."





#### However...



- The 10,000 hour rule applies to the Worldclass top performers
- You can get "pretty good" in 20 hours
- Josh Kaufman's rules for learning:
  - 1. Deconstruct the skill into smaller parts
  - 2. Learn enough to self-correct
  - 3. Remove barriers to practice
  - 4. Put in the full 20 hours...overcome the initial frustration barrier





#### Contesting is a personal endeavor



- Some do it to compete
  - Build station
  - Improve station
  - Operate a lot
- Some do it just for fun
  - Part-time operation
  - Pick up new countries, etc.
  - Take what they can get





## Some do it for both



- Most games are more fun when you develop a high level of skill
- Whatever your goal, have fun!





# Strategies on Improving your USA Contest Scores

Randy Thompson, K5ZD



• **CTU** •



# **Domestic Contests (USA / VE)**



- ARRL Sweepstakes
  - The biggest domestic contest.
  - Big emphasis on receiving accuracy.
  - Fast rates first day walking in mud the second (unless you are in KP4/KP2/VY1).
- NAQP
  - Great two radio event.
  - Uses all six bands multipliers by band.
  - Fast rates!!
- NA Sprint
  - QSY rule makes this a great challenge for the operator.
  - Lots of competition in low power and QRP categories.
- Other QSO Parties
  - Typically very sparse competition.
  - Good rates can be made just running guys who tune across you.
  - Should not be "advertised" as a contest.





# Why are domestic contests different?



- Easier propagation.
- Often lower antennas work better.
- Only one or two directions typically needed for good results.
- In some cases more reliance on working the non-contester (primarily on SSB).
- Exchange "quality" enables almost complete log checking.





# **Basic Strategies for Score Improvement**



- Get Louder
- Hear Better
- Antenna Flexibility
- Logging Accuracy
- Maximizing Rate
- Touchy Feely Stuff





#### **Get Louder**



- Understand how your location interacts with your antenna
  - Domestic contests are not typically low angle
  - Sharper beam patterns not always needed

 Do you need to point east and west at the same time?

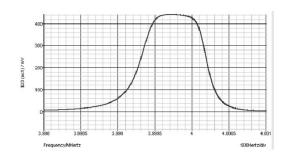


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#### **Hear Better**



- New receivers are really good at reducing QRM and QRN.
- Is your code speed holding you back?
- Are you listening to too narrow of a bandwidth?
  - Do you hear people calling you off frequency?



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#### **Antenna Flexibility**



- Can you quickly locate a signal and select the best receiving antenna for it quickly?
- Can you optimize your transmitted signal for busting through pileups.
- Can you change your antennas pattern based upon conditions (time of day or propagation).







## **Logging Accuracy**



- If your error rate is over 1 percent you can improve your score simply by making fewer mistakes.
  - Get copies of your log check reports look for areas of focus to improve accuracy.
  - Compare your reports against audio recordings.
  - Stay in the moment most people have found that using a database of exchanges actually hurts their accuracy. Copy what was sent instead.
- However, don't over-do it you do not want to be asking for un-necessary repeats. You should build confidence in your ability to get it right the first time.
  - Operating a lot between contests helps your ear stay in shape. Spend time on "weak signal" bands.





#### **Maximizing Rate**



- On SSB
  - You are giving a performance that is trying to suck in non-contesters
  - Make sure your audio is pleasant to listen to.
    - Don't be that guy with a CQ that sounds totally different than the live operator.
  - Imagine an SWL working on his Heathkit and you need to entice him to put in the effort to find a footswitch and call you.
  - Avoid repeating received exchanges and other un-necessary words.
- On CW
  - Make sure your CW is pleasant to listen to.
  - Code speed should change based upon your rate.
  - Minimize the "pregnant pause" the time between when you get an answer and when you come back.
  - QSK can improve efficiency but also might make you more tired.
- Diversity reception can eliminate one letter drop-outs from QSB.
  - It can also help you identify location of a signal quickly.





## The ARRL Sweepstakes



- Logging accuracy is a big factor
- On CW a second radio has a big impact.
  - An SB-101 & trap vertical can work most CQers.
  - Many stations work > 100 QSOs on their 2<sup>nd</sup> rig.
- Clean sweep is nice but don't sacrifice rate.
- Off time strategy is important
- Focus on your best two bands





# **Sprint (mostly CW)**



- Strategy depends on your ability to win "jump balls".
  - If you own the band find guys to work and get "doublets" on each frequency.
  - If you are weak calling CQ a lot might be more effective.
- Code speed is important
  - Many stations sending 35+ WPM
- Need to be effective on three bands
- Advanced two radio techniques are used by most top-ten, high-power entrants.
  - · Call CQ while tuning on another band
  - Call CQ while receiving exchange from a CQ solicited QSO on another band.
- SSB Sprint is a contest in flux.





#### **NAQP**



- If you are in a rare state you can have a decent score just running guys.
- Two radio techniques really work well on CW.
- Move multipliers!!
- When the rate gets slow changes bands.
- Be careful not to miss a 10 meter opening.



# Other points



- Are you having fun?
- Are you setting firm goals?
- Do you over-plan?
- Do you have a good off time strategy?
  - Can it adapt to the unexpected?
- Are you able to "see" band openings
- Do you operate too many contests (AA3B does not need to answer this question).



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# **Summary**



- Domestic contests offer opportunities to have pretty competitive scores with modest stations and fixed directional antennas.
- NAQP with low power further enables two radio operation that would be challenging at high power levels for most city lots.
- Get on and have fun!!



# Thanks for your time



See you in the next contest!!







# CTU 2015 Presents 2015 RTTY Contesting Essentials Ed Muns, WOYK CONTEST CONTEST

## RTTY Contesting *Technology Topics*



- Transmitting AFSK vs. FSK
  - Which is "best"?
  - Bandwidth
  - FSK creation and inaccuracies
- Receiving Decoders
  - IF bandwidth
  - Multiple decoders
- Interfaces
  - Homebrew
  - Commercial

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#### RTTY vs. CW/SSB

Key Difference



#### Signal encoding/decoding:

- By technology vs.
- By human brain

Kinda' like Assisted vs. Unassisted!

(Accordingly, what does the "Assisted RTTY" operator really DO?!)

3/94



#### RTTY vs. CW/SSB

Key Difference



**Technology exploitation** replaces **operating skill** in encoding/decoding the RTTY signal.

- The 2 cornerstones of ham radio!
- RTTY technology is very important.

4/94

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#### What is RTTY?

#### compared to CW



#### **CW**

- One RF carrier
- Local audio *pitch*
- On *or* off
  - key up is data 0
  - key down is data 1
- Morse code
  - typically 25-40 wpm

#### RTTY

- Two RF carriers 170 Hz apart (Space & Mark; Shift)
- Local audio tones
- One on and other off
  - Space is data 0
  - Mark is data 1
- Baudot code
  - constant 60 wpm (or 45.45 Baud)

COM

#### RTTY Transmission

AFSK vs. FSK



Two methods of transmission:

- AFSK (Audio Frequency Shift Keying)
  - keyed audio tones into SSB transmitter via:

5/94

- Mic input, or
- Auxiliary audio input. e.g., Line In
- FSK (Frequency Shift Keying)
  - keys the transmitter just like CW

Note: Receiving is the same in either case.

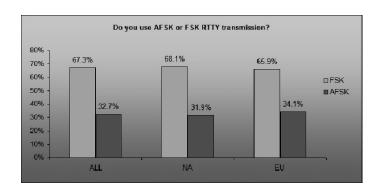




#### AFSK vs. FSK

#### 2010 survey





 AFSK has been overtaken by FSK since it first appeared in radios, circa 1990

7/94



#### AFSK vs. FSK

#### comparison



#### **AFSK**

- Indirect (tones → Mic input)
- Any SSB radio (esp. legacy)
- SSB (wide) filtering
- Dial = sup. car. frequency
- VOX
- Audio cable (same as PSK31)
- Should use high tones
- NET (automatic TX tone control for S&P)

Easy set-up; better signal; NET

Less bandwidth

#### **FSK**

- Direct (like CW keying)
- "Modern" radios
- RTTY (narrow) filtering
- Dial = Mark frequency
- PTT
- FSK keying hardware
- Can use low tones
- No audio level adjust
- No disabling speech proc.
- No erroneous sound keying

Less pitfalls

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#### AFSK vs. FSK

#### dial frequency spots are often wrong!



RTTY RF is independent of local audio tones and

whether LSB or USB is used:

• The higher RF frequency is the Mark (14090.000 kHz)

- The lower RF frequency is the Space (14089.830 kHz)
- The difference between the two is the shift (170 Hz)
- FSK displays Mark (14090.000 kHz)
- AFSK displays suppressed carrier which varies with local audio tones and sideband used!
  - For Mark tone of 2125 Hz (Space tone of 2295 Hz):
    - LSB (14092.125 kHz)
    - USB Mark & Space tones reversed (14087.005 kHz)



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#### AFSK vs. FSK

#### which is "best"?





- "AFSK often has poor signal quality, causing heavy QRM."
- "FSK often has unnecessarily wide bandwidth, creating heavy QRM."
- "AFSK is simpler."
- "FSK is simpler."





#### AFSK vs. FSK

#### which is "best"?





#### Two challenges:

- Transmission bandwidth, and
- Bit timing



11/94



#### **RTTY Transmit Bandwidth**



#### **AFSK**

- Use radio FSK fixer
  - DSP TX filter (K3)
  - Lobby other mfrs
- Use MODEM TX filter
  - MMTTY 512-tap, not 48tap default
  - 2Tone default
- Properly adjust
  - Level
  - Compression disabled

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#### FSK

- Use radio FSK filter
  - DSP TX filter (K3)
  - Lobby other mfrs
- Otherwise, use AFSK

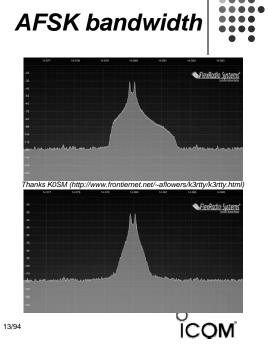
#### **MMTTY - AFSK**

- No TX filter
- K3 @ 1 mW

#### MMTTY - AFSK

- Default 48-tap TX BPF
- K3 @ 1 mW

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#### **RTTY Radios**

#### **MMTTY - AFSK**

- Default 48-tap TX BPF
- K3 @ 1 mW

#### MMTTY - AFSK

- 512-tap TX BPF
- K3 @ 1 mW

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## Thanks KOSM (http://www.frontiernet.net/--aflowers/k3rtty/k3rtty.html)

#### **MMTTY - AFSK**

- 512-tap TX BPF
- K3 @ 1 mW

#### 2Tone - AFSK

- Default "AM" setting
- K3 @ 1 mW

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## Thanks KOSM (http://www.frontiernet.net/-allowers/k3rtty/k3rtty.html)

## RTTY Radios PA IMD impact on AFSK bandwidth

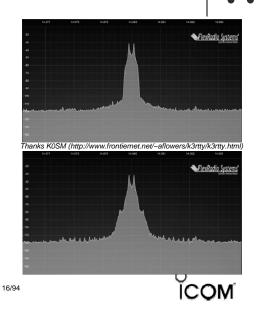
#### MMTTY - AFSK

- 512-tap TX BPF
- K3 @ 1 mW

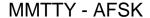
#### **MMTTY - AFSK**

- 512-tap TX BPF
- K3 @ 100 watts

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PA IMD impact on AFSK bandwidth

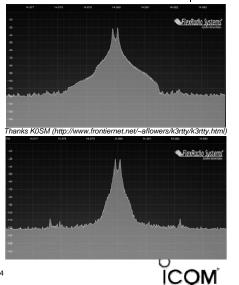


- No MMTTY filter
- No K3 AFSK filter
- K3 @ 100 watts

#### MMTTY - AFSK

- No MMTTY filter
- K3 AFSK filter
- K3 @ 100 watts • **FT** •

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#### **RTTY Radios**

PA IMD impact on AFSK bandwidth



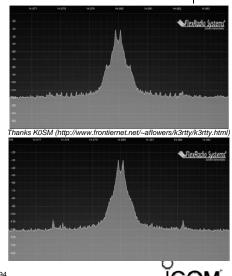
#### MMTTY - AFSK

- 512-tap TX BPF
- No K3 AFSK filter
- K3 @ 100 watts

#### MMTTY - AFSK

- No MMTTY filter
- K3 AFSK filter
- K3 @ 100 watts o CTTO o

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#### PA IMD impact on RTTY bandwidth

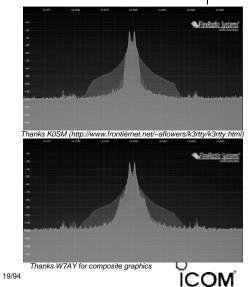


#### FSK/MMTTY/2Tone

- FSK unfiltered
- MMTTY 512-tap BPF
- 2Tone "AM" setting
- K3 @ 1 mW

#### FSK/MMTTY/2Tone

- Same encoders
- K3 @ 100 watts



#### **RTTY Radios**

#### Old K3 FSK bandwidth

- No waveshaping
- < DSP281 firmware
- Typical of all radios
- 50 watts

#### New K3 FSK bandwidth

- Optimal DSP filter
- DSP281+ firmware
- Lobby other mfrs to add a FSK filter!

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## Thanks KOSM (http://www.frontiernet.net/-aflowers/k3beta/)

## AFSK Signal Quality Operator Skill & Attention



- Speech compressor disabled
- Audio drive level below clipping
- RF amplifier drive level below hard limiting
  - Including change of operating frequency
- Elimination of ground loop hum
- Muting of Windows sounds

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#### **FSK Bit Timing**

#### PC vs. dedicated timing



#### PC

- Stop Bit "jitter"
  - Varying Stop Bit length
  - Not nominal Stop Bit length
  - Not 45 vs. 45.45 Baud
- PC CPU speed vs. application demand
  - Quad-core, > 2 GHz
- USB loading
  - Minimize other USB
- System clock inaccuracy
  - Motherboard UART

#### **Dedicated**

- Bit timing outside PC
- TinyFSK
  - N1MM only
- rpiFSK
  - N1MM, WriteLog, WinWarbler, others



#### **RTTY Decoders**

#### typically bundled with an encoder



- MMTTY
- 2Tone
- Other software: MMVARI, Fldigi, MixW, etc.
- Hardware TNCs:
  - Hal DXP38
  - Timewave PK-232
  - Kantronics KAM

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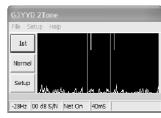
23/94

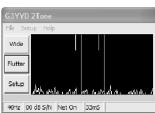


#### **RTTY Decoders**

#### 2Tone







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- Outperforms MMTTY
- Uses less CPU cycles
- AFSK only
- Pseudo FSK
- Contest loggers:
  - N1MM Logger
  - WriteLog
- Introduced late 2012
- David Wicks, G3YYD





or "Modem"













25/94



#### **Logger Support**



- WriteLog
  - MMTTY, MMVARI, 2Tone
  - PCI-3000/4000, DSP-4100/DXP-38, P-38, PK-232, KAM, STS, KT4FY MM, dumb terminal
- N1MM Logger
  - MMTTY, MMVARI, 2Tone, Fldigi
  - DXP38
- Win-Test
  - MMTTY

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#### Logger support

#### MMTTY & 2Tone



Feature	MM	TTY	2Tc	one	
reature	AFSK	FSK	AFSK	FSK	
WriteLog	•	•	<b>(1)</b>	•	
N1MM Logger	•	•	•	•	
Win-Test	•	•	8	8	

NET on

not available

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#### **IF Bandwidth** optimal decoding Narrow IF filters (Roofing & DSP) • 400-500 Hz - normal • 250 Hz - "may help" with strong QRM Tone filters – don't use! Icom Twin Peak Filter K3 Dual-Tone Filter Audio filtering • JPS NIR-10/12 Timewave DSP-599zx Modern DSP rigs · CTTO · ICOM CONTEST 28/94

#### **RTTY Decoders**

#### choice of Tones



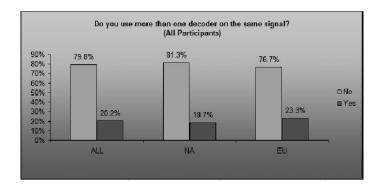
- Less fatiguing
- Low/High tones can be mixed to put two audio streams in one ear:
  - SO2R plus SO2V per radio
  - SOnR

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## Multiple RTTY Decoders 2010 survey





• 20% use multiple decoders

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#### **Multiple RTTY Decoders**

Why?



- Diversity of decoding algorithms
  - The more diversity, the closer to human brain
- Higher probability of clear print
  - All decoders equal 95% of the time
  - 1% of the time, only one will print clearly
  - Each of the them is the "winner" at some time
- Less wasted time asking for repeats
- Zero cost



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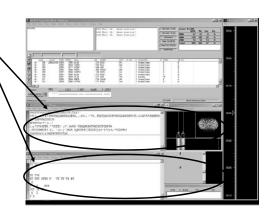
## Multiple RTTY Decoders MMTTY & DXP38-WriteLog

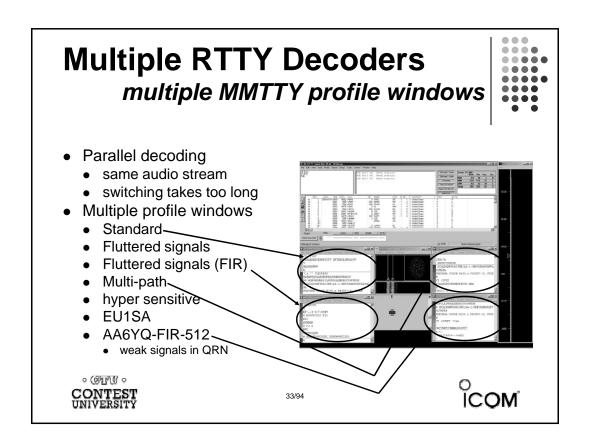


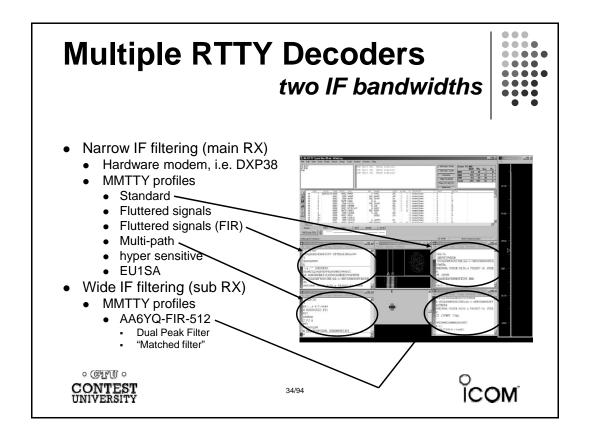
- Parallel decoding
  - Software, e.g., MMTTY
  - Hardware, e.g., DXP38
- Diverse conditions
  - Flutter
  - Multi-path
  - QRM, QRN
  - Weak signals
  - Off-frequency stations

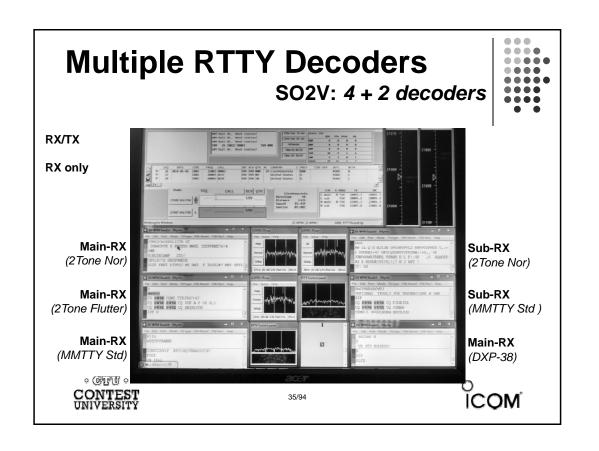


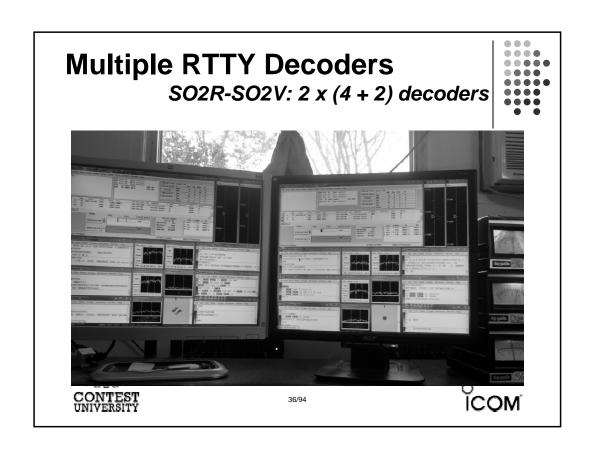












#### **Interfaces**

#### AFSK & FSK keying



#### **AFSK**

- Standard audio cable
  - 3.5mm (SC) to ?? (radio)
- Optionally
  - Isolation transformer
  - 40 dB pad, if Mic input
  - Level control

#### **FSK**

- FSK/PTT keying cable
  - Homebrew
  - Commercial
- Optionally
  - USB-Serial adapter
    - Edgeport/4 or /8
    - "some" consumer units



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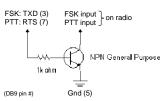
#### Homebrew FSK/PTT cable



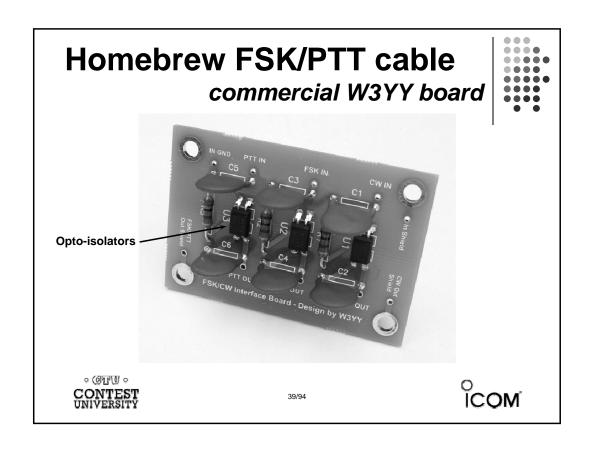


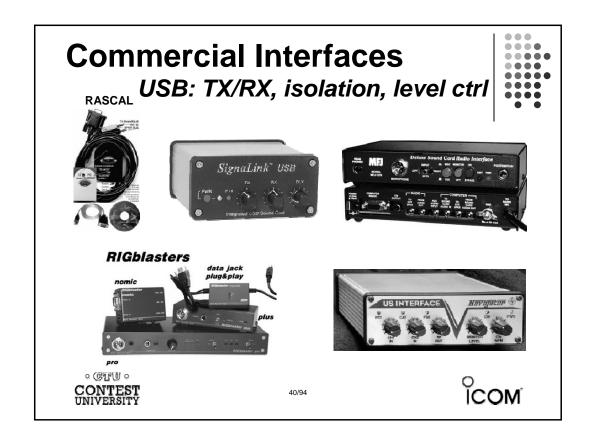
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## Commercial Interfaces comparative choices

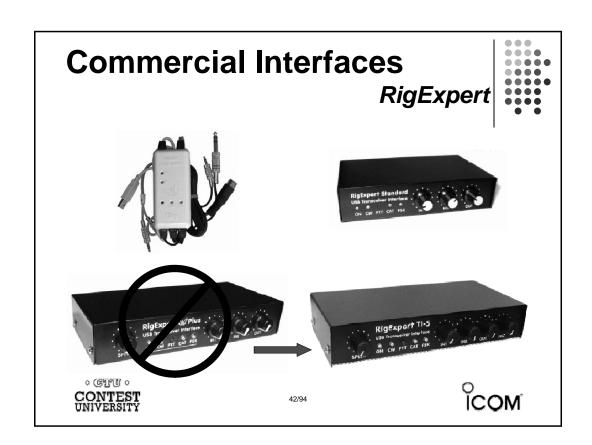


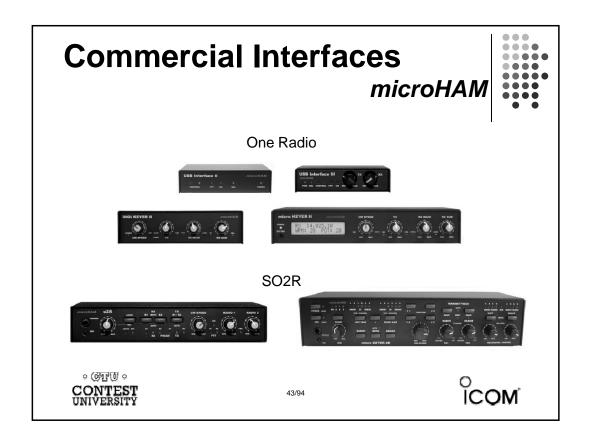
Vendor	Model	Price	PC In'fo	PTT	Soundcard	Level atri	FSK	·CW	WinKey	Voice	Radio in fo
generic (with K3)	(2) 3.5mm M-M audio cables	\$ 10	-			1					
Buxcomm	Rascal-IIB or -IIIA	\$ 69									
Buxcomm	Rascal GLX	\$ 79	Serial	V						1 3	
Tigertronics	SL-1+	\$ 80	-	auto							
Tigertronics	USB	\$ 110	USB	auto	٧	V					
MFJ	1273B	\$ 60	Serial	V							
MFJ	1275	\$ 110	Serial	V							
MFJ	1279	\$ 140	Serial	V	V						
Mountain Radio	RIGblaster Nomic	\$ 60	Serial/USB	V		) I		100			
Mountain Radio	RIGblaster Plug & Play	\$ 120	USB	V				V			some
Mountain Radio	RIGblaster Plus II	\$ 160	USB	V	200	3000	v or CW	√or FSK			some
Mountain Radio	RIGblaster Advantage	\$ 200	USB	V	4	1	√ or CW	√or FSK			V
Mountain Radio	RIGblaster Pro	\$ 300	Serial/USB	V			4	4			V
Navigator	Navigator	\$ 417	USB	V	4	V	1	V	V		V

See May-June 2012 NCJ, "RTTY Contesting" column

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## Commercial Interfaces RigExpert & microHAM comparison



Vendor	Model	Price	PC In fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fe	S02F
RigExpert	Tiny	\$120	USB	٧	- √	4		4		N	√	
RigExpert	Standard	\$265	USB	٧	√	V	V	V	√	V	√	
RigExpert	TI-5	\$365	USB	V	√	√	V	V	√	V	√	
microHAM	USB Interface II	\$179	USB	V		i		√	i	i	- √	
microHAM	USB Interface III	\$225	USB	V	√	V		V			√	
microHAM	Digi KEYER II	\$369	USB	V	√	√	N	√	√		. √	
microHAM	microKEYER II	\$479	USB	V	√	√	N	1	√	N	√	
microHAM	micro2R	\$ 369	USB	V		√	V	√	√	V	√	√
microHAM	MK2R	\$899	USB	V		V	٧	√	√	N	√	√
microHAM	MK2R+	\$ 999	USB	V	√	V	Ŋ	7	V	V	√	V

See May-June 2012 NCJ, "RTTY Contesting" column

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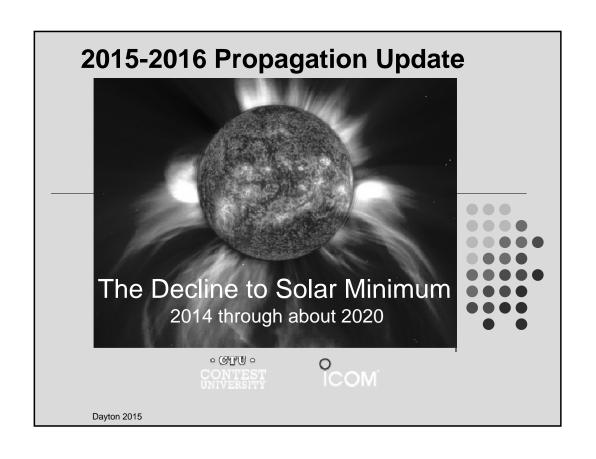
#### Resources

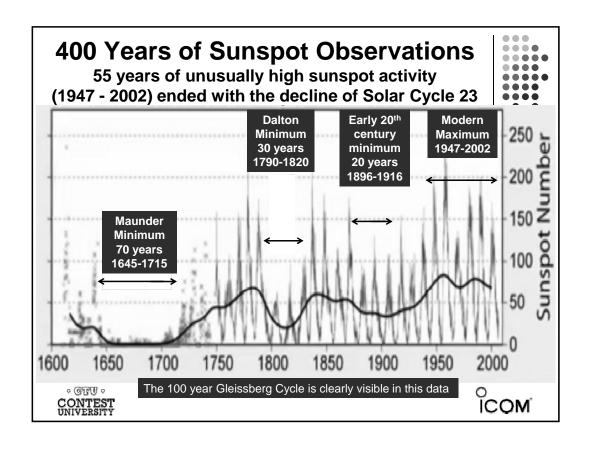


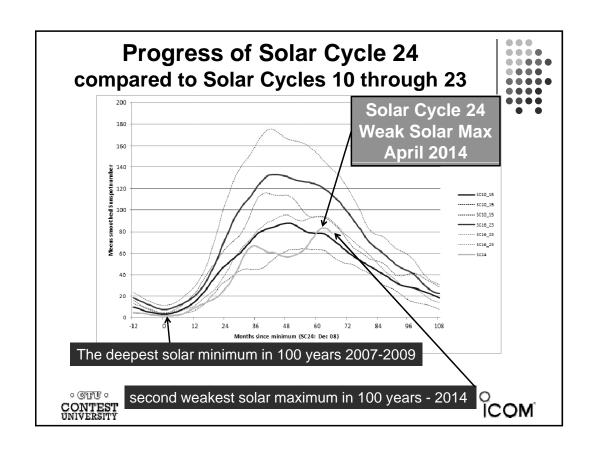
- NCJ RTTY Contesting columns
  - Decoding: Jul/Aug 2013 and Jan/Feb 2014
  - Commercial RTTY interfaces: May/Jun 2012
- Prior CTU RTTY presentations
  - 2014 CTU textbook from DXE (\$19.95)
- AA5AU website: www.rttycontesting.com
  - Tutorials and resources (beginner to expert)
  - WriteLog/N1MM Logger and MMTTY/2Tone
- Email reflector: <a href="mailto:rtty@contesting.com">rtty@contesting.com</a>
  - RTTY contester networking
  - Q&A ∘ @₽₩ ∘

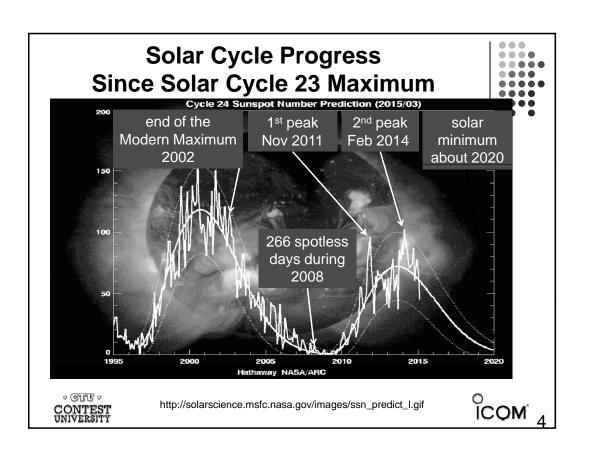
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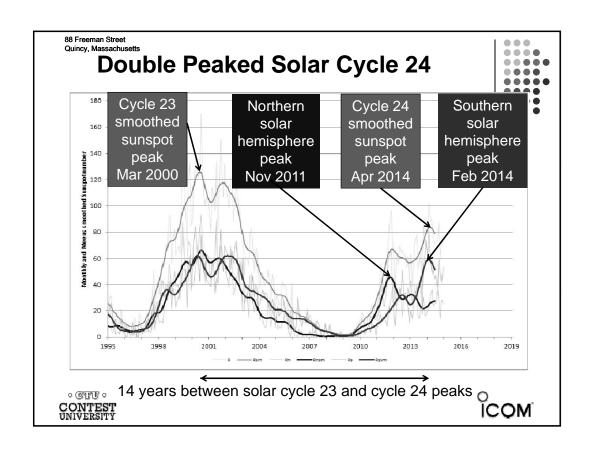


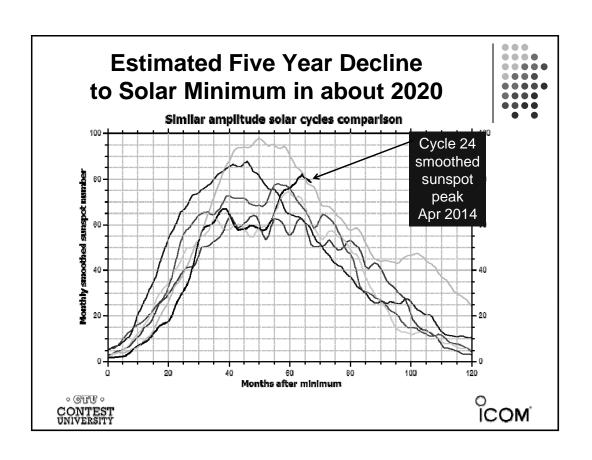


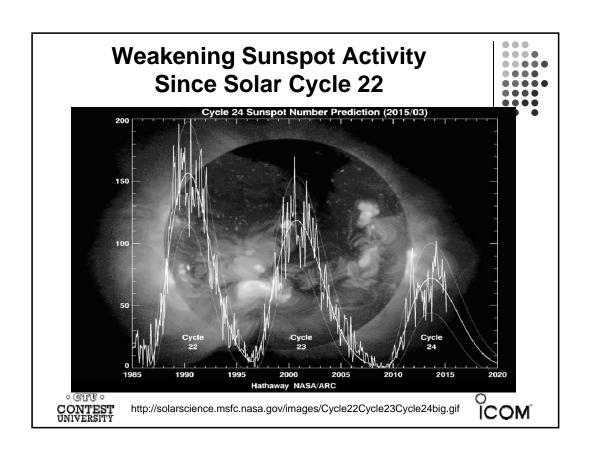


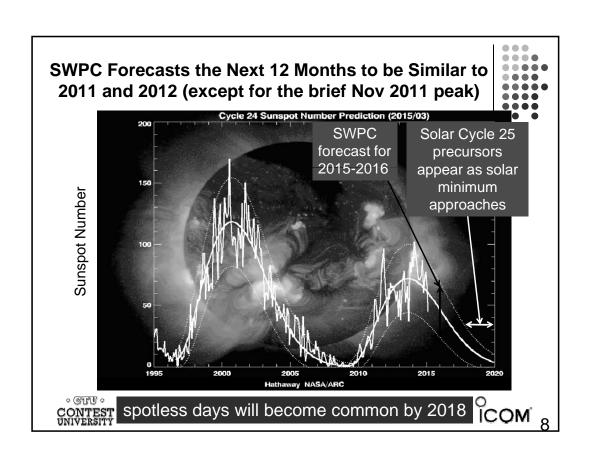












#### **Forecasting Solar Cycle 25**





- Weaker than normal solar polar magnetic fields as they near peak intensity from 2018 through 2020
  - as reported by the Wilcox Solar Observatory
- Unusually large numbers of spotless days
- Quieter than normal geomagnetic field from 2018 through 2020
  - reported by the A-index
- Failure of the first Solar Cycle 25 sunspots to appear by 2020
- Solar minimum extending beyond 2020



An accurate forecast is not possible until two or three years *after* solar minimum



A Long Range Estimate of Solar Cycle 25 could sunspots nearly disappear by 2025?

Modern Maximum 1947 - 2002

19

1790 - 1835
Dalton Minimum 7

191
1799 some solar scientists expect Cycle 25 to be the weakest solar cycle (SSN=7) in more than 300 years

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http://www.landscheidt.info/?q=node/280

#### Enhancing Contest Station Audio Bob Heil, K9EID





## AMATEUR RADIO HAD NO DEDICATED MICROPHONE



- We only had microphones designed for public address or home recording.
- We were trying to cut pileups and noise with flat response, mushy sounding microphones



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#### **TYPES of MICROPHONES**



**Dynamic** 

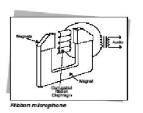


Condenser

Condenser

Ribbon





Dynamic

Ribbon COM,

#### **MICROPHONE CHARACTERISTICS**



- Frequency Response Most Important
- Proximity Effect A blessing or a curse
- Pattern Pick up pattern is important
- Rear Rejection Most important but seldom
- discussed

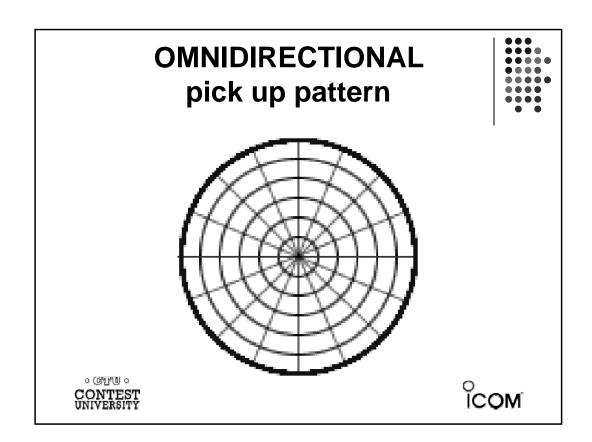


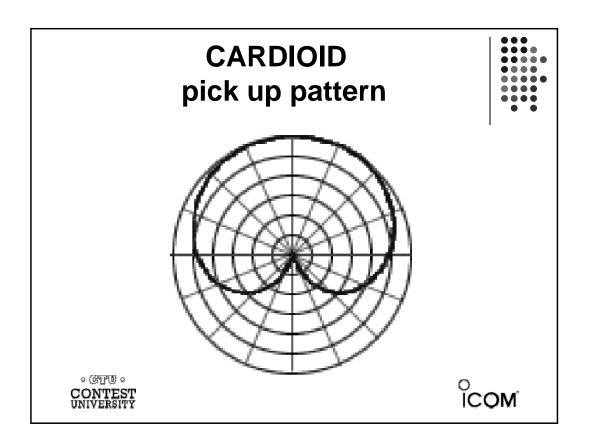
#### **Microphone Pick Patterns**



- All microphones pick up audio
- But not all the same
- Some pick up from all angles
- Others favor sound from one angle
- Omni, Cardioid, Supercardioid patterns



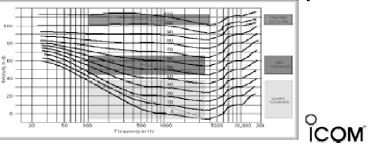




#### FLETCHER MUNSON CURVE



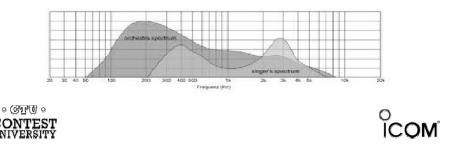
- Humans do not hear all frequencies at the same sound level. Our ears are more sensitive to some frequencies than others.
- In the 1930's Dr. Fletcher and Dr. Munson of Bell Labs made this important discovery



### Tailored Response Audio WHY ?



 In studying the Fletcher Munson curves and their many papers written at the early Bell Labs about what voice frequencies are most important, it was evident a tailored response audio was needed for Amateur Radio



## Choose your frequency response requirement



- Flat is NOT always (if ever) the 'preferred'
- Your ears certainly are not flat
- A 'shaped response' with a boost in the correct place is the best for speech. Most microphones do NOT have this shaping
- Heil Sound figured it out and did it





## HEIL EQ 200 forever changed Amateur Radio audio



- In 1982, Heil Sound changed the Amateur Radio industry with the introduction of the very first equalization system, the EQ 200.
- It appeared in a DIY feature article in the July 1982 QST and received the cover award for that issue
- It brought awareness to the importance of speech articulation
- It was apparent that it should become a feature product for Heil Sound. Thousands were built and sold during the 80s



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#### Amateur Radio Needed a Dedicated Microphone



- Following the scientific studies of Dr. Fletcher and Dr. Munson
- After two years of experimenting and using the EQ 200 equalizer it was easy to determine the exact response we needed to cut through the pileups and noisy conditions
- Heil tailored response elements were born





#### It Changed the audio world







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## The Heil GOLDLINE



- The dual element Goldline has brought great audio performance to ham radio – worldwide
- The first microphone designed for Amateur Radio
- Each element addresses the importance of speech articulation with a rise at 2K to 3K
- The full range element 50 Hz 16 kHz with a 4 dB rise in the 2K 3K region.
- The Narrow (dx) element has a response of 200Hz to 8k with a 10 dB rise at 2 to 3K
- .....with great rear rejection to reduce room and blower noise

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### Then Joe suggest something better - The PR 40 was born



- Two hams with good ears and a soldering
- iron figured it out







#### The specifications



- Widest frequency range 28Hz. To 18kHz.
   with a + 4dB rise at 2.4 kHz- 5kHz producing great articulation.
- trademarked Heil rear rejection of -40dB.



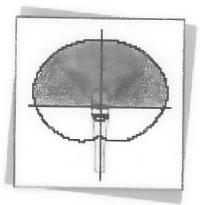


# The HEIL PATTERN Omni front -40 dB rejection



OMNI front pattern allows you to move about freely

The Heil Pattern hears nothing from the back



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# HOW DID WE DID THIS? It's all about phasing



 .....and I learned it from lots of antenna experiments during me early ham radio days



OTTU O

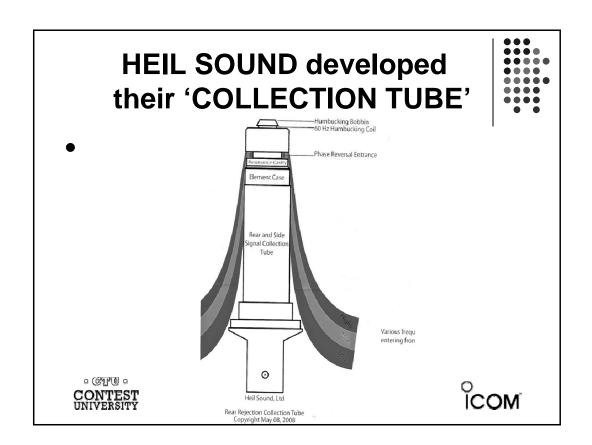
# It's All About the Heil 'Collection Tube'



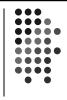
- While all others have a few small holes around the side to receive unwanted rear info
- That is not enough for good rear rejection



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# What is a 'Humbucking coil'?



- A coil of wire, tuned to 60Hz is wired across the voice coil – out of phase so if the microphone is passed in front a monitor screen that emits noise, it cancels.
- A necessity for broadcast studios





## **DESIGN DETAILS**



- All Heil microphones are much more than a 'matching' (painted same color) microphone
- Attention is paid to Transient Response the ability to respond to rapidly changing speech levels and response.
- Better dynamic range being able to handle SPL (sound pressure) of 145 dB.
- Serious -40 dB rear rejection





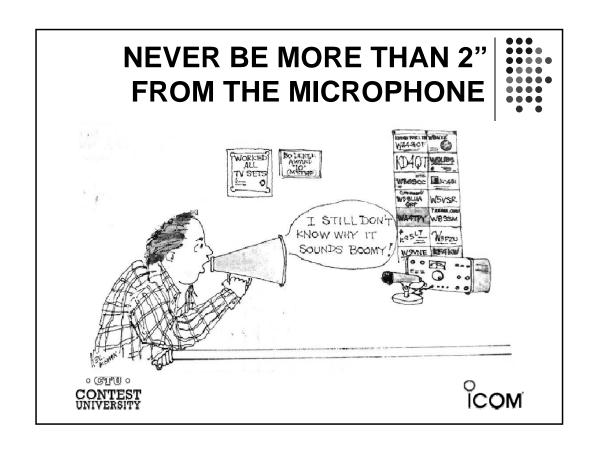
# It all starts at the Microphone!

- An audio chain is only as good as its weakest link.
- We start with a properly designed microphone for the proper application
- Apply Proper microphone technique



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# Place that microphone correctly



- Forget the usual desk stand that you sit back three feet and address the microphone...no!
- Oh, I forgot it's "matching"
- Desk stands allow you to be too far away.
- Never be more than 2"
- Booms are the answer
- ....or desk stands WITH booms! PR 10

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# So Many Reasons.....



- You loose dynamic range
- You loose transient response
- You loose speech articulation
- Scientific fact every time you double the distance from your microphone you loose SIX dB! Think about that.
- To 'try' and make that up you 'crank up' the gain
- The result? You sound like you're in a barrell





# The answer -



• The Heil PR 10 package



HB-1 or PL2 T boom



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# PROPER ADJUSTMENTS are crucial



- Each transmitter has a different mic input.
- Different pre amp gains and audio response.
- Different types of operation requires very different equalization. Rag Chew, DX, nets
- Full Response mics don't make it for DX
- Narrow (DX) mics are not 'ragchew' popular
- Monitor yourself through a second receiver

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# And then there is iCOM!

- Dynamic mics will usually not work. Not enough gain to drive the low level inputs usually found on early models. (pre PRO)
- Dynamic mics work beautifully on all of the Pro series, 7600,7700,7800
- BEWARE! All iCOM has +8 volts superimposed on mic line
- iCOM has several different mic inputs.
- 'Early' iCOM (pre PRO) mic inputs are -15dB
- Very early iCOM had their mic pre amp inside the microphone, not in the transmitter (720,30,40)
   Finally put it inside with the iC735

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# The iCOM 'fix for low level inputs



- In working with iCOM, we designed the perfect microphone for those low level inputs
- The 'iCM'



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# The HEIL 'iC' for iCOM only



- Used in our iCM microphone and all headsets built exclusively for low level inputs.
- Works great on all late model iCOM as well on Elecraft K2 and K3 (turn on the phantom power) No other transmitter furnishes phantom power. iCOM and Elecraft.
- It is a full range element but accepts EQ easily to tailor for DX or contest work as well as full range casual rag chew operation

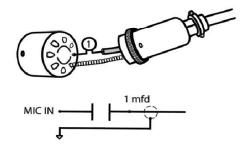




# **Decoupling the iCOM inputs**



- Always beware that every iCOM has +8 volts d.c. superimposed onto the mic line. It's called Phantom Power
- Audio is A.C. and carried down the mic line to the input.
- On the same mic lead, the + 8volts is fed back up that line to power the electret element needed on some iCOM
- Always be sure to decouple that lead with a one mFd capacitor





# The microphone is only one half of the audio in your station



- Now you have the microphone all set, what about receive audio?
- All of the transceivers have very poor receive audio components and specifications. (yes, even the \$10K ones!)
- When have you ever seen ANY receive audio specifications?
   Nope, they don't publish them
- Why? Most are producing 1 watt @ 10% distortion!
- And then you plug in the 'matching' (painted the same color) 50 cent speaker. True
- The listening fatigue is awful but you never think of it

A new world is in front of you





# THE answer to a great receive system



- Small mixer (many out there) driven from the line out signal in your accessory jack
- The mixer drives the pair of JBL Control 2P
- Most of the mixers have 2, some 3 way EQ
- JBL has two 35 watt @ .5 (point 5) distortion
- So many things you can do with this set up
- Also is one incredible headphone amplifier





# All done for under \$200.00



- Berhinger UB 802
- JBL Control 2P





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# Headphones, Headphones, Headphones.....



- Heil Sound continues to lead the headphone industry since 1985
- · Many choices for you
- The PRO 7 is the ultimate for serious contest or DX work as well as casual operation
- Comfort is important. The steel band inside the padded top can be adjusted for more or less pressure



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### PRO 7 The Next Generation of headsets





- \* Extremely Comfortable
- \* Specially designed 2" foam Gel ear pads
- \* -26 dB of outside noise cancelling
- \* Exclusive Heil speaker Phase reversal
- \* Two detachable cables...coil or straight
- \* Military grade fiber reinforced cables
- \* Interchangeable microphone elements
- \* Features the HC 7 articulate dynamic or Heil 'iC' electret for early iCOM
- \* 40 mil speakers in acoustically tuned cavities\*

O COM

# The Heil PRO 7 The new Boss in Headsets



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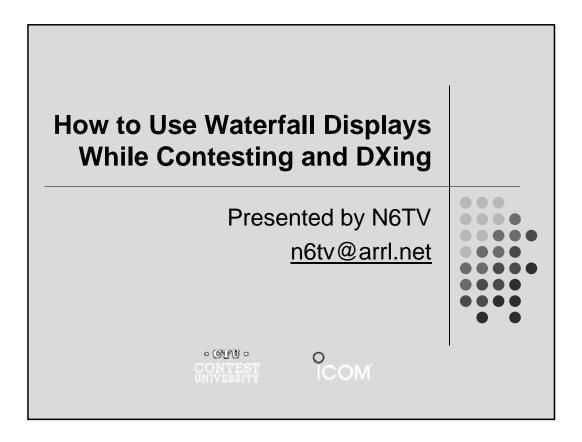
# **LISTEN, LISTEN!**



- Remember this important audio fact:
- LISTENING is a MENTAL process
- HEARING is a PHYSICAL process
- Make sure you are mentally evaluating what you hear when adjusting your station audio







# **Presentation Overview**



- Legacy "Panadapters"
- CW Skimmer's SDR waterfall
- Current radios with waterfall displays
- Waterfall display advantages
- How to use waterfall displays while contesting or DXing
- Q & A

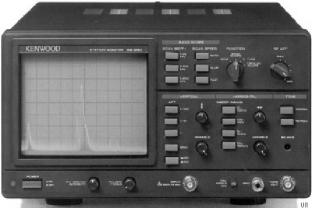
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# **Legacy Panadapters**



 Kenwood SM-230 Station Monitor (25, 100, or 250 KHz):



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Photo courtesy http://www.universal-radio.com/



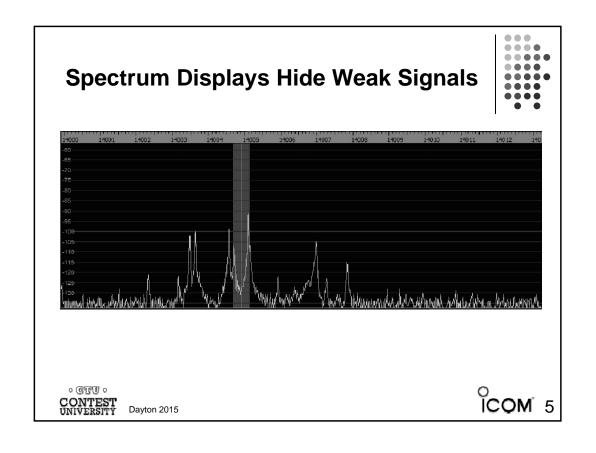
# **Legacy Panadapters**

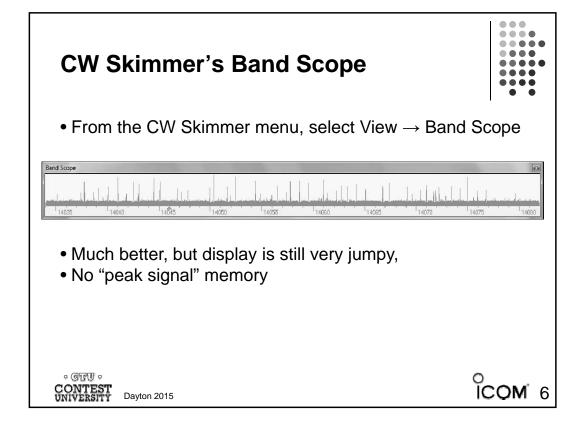


• "Band Scopes" in Icom IC-781, IC-756ProIII, IC-7800 (before V3.0), IC-7700, etc.



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# **Legacy Panadapter Limitations**



- Big signals dominate the display
- Weak signals very difficult to spot
- Signal peaks disappear, no history
- Difficult to find "clear spots" on a crowded band
- Limited zoom in or out
- Display jumpy, distracting
  - Signal averaging helps, but it also hides things



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# **CW Skimmer Waterfall Limitations**



- You only see 10 15 kHz of the band at most
- Scale is fixed, cannot "zoom" in or out, or tune smoothly
- Narrow 500 Hz CW filter not useable on phone

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# **Better Waterfall Displays**



• The Elecraft P3 Panadapter



Major improvement over legacy designs



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Photo courtesy <a href="http://www.elecraft.com">http://www.elecraft.com</a>



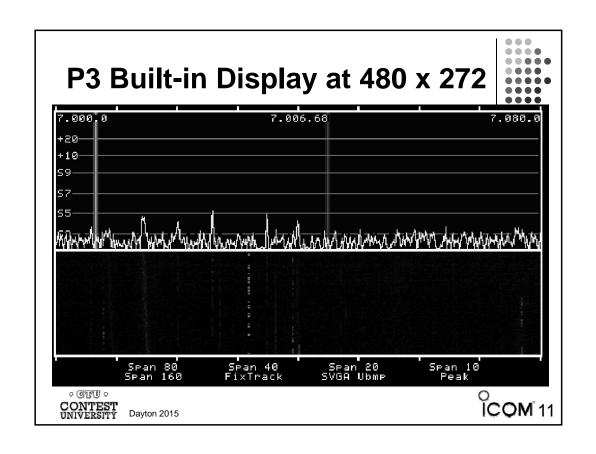
# Elecraft P3 + P3SVGA Option

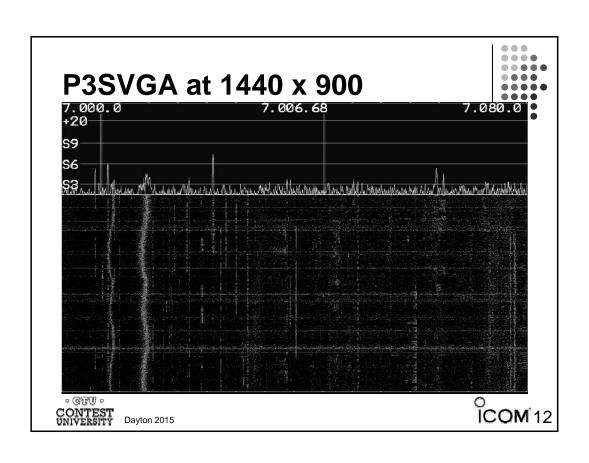


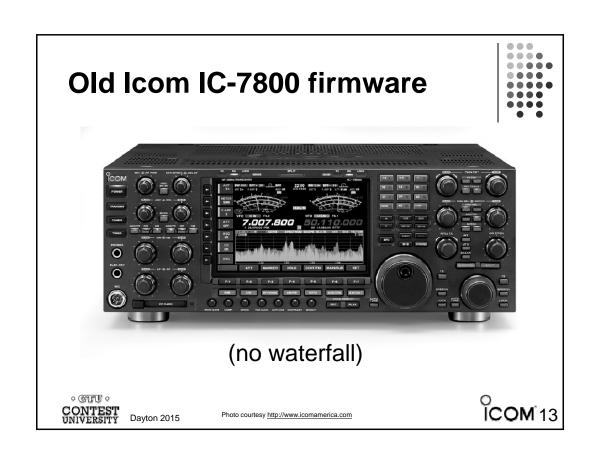
- P3 resolution only 480 x 272 pixels
- P3SVGA: internal SVGA Large Screen
  Adapter
  - 1024 x 768
  - 1280 x 1024
  - 1440 x 900
  - 1920 x 1080
- Displays far more signals

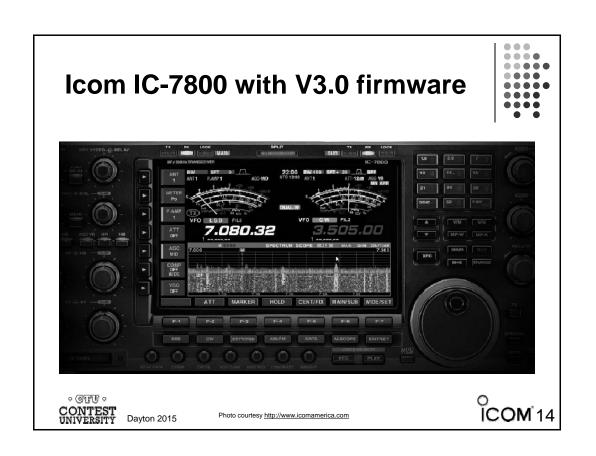


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Photo courtesy <a href="http://www.elecraft.com">http://www.elecraft.com</a>



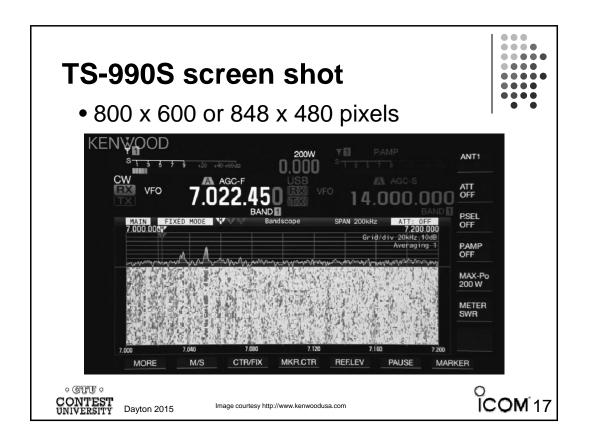




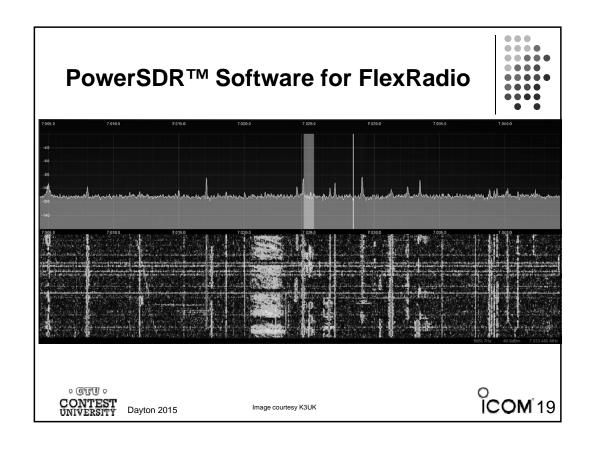


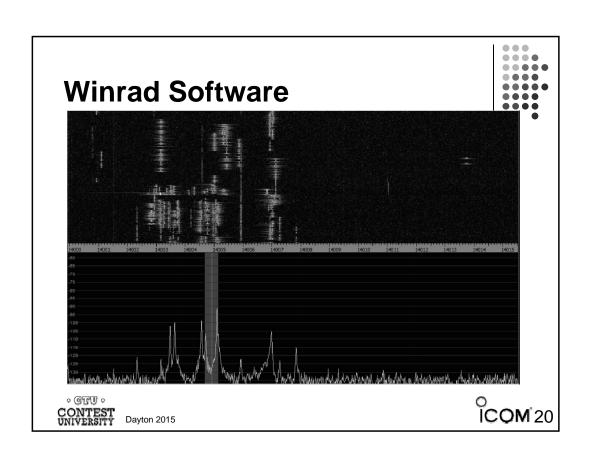
# IC-7800 V3.0 Screen Shot IC-7700 V2.0 Also Supports Waterfall Feature • 800 x 480 (with or without external monitor) ANT BW 24k SFT 0 70 BW 188 SFT 0 710 BW

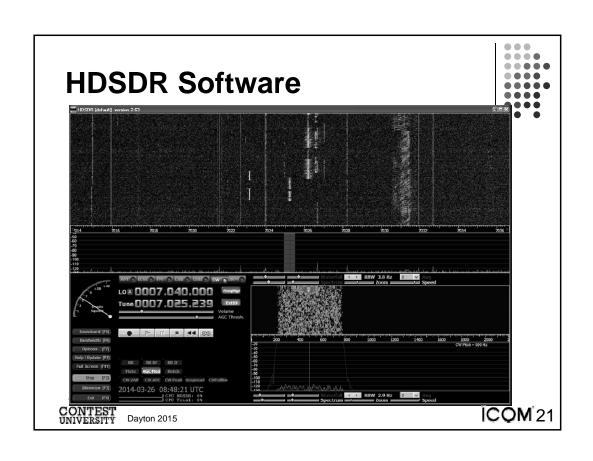


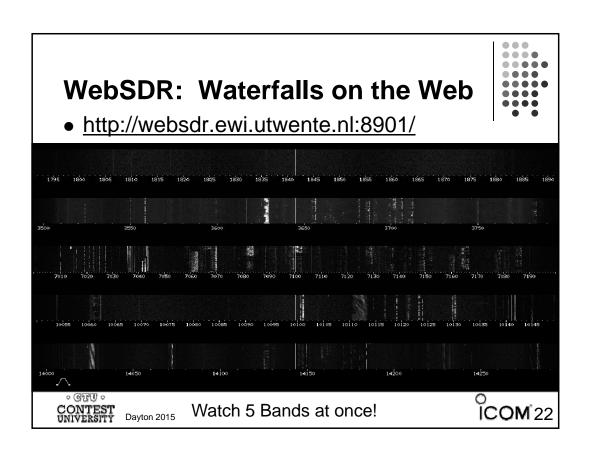












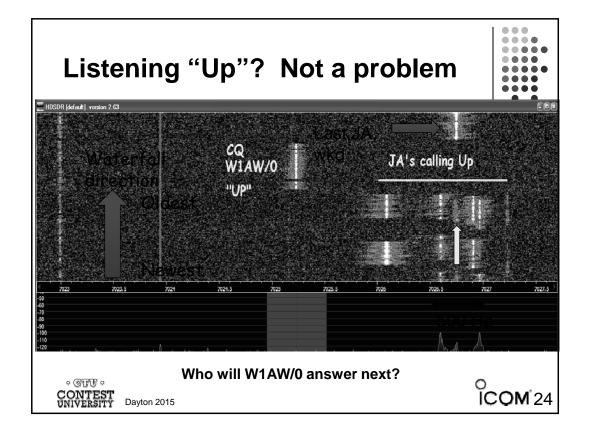
# **Waterfall Display Advantages**

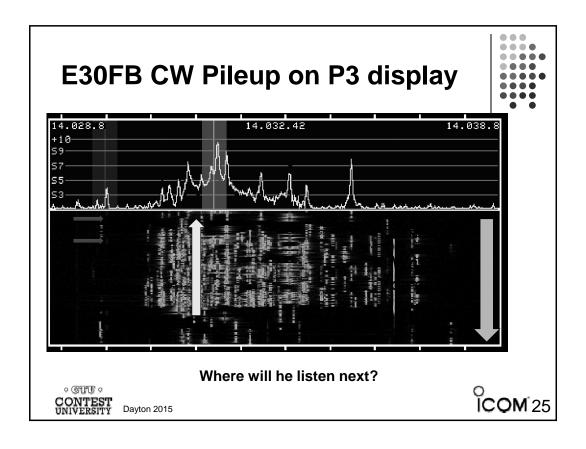


- "Click to Tune" direct access using a mouse
  - IC-7800 V3.0, IC-7850, Flex/PowerSDR, HDSDR (but not K3/P3)
- Weak signals easy to spot (faint traces)
- Many zoom levels: 7.5, 15, 30, 60, ..., 800 KHz
  - Watch the whole band at once, or a small slice
- Find clear frequencies fast
- Find who the DX just worked, fast
- Spot the gaps in a crowded CW pileup



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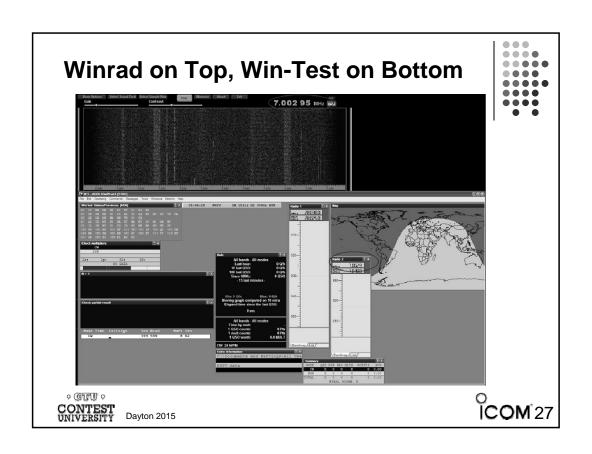
# **Advantage: Waterfall**

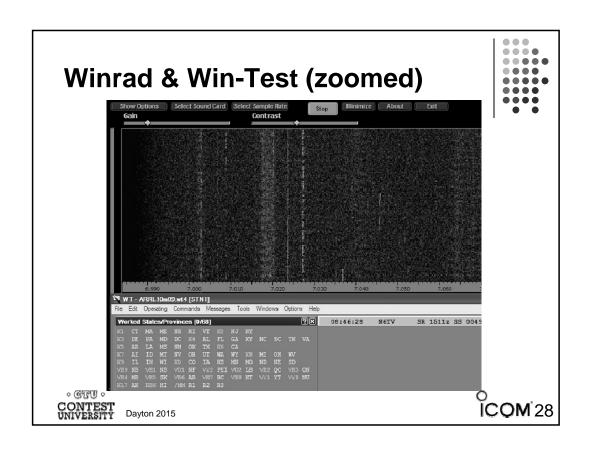


- Find "good spots to call" in a CW pileup
- Find clear spots to call CQ
- QRM? You can see where to move your VFO to minimize it
- During S&P, find the "next" signal fast (no more slow tuning)
- Position VFO B or 2<sup>nd</sup> receiver without having to *listen* to it
  - S&P while CQing, "SO2V" (single-op, two VFOs)
- Monitor overall band activity
- Keep an eye on the local competition

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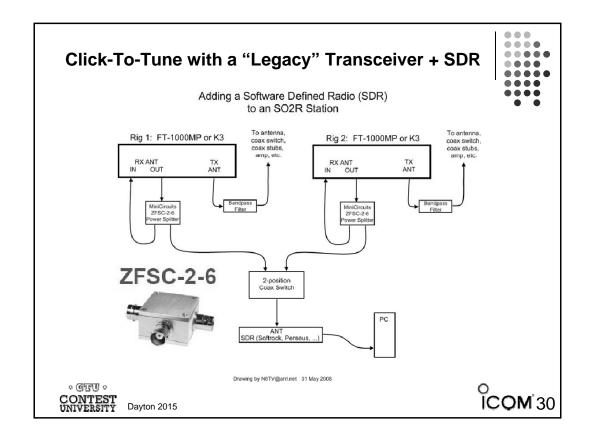
# Waterfall Display Disadvantages



- Radios don't automatically jump from signal-tosignal like CW Skimmer (yet)
- Clicking on a signal with the mouse not as precise as tuning with VFO, must still fine tune, contest software loses focus
- Can be visually distracting to some
- But, if you're not using a waterfall display in a contest, you're really operating "blind"
- A waterfall display is really the "killer app"

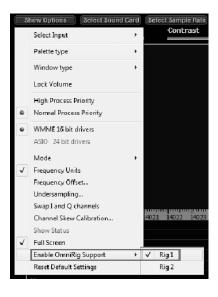


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# Use Omnirig support in Winrad or HDSDR to synch freq. with any transceiver







**COM** 31

# **Demo of Winrad's Waterfall**



- Perseus SDR used to make a wideband recording (122 KHz for 10 minutes = 300 MB)
- Demo will play back that recording and others
- To try the demo yourself, follow instructions at
  - http://www.kkn.net/~n6tv

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# **Questions?**



- <a href="http://www.winrad.org">http://www.winrad.org</a> Winrad software
- <a href="http://www.hdsdr.de/">http://http://www.hdsdr.de/</a> HDSDR software
- http://www.kkn.net/~n6tv Winrad demo file
- <a href="http://www.qrz.com/db/n6tv">http://www.qrz.com/db/n6tv</a> Links to this and other presentations



# CTU 2015 Presents Advanced RTTY Topics Ed Muns, WOYK CONTEST C

# RTTY Contesting Operating Topics



- User interface
  - Keyboard
  - Mouse vs. trackball
  - Accelerator keys
- Optimizing messages
  - UnShift On Space (USOS or UOS)
  - Space vs. hyphen
- Call sign stacking ("slow down to win")
- SO2V, SO2R-SOnR
- RTTY contest loggers
  - WriteLog
  - N1MM Logger
  - Win-Test
- Sharing the road

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# RTTY vs. CW/SSB

Key Difference



**Technology exploitation** replaces **operating skill** in encoding/decoding the RTTY signal.

- The 2 cornerstones of ham radio!
- RTTY technology is very important.



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# **User Interface**

# focused keyboard



- Predominantly a few function keys
  - Minimal QWERTY typing
- Compact size is efficient for RTTY
- Key labeling
  - Organized by QSO phase
  - Phases 1 & 3 mapped to keys surrounding Enter

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SOnR scaling (networked PC per radio)





# **Focused Keyboard**





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# **User Interface**

# pointing device



- Mouse
  - Most familiar and popular
- Trackball
  - Space efficient
  - No mousepad or surface requirement
- SO2R with PC/radio
  - Ambidextrous skill (ala paddle sending)
    - Train non-dominant hand daily on home/office PC



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# **User Interface**

# keyboard or mouse?



# RTTY requires little touch typing →

### **Keyboard**

- Array of function keys
- RTTY doesn't require eyes on screen 100%
- Easier motion
- Easy for 2-kybd SO2R

### Mouse/Trackball

- Clickable screen buttons
- Keeps eyes on screen
- Usable higher % of time
- Easy for single PC SO2R
- Strong vocal advocates
  - Esp. N1MM users

# → Personal preference

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# **Trackballs**

### SO2R PC/radio





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# **User Interface**

# accelerator keys



- CT accelerator keys
  - INSERT: grab call sign and send exchange
  - PLUS: log QSO and send TU/QRZ (use ESM)
- ESM (Enter Sends Message)
- Remapped keys for compact efficiency
  - Around Enter key
  - CQ, exchange, TU/QRZ; My Call, S&P exchange
  - Call sign stack manipulation
- Use Fn keys for fill messages

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# Focused Keyboard accelerator keys





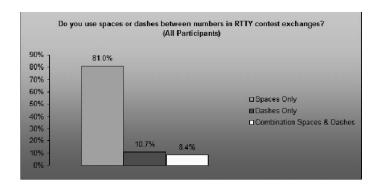
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# **Space Delimiters**

# 2010 survey





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# Space Delimiters UnShift On Space\*

\*UOS or US



- Protocol that provides some noise immunity for shift characters by:
- forcing the Letters set after a received Space
  - sending a FIGS character after a Space when the next character is in the Figures set
- MMTTY:
  - RX UOS and TX UOS can be independently enabled or disabled

TX RX	599 123 123	599 CA CA
UOS on	f599 f123 f123	£599 CAI CIA
UOS on	f599 f123 f123	f599 CA CA
UOS on	f599 f123 f123	£599 CAI CA
UOS off	f599 f123 f123	f599 :- :-
UOS off	f599 123 123	£599 1CA CA
UOS on	f599 QWE QWE	£599 1CA CA
UOS off	f599 123 123	f599 1CA CA
HOS off	f599 123 123	f599 1CA CA

f: FIGS character
I: LTRS character

Garbled copy

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# Space Delimiters UOS and a noise hit



	TX RX	599 123 123	599 123 123	599 CA CA	599 CA CA	
best case	UOS on		f599 f123 f123	£599 CA CA		f: FIGS character
Desi Case	UOS on	×T00 f123 f123		×TOO CA CA	f599x:- CA	/ / TDO /
	UOS on	f599 f123 f123	f599 f123 f123	f599 CA CA	f599 CA CA	I: LTRS character
		×T00 f123 f123		xTOO CA CA	f599x:- =-	x: noise hit
	UOS off			£599 1CA CA	f599 1CA CA	A. HOISE HIL
worst case	UOS on	×IOO QWE QWE		xT00 1CA CA	f599 x:- CA	
	140 SON	£599 123 123		£599 1CA CA	£599 1CA CA	Garbled copy
	UOS off	×TOO QWE QWE	f599xQWE QWE	×TOO 1CA CA	f599 x:- :-	

Turning on UOS for both RX and TX is the best hedge:

- Most other stations will be that way
  - MMTTY default; 78% of survey respondents use MMTTY
- With only one noise hit, at least one of the important exchange elements is received properly



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# **Hyphen Delimiter?**



UOS is defeated: so all four cases have identical noise results

_	IX	RX	599-123-123	599-123-123	599-CA-CA	599-CA-CA
$\overline{}$	200	on	f599-123-123	f599-123-123	£599-1CAF-1CA	£599-1CAf-1CA
1	UOS	on	×T00AQWEAQWE	f599x123-123	×TOOA 1CAF-1CA	f599-x:-f-1CA
-	UOS	on	f599-123-123	f599-123-123	£599-1CA£-1CA	f599-1CAf-1CA
) [	UOS	off	xTOOAQWEAQWE	f599x123-123	xTOOAlCAF-1CA	f599-x:-f-1CA
١ -	uos	off	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
"	200	on	xTOOAQWEAQWE	f599x123-123	×TOOA1CAF-1CA	f599-x:-f-1CA
"	UOS	off	f599-123-123	f599-123-123	£599-1CAF-1CA	f599-1CAf-1CA
r.	UOS	off	×T00AQVEAQWE	f599×123-123	×TOOAICAF-1CA	f599-x:-f-1CA

f: FIGS character I: LTRS character x: noise hit

Garbled copy

- Sending Hyphen instead Space "defeats" UOS and speeds up the message slightly by eliminating the FIGS character
  - However, if the first FIGS character is hit by noise, then the entire exchange is garbled
- Space with USO enabled is a slightly better hedge
  - Majority of stations use MMTTY with UOS enabled so at least one of the important exchange elements is received





# LTRS/FIGS Characters noise immunity



- MMTTY Double Shift may be enabled to send two LTRS or FIGS characters instead of one
- Eliminates single noise hits on LTRS and FIGS characters
- Small speed penalty for all transmissions

#### Probably not a good trade-off

(very low probability of a noise hit on just the shift character)



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# Callsign Stacking "Slow Down to Win"



- Sailboat racing analogy:
  - Pinwheel effect at mark-rounding
- Let pile-up continue 0.5-3 seconds after getting first call sign
  - Increase chance for another call sign or two
  - Increase chance for QSO-phase-skip
- Apply same tactic for tail-enders ... pause before sending TU/CQ message





#### The 4 Phases of a QSO



#### Normal Run mode flow:

- +1. CQ: Enter or F1 (CQ)
  - repeat
  - AGN?
- 2. Pile-up
- **3. Send exchange:** Insert or ' (grab call sign, send exchange)
  - Send fill(s)
- 4. receive exchange:
- check pre-fill, click their exchange
  - AGN? or NR? or QTH? or NAME?
- -1. TU/CQ: Enter or + (log contact, send TU/CQ)
  - optionally send F7 (QRV message)

Normal S&P mode flow:

- + 1. Find CQ
- 2. Send call: Enter or F4
  - repeat
- 3. Receive exchange
- check pre-fill, click their exchange
  - AGN? or NR? or QTH? or NAME?
- 4. Send exchange: Enter or F5
  - Send fill(s)
- -1. Find next CQ

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### **Callsign Stacking**

#### skip 2 phases



#### **Normal**

- - 2. K3LR K3LR K5ZD K5ZD
  - 3. K3LR 599 2419 2419
- 4. TU 599 842 842

- **Shortened**
- 1. (skip CQ) -----
- 2. (skip pile-up)
- 3. K3LR TU NW K5ZD 599 2420 2420
- 4. TU 599 1134 1134

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# **Callsign Stacking**

#### tail-ender



#### Normal

#### Shortened

- ······ K3LR TU P49X CQ
- 2. K3LR K3LR
- 3. K3LR 599 2419 2419 K5ZD
- ..... 4. TU 599 842 842 <

- 2. (skip pile-up)
- →3. K3LR TU NW K5ZD 599 2420 2420
- 4. TU 599 1134 1134

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# **Callsign Stacking**



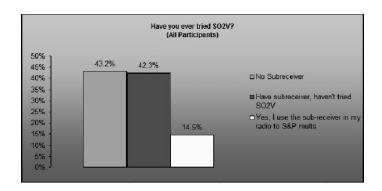
- Efficiently work:
  - multiple callers in a pile-up, and
  - tail-enders
- Calls pushed onto the stack as they arrive
- Message parameter pops call off of the stack into the Entry window
- Eliminates 2 of 4 QSO phases, which doubles rate

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#### SO<sub>2</sub>V

#### 2010 survey





Almost 15% have tried SO2V

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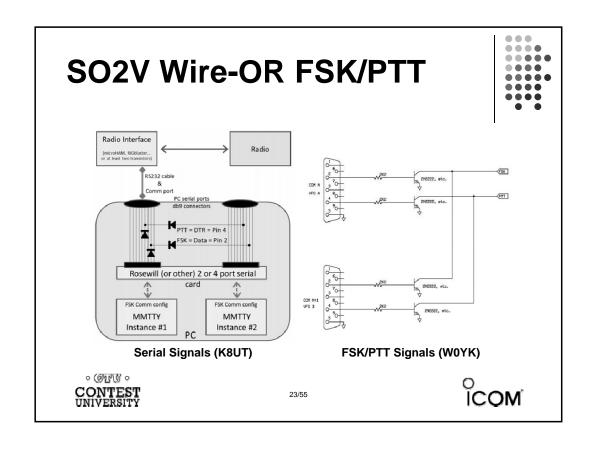
#### SO<sub>2</sub>V

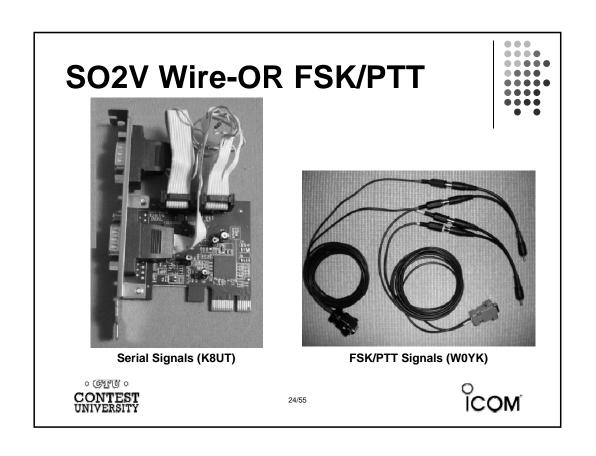


- 1. If Assisted and running on VFO-A, then
  - A<>B
  - Click spot, tune, ID station, work station
  - A<>B, resume running
- 2. Or, setup decoder windows on A and B
  - Radio must have two true receivers
  - Monitor both frequencies simultaneously with right/left channels of sound card
    - Right-click call from 2<sup>nd</sup> RTTY window into VFO-B Entry Window
  - Two ways to transmit on VFO-B:
    - A. A<>B, work the mult, A<>B
    - B. SPLIT, work the mult, SPLIT, resume running
      - Requires "wire-OR'd" FSK or AFSK and two transmit RTTY windows
      - K3/WriteLog invokes SPLIT when call is left-clicked in Sub-RX





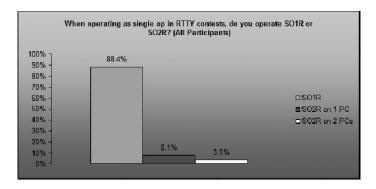




#### SO2R

#### 2010 survey





- 12% operate SO2R
- 30% of SO2R users use 2 PCs

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### SO2R

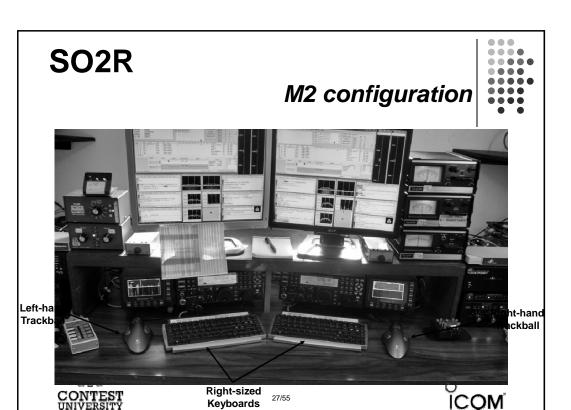


- Eliminates SO1R RTTY boredom
- Think beyond run and S&P:
  - Dueling CQs; run on two bands simultaneously
  - S&P on two bands simultaneously, esp. w/Packet
  - SO2V on one or both radios (SO4V!)
- Two networked computers:
  - Eliminates PC focus swapping
  - RTTY doesn't require much typing
    - Mini-keyboards ideal for RTTY
  - 2 x SO2V=SO4V for picking up mults on both run bands
  - Easily extendible to SO4R

No time to watch TV or do email!







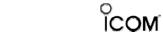
# **SO2R** in the NA Sprint

Keyboards



- Set VFOs at least 10 kHz apart on both radios
- Find a clear spot on one radio and CQ while you tune the other radio for a station to work
- If you don't find a station to work quickly (within a minute), find a clear frequency and duel CQ
- After a QSO swap VFOs on that radio, search for up to a minute, then resume dueling CQ
- Don't waste time trying to work the "couplet" ... CQing is OK in Sprint!





### **SOnR**

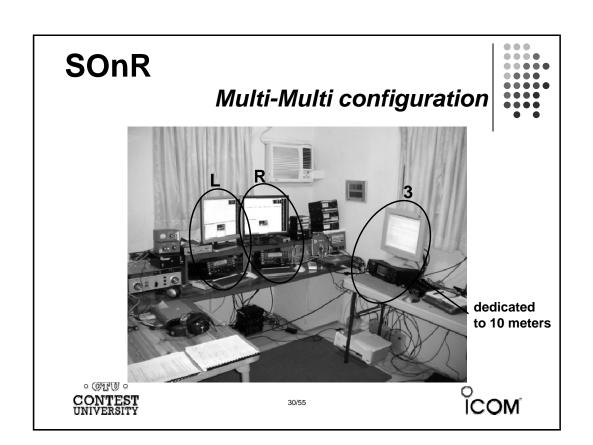
#### > 2 radios

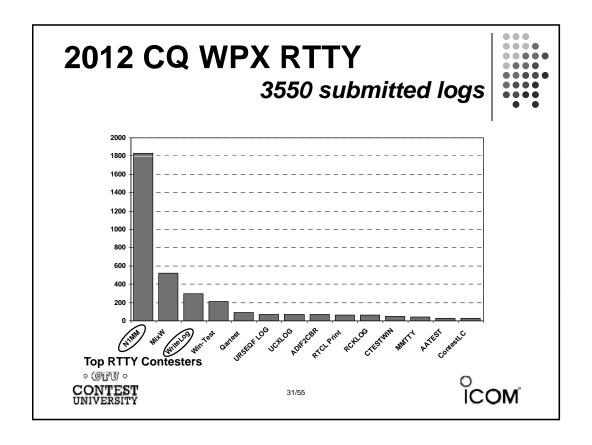


- Simplify antenna/filter band-decoding:
  - Dedicate a band/antenna to the 3<sup>rd</sup> (or 4<sup>th</sup>) radio
- Networked PC/radio simplifies configuration
- RTTY (vs. CW or SSB) easier for operator
  - PC decodes for operator
  - Low tones & high tones allows two radios per ear
    - Classic audio headphone mixer provides radio 1, radio 2 or both









# **Logging Software**



- WriteLog (1994)
  - created for RTTY (CW & SSB came later)
  - www.rttycontesting.com web site
- N1MM Logger (2000; dedicated RTTY software designer)
  - Free
- Win-Test (2003; RTTY is low priority)

All three integrate MMTTY and have similar functionality for basic RTTY contesting.





### **Logging Software**



	WriteLog	N1MM	Win-Test
MMTTY	•	•	•
2Tone	•	•	-
other decoders	•	some	none
Call sign acquisition	•	•	•
Contests supported	•	•	fewer
Advanced RTTY	•	•	none

- All three are entirely adequate for basic RTTY contesting
- Use the logger you are already familiar with for CW & SSB

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# Logging Software WriteLog, N1MM Logger, Win-Test



- 13 features compared
  - Simplifying assumption: features equally weighted
  - Rated 0 to 5
- All three score '5' on:
  - MMTTY integration
  - Stateful Enter key (ESM: Enter Sends Message)
  - Accelerator keys
  - QRV message parameter
- Another 9 advanced RTTY features distinguish these loggers

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# Logging Software MMTTY integration



- Install free MMTTY software
- Logger integrates MMTTY

- All three loggers
- Integrated excellent encoder/decoder

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### **Logging Software**

#### stateful Enter key



- Stateful Enter key (ESM=Enter Sends Message)
  - Cursor in call sign field:
    - 1. Sends CQ if Call Sign Window empty, else
    - 2. Sends call sign & exchange
  - Cursor in exchange field:
    - 3. Sends TU/CQ
- N1MM Logger highlights active key(s)
- All three loggers
- Efficient keyboarding





# **Logging Software**





- Insert grabs call sign & sends exchange
- + logs QSO & sends TU/CQ
- All three loggers
- Saves keystrokes



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### **Logging Software**

automatic QRV



- QRV 28079.3
- Message parameter for other radio's VFO
- All three loggers
- Efficient QSY, mult move or "self-spotting"

38/55



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# RTTY Contest Loggers





WL	N1	WT
5	5	4
5	4	0
5	4	0
0	5	3
5	5	0
5	3	3
5	4	5
5	5	3
5	4	5
40	39	23
- 15 AZ		

#### Logger

- RTTY window readability
- Multiple decoders
  - multiple MMTTY or 2Tone
- ESM mouse ctrl & Sprint mode
- SO2V
- M2 SO2R configuration
- Re-mapped keys
- Call sign stacking
- AFSK/FSK flexibility

Overall



39/55



# Logging Software RTTY Window Readability



#### **N1MM Logger**

# | Control | Cont

Colored text is difficult to read, especially the dark blue (unworked call) which has negligible contrast to black text or black background. The dark blue cannot be changed by the user. **HOWEVER**...

#### WriteLog



Colored highlighting has outstanding readability. The text all remains black for maximum contrast and the highlighting does not detract. Rather the large highlight area around the text make it extremely easy to zero in on the call sign of interest, especially when quickly moving one's eyes between multiple windows.



# Logging Software RTTY Window Readability



#### N1MM Logger



Colored text is difficult to read, especially the dark blue (unworked call) which has negligible contrast to black text or black background. The dark blue cannot be changed by the user. HOWEVER, there is now an option for highlighting like WriteLog and WinTest.

#### WriteLog



Colored highlighting has outstanding readability. The text all remains black for maximum contrast and the highlighting does not detract. Rather the large highlight area around the text make it extremely easy to zero in on the call sign of interest, especially when quickly moving one's eyes between multiple windows.

WriteLog is unique in having a NON-SCROLLING RTTY window, so you don't have to chase text up the screen!

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# **Logging Software**

#### multiple decoders



- N1MM Logger limited to 4 total, but has best DXP38 support
- WriteLog has 10 additional decoders per rcvr and the most hardware MODEMs
- Win-Test only supports one instance of MMTTY
- WriteLog & N1MM Logger only
- Multiple parallel decoders for marginal copy



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# Logging Software ESM mouse control



- Left-click enters call sign or exchange
- Right-click (ESM) sends exchange or TU/CQ
- QSOs can be worked entirely with mouse action, except for the rare instance where a call or exchange must be typed in
- N1MM Logger only
- Minimizes keyboarding for efficiency

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### **Logging Software**

SO<sub>2</sub>V



- Basic capability with two VFOs
- Advanced capability with two receivers
  - Requires second receiver in radio
  - Independent RTTY window for second receiver
  - radio/logger SPLIT mode
- N1MM Logger & WriteLog
- Interleave S&P QSOs on Run band

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# Logging Software SO2R M2 configuration



- PC & UI per radio; networked
- Single signal interlock
- Extendible to SOnR
- Only WriteLog
- Another user preference alternative; SOnR

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### **Logging Software**

#### key re-mapping

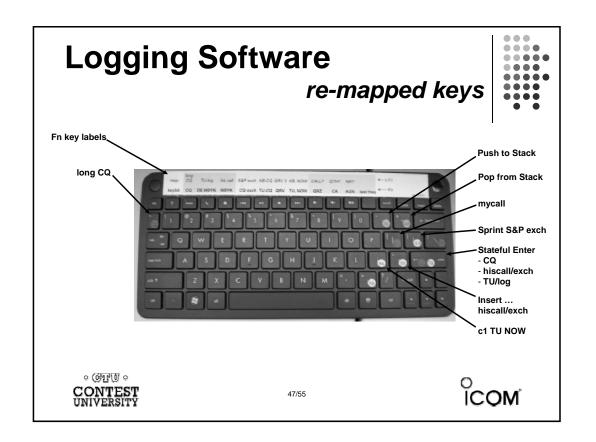


- Soft re-definition of keyboard keys
- Examples:
  - Insert → '
  - = → PopCallFromStack
- WriteLog provides a rich built-in function set for key shortcuts
- WriteLog & Win-Test remap keys and functions
- N1MM Logger uses HotKeys
- Relocates keys for efficiency

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# Logging Software callsign stacking



- N1MM Logger can automatically fill stack
- WriteLog has convenient stack management
- Win-Test script can use partner stack
- All three loggers
- Doubles rate by skipping CQ & pile-up





# Logging Software callsign stacking



- N1MM Logger automatically pushes calls into the Grab window.
  - It can also explicitly push calls onto the Call Stack (like WriteLog and Win-Test)
  - There is a rich list of stack functions and ESM integration
- WriteLog explicitly right-clicks calls onto the call stack
- Win-Test requires a LUA script to push calls onto the Partner Stack

Automatic vs. explicit pushing is personal pref.



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# Logging Software AFSK & FSK flexibility



- WriteLog has built-in AFSK & FSK
  - Can be used with any supporter decoder
- N1MM relies on MODEM for AFSK or FSK
  - TinyFSK & rpiFSK available
- WriteLog
- Independence from MODEM for transmit



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# RTTY Contest Loggers

relative ratings



WL	N1	WT	Logger
5	5	4	<ul> <li>RTTY window readability</li> </ul>
5	4	0	<ul> <li>Multiple decoders</li> </ul>
5	4	0	<ul><li>multiple MMTTY or 2Tone</li></ul>
0	5	3	<ul> <li>ESM mouse ctrl &amp; Sprint mode</li> </ul>
5	5	0	• SO2V
5	3	3	<ul> <li>M2 SO2R configuration</li> </ul>
5	4		
5	5	5	<ul> <li>Call sign stacking</li> </ul>
5	4	5	<ul> <li>AFSK/FSK flexibility</li> </ul>
40	39	25	Overall

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### **Sharing the Road**

RTTY sub-bands



- FCC rules govern, not band plans
  - You have a right to use amateur frequencies!
- Respect band plans when possible
  - Avoid common sub-band "claims" unless it's the only clear freq.
- Insure frequency is not in use
  - You may not be able to hear or copy some modes
  - There may be one-way propagation





#### **RTTY Sub-Bands**



- 10 meters: 28080-28100, during contests 28060-28200
  - JA: 28070-28200
- 15 meters: 21080-21100, during contests 21060-21150
  - JA: 21070-21150
- 20 meters: 14080-14100, during contests 14060-14140
  - JA: 14070-14150
- 40 meters: 7025-7050 and 7080-7100, during contests 7025-7100
  - JA: 7030-7100
  - EU: below 7050
  - US: can go to 7125
- 80 meters: 3580-3600, during contests 3560-3600
  - JA: 3520-3575
- 160 meters(no RTTY contesting): 1800-1810
  - JA: 1907.5-1912.5

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# Common Frequency Claims don't QRM!



- Avoid PSK-31 operations near:
  - 28120, 21070-2, 14070-2, 7070 and 3580
- Avoid the NCDXF beacons:
  - 28200, 21150, and 14100
- More details:

www.aa5au.com/rtty/rtty-sub-bands/





### Resources



- NCJ RTTY Contesting columns
  - Spaces vs. hyphens: Sep/Oct 2013
  - Call sign stacking: Jul/Aug 2010 and Jan/Feb & Mar/Apr 2015
  - SO2R in Sprint: May/Jun & Sep/Oct 2014
  - Sub-bands: Mar/Apr 2013
- Prior CTU RTTY presentations
  - 2014 CTU textbook from DXE (\$19.95)
- AA5AU website: www.rttycontesting.com
  - Tutorials and resources (beginner to expert)
  - WriteLog/N1MM Logger and MMTTY/2Tone
- Email reflector: <a href="mailto:rtty@contesting.com">rtty@contesting.com</a>
  - RTTY contester networking
  - Q&A
- Logging Software web sites
- Logging Software Reflectors

• **GLA** •

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### **CTU Presents**

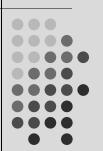
Radio Contesting's Future How Can You Help?

Tim Duffy K3LR

**CTU Chairman** 

o **GTU** o CONTEST





### **Contest University Update**

- 9th year for Dayton CTU
- Over 4000 students have now attended CTU
- CTU Live Stream thanks Icom
- Strategic Partnership with the NCDXF
- Support the vendors that support CTU
- YouTube and slide decks available on web
- Look for more exciting CTU's in the future



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#### **Getting the most out of CTU 2015**



There is a note pad in your bag – how many ideas have you written down today? You have access to some of the finest contesters – ask questions!

- You meet lots of people during contests try calling "CQ" here at CTU – you just might make a new friend.
- Everyone has a contesting story tell yours and listen to others.
- Commit to giving a program at your local club in the next 12 months.

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#### K3LR 2015 Notebook



- Make sure you use the best coax connectors possible.
- Always weatherproof your outdoor connections. Moisture will cause failures.
- Check, Double Check, Re-Check
- Develop a pre contest "Proof Of Performance" plan – KEEP NOTES!
- How many wall warts are causing RFI?

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# What are you doing to improve Contesting?



- Be voracious about reading contesting news.
- Take an interest in helping new hams to become involved in contests.
- Maintain the radio contesting good name do the right thing be a model operator.
- Find a way to "give back" to our hobby.
- Set goals for your contest self improvement. Set something achievable for you and then go hard after your goal.
- Remember as a CTU Graduate you are a winner!



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# It's 2359 Zulu – Are you worried about your connectors?













### **Having Fun with Contesting**



- Be the best example of a model contest operator
- Share your contesting passion with others help THEM put up or fix an antenna. Please be SAFE!
- Get on the air and operate. Teach others to operate in a contest.
- Have an open heart to all who are willing to learn encourage and send congratulations emails.
- Be active in your local club not just Field Day. Join, pay dues and contribute your time and experience!





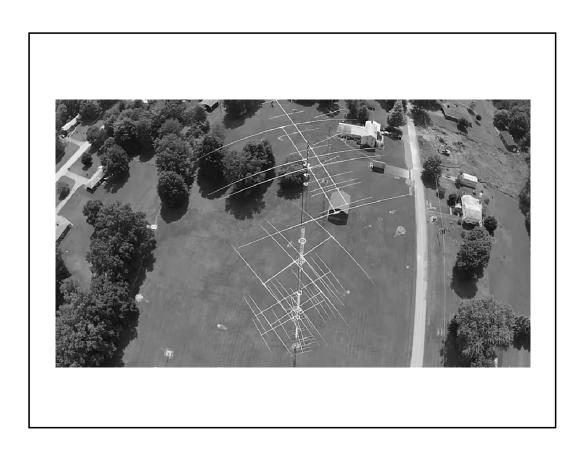
### **Towers and Antennas**

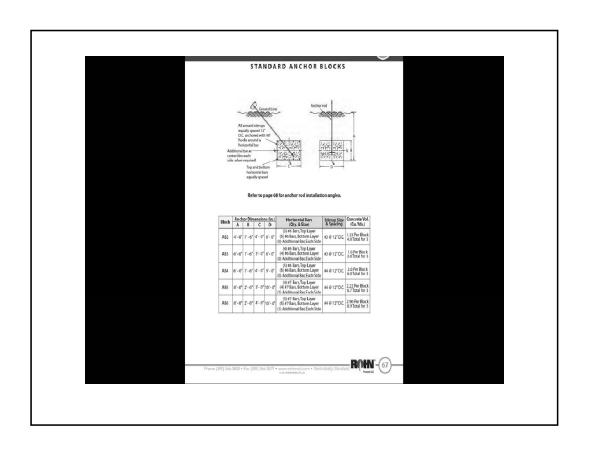
Tim Jellison W3YQ/KL7WV

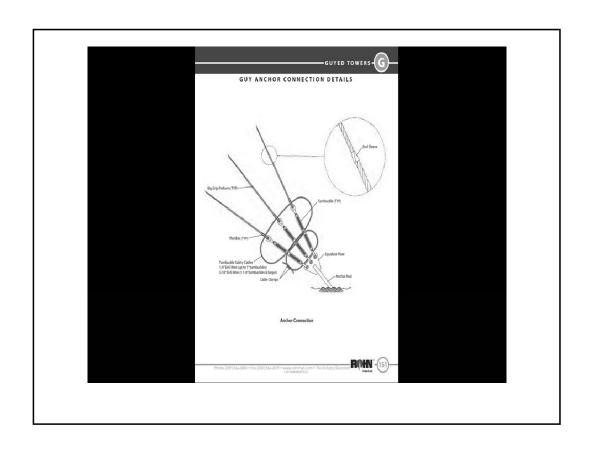


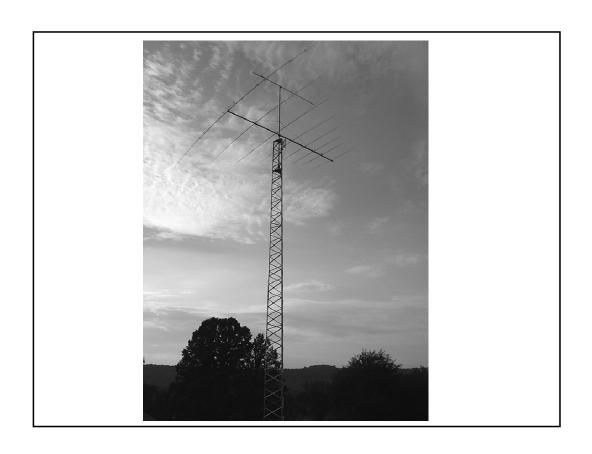
www.KL7WV.com

- Do it right, or don't do it!
- Follow the manufacturers' design rules
- Do your homework prior to starting your project (budget)
- Take a safety training course
- Use the proper equipment

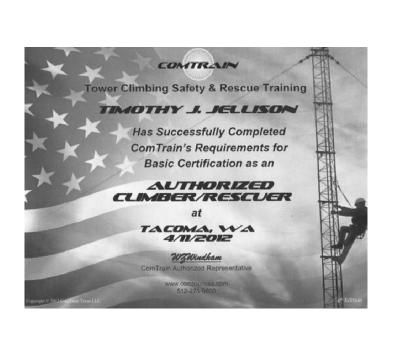






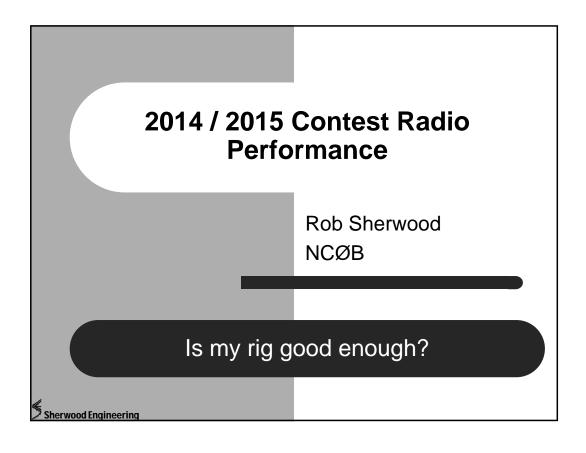


Item	Amount
Tower - AN HD60	\$4,450
Tower - Rohn TB3 Thrust Bearing	\$160
Tower - Mast	\$832
Tower - Shipping	\$250
Tower - Concrete Work	\$4,500
Tower - Crane	\$420
Tower - Labor	\$3,830
Rotator - M2 Orion 2800	\$1,803
6M Yagi - M2 6M5XHP	\$350
HF Antenna - M2 7-1030LP8	\$2,200
Coax - BuryFlex Wireman #103A	\$632
Rotor Cable - Wireman #306	\$376
Entrance Panels, Strap, Clamps,	
Arrestors	\$850
Machinging of rotor plates	\$50
Installation of Entrance	
Panels/Grounding	\$900
* Total *	\$21,603



# Finally a nice day!





- What is important in a contest or DX pile-up environment remains constant.
- We need Good Dynamic Range to hear weak signals in the presence of near-by strong signals.
- You need a better receiver for CW than for SSB.
- 2014 / 2015 Contest performance observations
- How does published test data relate to reception of weak signals?

Contests October 2014 – February 2015

#### Rigs used at NC0B this past season

Flex 6700 series @ \$7,500

Kenwood TS-990S @ \$7,400

Apache ANAN 200D @ \$4,250

Elecraft KX3 with KXPA100 amp @ \$2,260

Kenwood TS-590SG @ \$1,710

#### Rig experience in 2014 / 2015

Kenwood TS-990: CQWW SSB October 2014

Flex 6700: ARRL 160 CW & ARRL 10 meter contests December 2014

ANAN-200D: Stew Perry W1BB 160 CW end of December 2014

Elecraft KX3 + KXPA100: CQWW 160 CW contest January 2015

Kenwood TS-590SG: CQWW 160 SSB contest February 2015

(All rigs drove an Alpha 89 PIN Diode QSK legal limit amplifier)

#### Details – Kenwood TS-990S

- Main receiver down conversion all bands
- Third-order transmit IMD excellent at -40 dB
- Has a cleaner 50 volt PA
- Band scope very effective
- Excellent low-fatigue receive audio
- RMDR is its weakest point, but should rarely be an issue in most environments.
- Needs NB and NR firmware improvements

#### Details - Flex 6700

Fantastic band scope with amazing resolution Clean audio, very low fatigue, minimal ringing Tuned receiver with FlexControl V1.38 software was a significant improvement. I used two separate computers, one for N1MM and SmartCAT for band data, plus second computer to actually run SmartSDR.

With V. 1.40 software, three logging programs support focus recovery after user adjustable time. (2 seconds default)

#### Apache ANAN-200D

- Initially CW selectivity was terrible
- Consultation with NR0V resolved the issue
- Tuning was done with a FlexControl
- Bandscope was good, though not as good as a Flex 6700 with the default settings.
- Could not view signals too weak to copy
- I could have fixed this if I had known how.
- Focus was a major shortcoming
- Many contacts were lost due to loss of focus
- Planned fix for N1MM+ by May 15<sup>th</sup>.

#### **ANAN-200D** continued

- CW selectivity fixed with buffer & filter change
- Initial shape factor @ 200 Hz was 4:1!
- Buffer & filter change shape factor = 1.6:1
- Dual 19-inch monitors, N1MM + PowerSDR
- Loss of focus was a rate killer.
- Improper keystrokes = shifts to BC band, 3 MHz, Shortwave bands, etc.
- APF excellent once selectivity corrected
- Software is open source, written in C & C#
- New NR code shipped in March

#### A Note on CW Selectivity

- Shape factor at 500 or 250 Hz = 2:1 minimum with any modern rig
- Most DSP rigs will have a shape factor 1.5:1
- If you are tuned 1 filter bandwidth away from a strong CW signal, you should only hear key clicks, not a CW signal.
- That was the tip-off that something was wrong with the 200D until the buffer setting and filter type was set properly.

#### **Details – Elecraft KX3**

- Operated as CE0Y/NC0B Easter Island
- Performed well in 2015 CQWW 160 CW
- QSK improved, but still had keying artifacts
- DSP provides excellent bandwidth control
- KXPA100 drove Alpha 89 to 1.5 kW
- Opposite sideband rejection is its performance limit, being around 60 dB.
- Would be my first choice for QRP operation compared to IC-703+ or Argonaut VI

## **KX3** continued

The only problem operationally I had was large QSYs on 160 with a narrow-band antenna.

Had to drop power to 10 watts to disable 100 watt PA

Then retune L-network to low SWR

Otherwise if I put Alpha 89 in standby, the KXPA100 would lockup on a high SWR.

10 dB preamp used during daylight hours 160, which should be considered normal.

(Battery and charger details available on request)

Operated SSB and CW on 10 & 15 meters

## Shack on Easter Island - Great Fun!



## **Kenwood TS-590SG**

- The 590S was improved as the 590SG
- The radio is now in the top 10 on my chart
- N2IC, a top contester, has a pair of the older TS-590S models.
- I don't know a better bang for the buck than this Kenwood transceiver.
- DSP selectivity is excellent and easy to use with Hi / Low adjustments on SSB or width on CW.
- Ergonomics are user friendly

## What is the least understood Spec?

When is the spec for noise floor significant?

Why does it rarely matter on most bands?

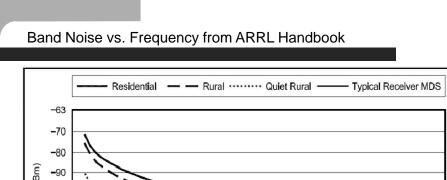
What is often not understood?

Noise Floor is usually significantly lower than Band Noise.

An ITU graph published in the ARRL Handbook gives us a starting point to relate band noise to noise floor.

This ITU data is in a 500-Hz bandwidth, just like typical noise floor data.

(Note: Noise floor is bandwidth dependent, unlike Noise Figure)



-100 -110 -120 -130 -143

HBK0131

Fig 1 — Typical noise levels versus frequency for various environments. (Manmade noise in a 500-Hz bandwidth, from Rec. ITU-R P.372.7, *Radio Noise*)

Frequency (MHz)

30

## Most Radios are designed for 10 meters

It is easy to assume that a -140 dBm noise floor is better than a -130 dBm noise floor.

If band noise on 20 meters is typically -110 dBm, of what value is a receiver noise floor that is 20 to 30 dB lower than band noise?

Use your 6 or 10 dB attenuator on the lower bands

Band noise easily changes 10 dB depending on beam heading.

Optimally receiver noise should be 8 to 10 dB lower than band noise to have minimal effect on receiving weak signals.

## How does band noise vary by band?

If we take the ITU rural data as a starting point, what is typical?

160 meters: -87 dBm 80 meters: -93 dBm 40 meters: -101 dBm 20 meters: -109 dBm 15 meters: -114 dBm 10 meters: -119 dBm

That's a 30+ dB difference in band noise

## Measured band noise at NC0B

160 meters 8:00 AM MST: -105 dBm January 2014 160 meters 4:00 PM MST: -101 dBm 160 meter CQ 160 meters 6:30 PM MST: -91 dBm CW Contest

ITU rural nominal value: -87 dBm

10 meters Beam Heading, October 2013 15 meters 0 degrees beam heading: -124 dBm -129 dBm 30 degrees: -124 dBm -123 dBm 60 degrees: -118 dBm -120 dBm 90 degrees: -114 dBm -120 dBm 120 degrees: -113 dBm -122 dBm 150 degrees: -114 dBm -122 dBm

ITU rural nominal value: -114 dBm -119 dBm

## ITU / ARRL Data is generally correct

- Those numbers = starting point for a rural QTH
- On a give day can be +/- 10 dB differences
- CQWW SSB 2014 my 10 meter noise floor was 10 dB lower than the ITU value, pointed West between 3 and 5 PM local time while working ZL, VK & JAs.
- (5 element monoband yagi @ 65 feet)
- 80 M mid-day band noise measured -120 dBm
- Urban QTH with RFI noise, all bets are off.
- How's your neighbor's Plasma TV?

## Typical receiver noise floor values

Rig Preamp OFF Preamp ON
 Pro III -132 dBm -140 dBm
 TS-990 -127 dBm -138 dBm
 K3 -130 dBm -138 dBm

 ITU night-time band noise on 40 meters is around -100 dBm, while typical receiver noise floor is -130 dBm, or 30 dB lower with the preamp OFF!

## What does all this imply?

- For most radios: Up-conversion / down-conversion
- On the lower bands at night, attenuation is often appropriate.
- There is no point in band noise reading upscale on your S meter.
- A preamp is usually NOT needed on 20 meters.
- A preamp would never be needed on 40 meters and below, assuming the transmit antenna is used on receive.

## Preamp on 160 or 80 meters OK?

- Many rigs today have an RX input for a receive only antenna.
- A Beverage or a small loop would usually have a head amp, at least for impedance matching. (Maybe just a transformer)
- A preamp for a receive-only antenna may well be appropriate on the low bands.
- Use common sense for special cases.

## Where do these examples not apply?

- Direct sampling radios are very different
- Examples of direct sampling radios:
- Perseus receiver (CW Skimmer)
- Apache ANAN-100D & ANAN-200D
- Flex 6300, 6500 or 6700
- The overload point of the Flex is much higher, and the noise floor is also much higher, with the preamp OFF.
- Apache is different in that it has a preamp in the circuit all the time, plus a variable attenuator.

## Some comparison data

Rig Noise Floor Preamp Off / On Noise Figure Preamp Off / On

 Icom Pro III
 -132 dBm / -140 dBm
 12 dB / 4 dB

 Elecraft K3
 -130 dBm / -138 dBm
 14 dB / 6 dB

 Kenwood 990S
 -127 dBm / -138 dBm
 17 dB / 6 dB

Flex 6700 -118 dBm / -132 dBm 26 dB / 12 dB

For classic radios with normal mixers (up-conversion or down-conversion) attenuation is often helpful in potential overload conditions (contests / DX pile-ups) on 40 meters and below. Possibly even on 20 meters.

For direct sampling radios, particularly the Flex 6000 series, attenuation would rarely be needed, but a preamp would be useful on 15 meters and up.

## How do we chose a new transceiver?

- On most bands receivers are too sensitive.
- Make the most of the radio's dynamic range by properly using the attenuator and using the preamp only when necessary.
- Published dynamic range can be misleading, depending on how it is measured. Read the fine print, as I discussed in past years.
- Look at RMDR, as this typically dominates.
- (RMDR\* = Reciprocal Mixing Dynamic Range)
- [\*QST April 2012 for sidebar Bob Allison]
- It is a numbers game today!
- Evaluation in contest conditions is critical.
- A lab setup can never approximate CQ WW!

## Speaking of RMDR - It means what ?

- Most of the time phase noise (reciprocal mixing dynamic range) isn't a problem.
- Poor RMDR likely implies bad transmitted broadband noise, too.
- When does it likely really matter?
- Field Day
- Multi-Multi contest stations
- You have a nearby neighboring ham within a few miles of you.

## **Example of transmitted phase noise hell**

- There are two hams in Boulder, CO that are 5 miles apart.
- Ham A never bothered Ham B with his Yaesu FT-1000 MP
- New FTdx-3000, Ham A wipes out the whole
   15 meter band with S9 broadband noise at
   Ham B's QTH
- We need to be a good neighbor, be it from a wide SSB signal, terrible key clicks on CW or poor transmitted phase noise.

## RMDR can be the limit instead of DR3

- My web site's the top 4 radios are outstanding from an RMDR standpoint.
- Flex 6700, Elecraft K3 & KX3, PT-8000A
- The new Elecraft K3 synthesizer board can upgrade any K3 to outstanding phase noise / RMDR performance
- For under \$200 you can be state-of-the-art
- (Part # KSYN3A)

## Passive IMD in Roofing Filters

- While testing the K3's new synthesizer, six roofing filters were tested for their effect on dynamic range.
- Some variation is expected, but there was significant variation with the 5-pole filters.
- This warrants further investigation.
- Roofing filter passive IMD has been observed with all "Down Conversion Radios".
- This has become the limit in the numbers race.

## How to cope on noisy bands

- Set the RF GAIN so punching in 6 dB attenuation definitely drops the band noise.
- If the band noise between words is as loud as a weak but Q5 signal, this adds to fatigue.
- If your receiver has hiss or hum in your phones, consider plugging your phones into a speaker that has high-pass and low-pass filters.
- Examples: Icom SP-20, SP-23 or SP-34
- Yaesu SP-2000 or Kenwood SP-990

## Transmit IMD Needs to be improved

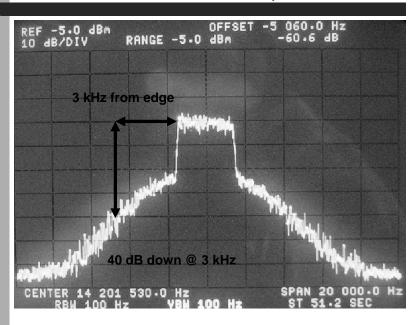
- Receivers have improved dramatically over the past 10 years, but rarely so transmitters.
- AI0L had complaints of being broad.
- Comparing rig A & amp A to rig B and amp B
- Desired sideband was S9 +15 dB
- Opposite sideband with "A" combo = S8
- Opposite sideband with "B" combo = S2
- "A" combo is current rig & solid-state amp
- "B" combo is 30 year old rig & 2x3CX800A7s

## Transmit Intermodulation IC-7410

- White noise fed into mic jack to approximate speech using IC-7410.
- (This is a typical example, not just this rig.)
- Look at the "shoulders" of IMD close-in to the transmit passband.
- If this station is 3 kHz away and is strong, hearing a weak signal will be difficult.

Noise source = GR 1381, 5-kHz -3 dB BW

## Icom IC-7410 Class AB, White Noise



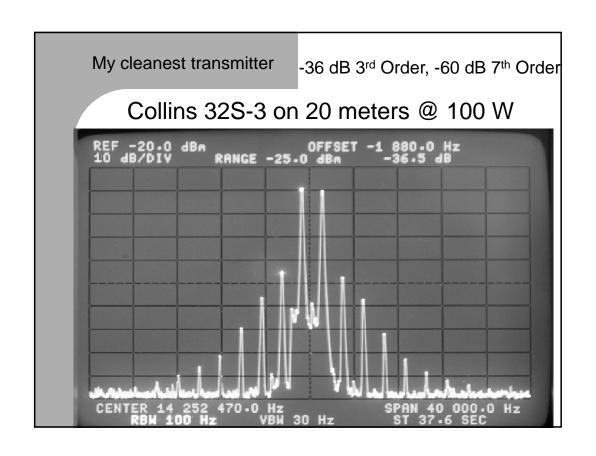
## Reception limits on SSB may be the other guy

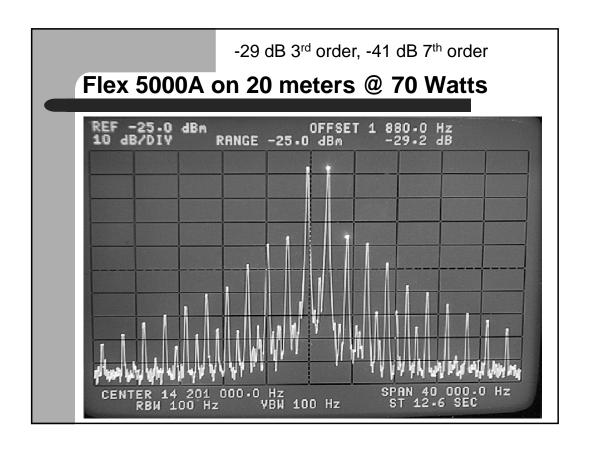
On SSB, adjacent-channel splatter is usually worse than the dynamic range of the receiver.

Today's 13.8 volt PAs are significantly worse from a transmitted IMD standpoint than tube PA circa 1962 (Collins 32S-3).

Why are rigs today, that will never be used mobile, still running on 13.8 volts?

With today's LDMOS FETs, 50 volt PA s should be the norm.





## Will you pay more for a cleaner signal?

We need help from our OEMs to clean up the bands

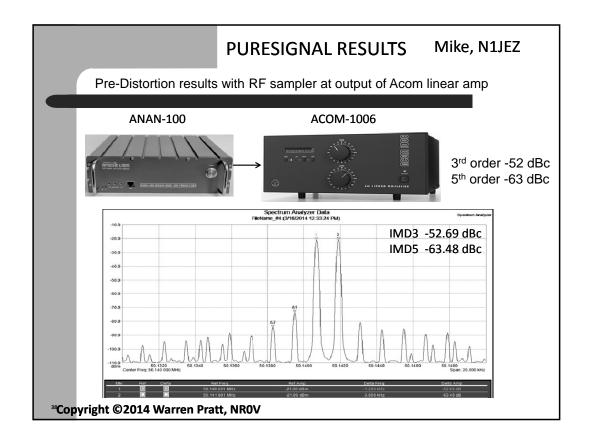
Will you spend \$100 to \$200 more for a cleaner SSB signal?

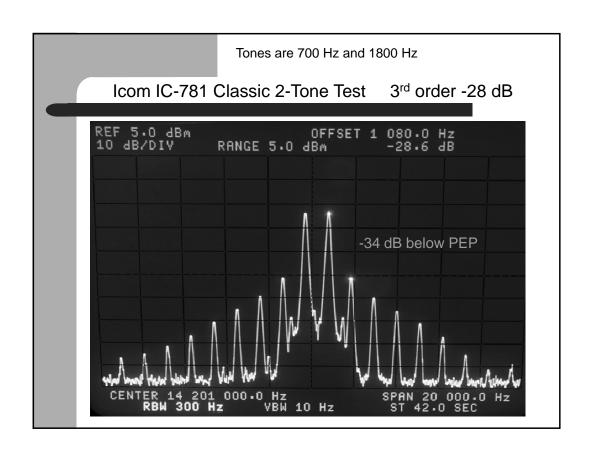
Pre-distortion could help even a 13.8 volt PA

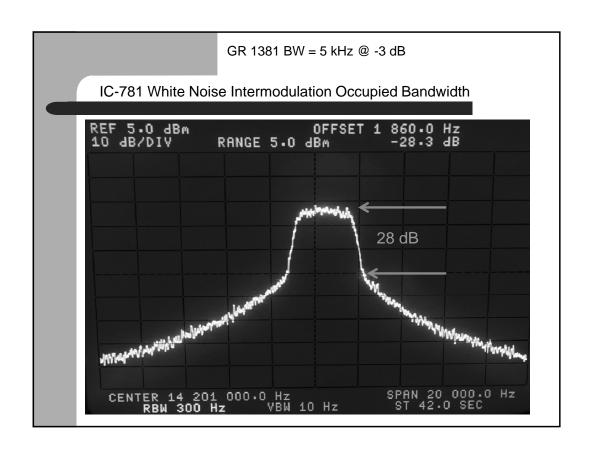
Apache offers that now, though setup is complex

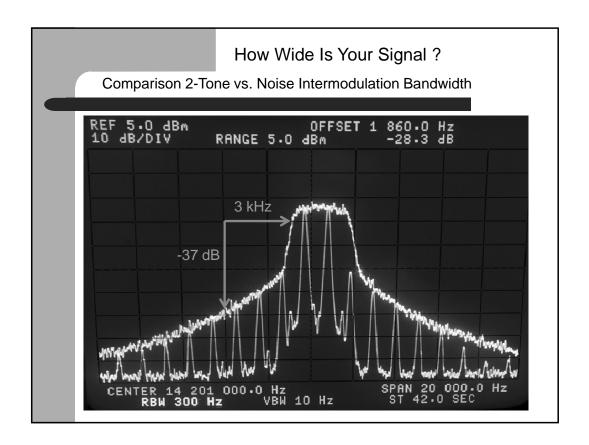
A cleaner rig is only useful if the operator doesn't over drive his linear into clipping. Who me splatter?

Every ham should have a scope or a real peak reading wattmeter if you run a linear amplifier.



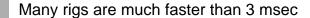






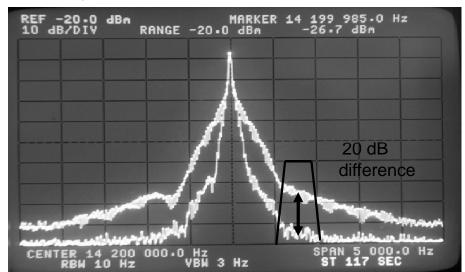
## **Broad signals Also Exist on CW**

- The following slide shows the difference between a rise time of 3 milliseconds vs. 10 milliseconds.
- There is a 20 dB difference in the strength of the key clicks 700 Hz removed from the transmitting station.
- (Transmitter was a Ten-Tec Omni-VII that has a menu to adjust the rise time.)



## Spectrum of CW Signal on HP 3585A Analyzer

Comparison of 3 msec vs 10 msec rise time



## Bad choices in the menus of many rigs

Many rigs today offer user adjustable rise times for CW operation.

The choices are often way too fast.

Typical choices: 1, 2, 4 & 6 milliseconds

I tested a \$7000+ rig with a 1.5 millisecond rise time that was 4.8 kHz wide at -60 dB.

Anything faster than 4 milliseconds will to too broad.

Again: Be A Good Neighbor!

## **Choices today on rig selection**

- We have rigs from \$1000 to \$14,500 for sale.
- Many do well in contest conditions.
- It is hard to evaluate on-air performance from some of the published data.
- Many aspects of a radio affect contest scores
- In the end, hopefully you enjoy using your rig on the air!

http://www.NC0B.com



Videos from past CTU presentations

CTU 2013 & 2014 (Select desired year) <a href="http://www.contestuniversity.com/main/page\_videos.html">http://www.contestuniversity.com/main/page\_videos.html</a>

CTU 2011

http://www.pvrc.org/webinar/radioperformance.wmv

## Contest Glossary – by Patrick Barkey, N9RV

#### 10-minute rule

The 10 minute rule restricts band changes for some multi-operator categories for certain contests. The implementation of the rule depends on the contest – in some cases it has been replaced by a band change rule. The rule was designed to prevent the interleaving of QSO's on different bands for "single" transmitter categories by stations which actually have multiple transmitters on different bands.

Categories: contest specific concept, operating classification, See Also: Band change rule, MS, M2, rubber clocking

#### 175 mile radius

A geographic requirement for groups of stations jointly submitting their scores as part of the club competition in ARRL contests. In the "unlimited" category of club competition, stations submitting their scores as part of a club for the club competition must either be within a single ARRL section, or within a 175 mile radius of a centroid, to be eligible to contribute their score to the club total..

Categories: contest specific concept, log checking and reporting See Also:

#### 3830

The frequency on the 75 meter band where stations congregate at the end of a contest to exchange scores informally. In actual practice, most of this now takes place on internet. The listsery, or reflector, where much of this takes place is called the 3830 reflector. It is hosted by contesting.com. A separate site, 3830scores.com, has comprehensive summaries of (unverified) contest scores reported by participants.

Categories: log checking and reporting See Also:

#### 4-square

An increasingly common array of four vertical antennas arranged in a square that is electronically steered in four, switchable directions using torroidal or coaxial delay lines. Once used mostly as transmit antennas, particularly on lower frequencies where yagis are not practicable, these arrays are also becoming common as receive antennas. 4-square controllers, which perform the switching, are both homebrew and commercially available.

Categories: station hardware See Also: Receive antennas

#### 8-circle

A circular array of eight vertical antennas arranged in a square that is electronically steered in a manner similar to the 4-square array, with greater gain and front-to-back, as well as more selectable directions. When these arrays are used as receive arrays they often use very simple ground systems and use basemounted preamps.

Categories: station hardware See Also: Receive antennas

#### **ADIF**

Amateur Data Interchange Format. A transport format for contest logs used for importing/exporting files between different logging software and other programs. Similar in function to Cabrillo.

Categories: operating software/hardware

#### **AFSK**

Audio Frequency Shift Keying is a RTTY mode where two audio tones are fed into the Mic or auxiliary audio input to the SSB transmitter to create the two RTTY RF frequencies.

Categories: general

See Also:

#### Assisted

Assisted is an "overlay" category that is interpreted in most contests as meaning that use of spotting information delivered from internet or packet radio based networks which give real-time information on frequencies and call signs of stations in the contest is allowed. It is a single operator overlay – most multi-operator categories already allow spotting assistance.

Categories: operating classification

See Also: SOA

#### Band change rule

A rule which restricts band changes for certain multi-operator categories in some contests. A band change rule says that a station can, say, only make 8 band changes per hour. Note that moving to a band to work something, and then returning counts as two band changes.

Categories: contest specific concept See Also: 10-minute rule, MS, M2

#### **Band Decoder**

A band decoder either operates through hardware or software to switch station hardware (e.g., antennas, filters) based upon the band selection of the radio. They are a fundamental part of most top tier stations.

Categories: station hardware

See Also:

#### **Band Edge**

The band edge generally refers to the lowest (or highest) frequency in the band where one can legally operate within the limits of his/her license. For US operators, for example, this would be approximately 21200.4, say, for 15 (USB), but would be about 7127 or so for 40 (LSB). The reverse is true for the upper band edge – e.g., on USB on 15 meters the practical limit for transmit frequency is approximately 21448. The lower band edge is sometimes desirable for US operators who are running since QRM from other W stations can only be on one side of your signal.

Categories: operating technique, ethics,

See Also:

#### **Band Map**

A graphical, real time display of stations arranged by frequency presented by most popular contest software. The map is either populated by telnet/packet spots from clusters and skimmers, and/or may be filled in using data entered by the user. Most software allows users to then click on stations on the map to be taken directly to the frequency the station is reported to be on. Stations listed on the map are color coded – with new multipliers distinctly noted. (Stations previously worked may not be listed at all). The accuracy of these maps is only as good as the data used to construct it – errors in call signs are frequently encountered. Use of band maps (or packet/telnet and skimmer spots) are not permitted for Single Operator Unassisted categories.

Categories: operating software/hardware

#### **Bandpass filter**

A tuned circuit which can be inserted into an RF line to attenuate signals above and below the design frequency. Bandpass filters are used in many multi-op and SO2R stations to reduce harmonics as other emissions from local transmitters on adjacent bands, which is important when trying to receive weak signals during times when transmitting on other bands.

Categories: operating software/hardware

See Also: stubs, SO2R

#### Beacon

Fixed, automated transmitters which transmit signals (typically CW) continuously to allow operators to check propagation. These transmitters are located around the globe and on HF are mostly found on bands such as 10 meters above 28.1 MHz. They typically use low power and omni-directional antennas. It can be good operating strategy to tune to these stations during contests to learn when propagation might support QSO's even if activity and thus stations in the contest are not heard

Categories: operating techniques

See Also: RBN

#### Bip/Bop

A hardware switching arrangement for stacked yagis or other all driven antenna arrays that allows the operator to select both in phase (BIP) or both out of phase (BOP) operation. The latter can be dramatically better for very high angles of radiation..

Categories: station hardware See Also: Stack, Yagi

#### **Blind Skimmer**

A mode of operation for a CW skimmer that disables the decoding of call signs as well as the integration with internet spots. In this blind mode, the operator only sees (potentially) a waterfall display showing recent historical activity across the band as with a panadaptor. Blind mode is legal for single operator, unassisted entrants in most major contests.

Categories: contesting hardware/software

See Also: skimmer, panadapater, spots, SOAB, SOA

#### Breakdown

The disaggregation of one's contest score into QSO's and multipliers worked, usually separately tallied for each band (or even additionally, for each hour).

Categories: log checking and reporting

See Also:

#### **Bust**

A bust is a QSO that is incorrect in some way – the call sign or exchange was inaccurately recorded. May also refer to spots which are incorrect.

Categories: log checking and reporting, ethics,

See Also: Spot

#### Cabrillo

Cabrillo is a very flexible and generalized computer file format that is supported for score reporting by all modern contest software. Most contests have moved to require that electronic log submissions provide contest logs in this format. In most cases contest software will do this automatically.

Categories: log checking and reporting

#### Check

A two digit number that corresponds to the first year that you obtained your ham radio license. The check is part of the exchange in the ARRL SS contest. Multi-operator stations use the same check regardless of who is.

Categories: contest specific concept

See Also: Exchange

#### Checklog

A category for log submissions which removes the entrant from any competition or score listing. Instead, the log information is submitted solely for log checking purposes by the contest sponsor.

Categories: operating classification

See Also:

#### Claimed Score

The contest score that is computed before any deductions for incorrectly logged information (conducted after the contestant submits the log to the contest sponsor) take place.

Categories: log checking and reporting

See Also:

#### Ck

The CW abbreviation of "check," a part of the ARRL SS exchange.

Categories: contest specific concept

See Also: Check, Exchange

#### Cty.dat

Cty.dat, or sometimes wl\_cty.dat, also known as a "country file." is the computer file containing the lookup information that translates prefixes of call signs into country and/or zone multipliers. Software would use this file, say, to tell you that N9RV counts as a W, and is in CQ zone 4 (or ITU zone 6). Since worldwide prefixes are frequently in a state of flux, an up-to-date country file is always desirable. More recent country files also contain data that may help determine a station's zone. Such information can be inaccurate and in all cases operators should gather such information from the contest exchanges themselves.

Categories: operating software/hardware

See Also: Multi, Exchange

#### **Deadline**

The latest day that logs can be submitted to the contest sponsor to be included in the competition.

Categories: log checking and reporting

See Also:

#### **Digital Voice Keyer**

Hardware which digitally records one's voice for CQ's, contest exchanges and other frequently spoken information. The recording is played back using keystrokes defined by software (or by pushing a button for a standalone box), thus saving the operator the fatigue of doing it manually. Most modern software uses computer sound cards for this purpose. Older software used specially designed cards (e.g., the DVP by K1EA, the W9XT card) or even a standalone box.

Categories: operating software/hardware

#### **Diversity Reception**

Receiver diversity occurs when on uses two receivers tuned to the identical frequency but employing different antennas. Ideally the antennas could have different polarization, different heights, or have some other distinguishing characteristics. Diversity reception can be mixed in both ears, or fed to each ear separately. Particularly on the low bands, diversity reception can mitigate the effect of deep QSB that is often present in low band propagation. Many radios now contain multiple independent receivers and support diversity reception.

Categories: station hardware

See Also:

#### DQ

Disqualification (DQ) is the disallowal of a contest entry by the sponsor of the contest, for serious rule violations. DQ is a serious step, which can have ramifications for WRTC eligibility and participation in future contests.

Categories: log checking and reporting

See Also: red card, yellow card

#### **Dual-CQ**

Dual-CQing (or dueling CQ's) is supported by some contest software in a SO2R environment, where a CQ is called alternatively on each radio (typically on separate bands). It adds complexity, but can increase your transmitted presence in a

Categories: operating technique, operating software/hardware,

See Also:

#### **Dummy CQ**

A dummy CQ is a CQ sent out by a SO2R station as a means of holding a frequency (e.g., discouraging others who might start CQing themselves). Although it sounds just like any ordinary CQ, in a dummy CQ scenario the SO2R station is not prepared to answer responding stations until his/her QSO on the other radio is completed.

Categories: operating technique, operating software/hardware,

See Also:

#### **Dupe**

A dupe is a second contact with a station that does not count for additional points. Most contest software will inform you whether or not a station is a "dupe" so you don't waste time working it.

Categories: log checking and reporting

See Also:

#### **ESM**

Enter Sends Message mode. A concept for logging software that uses the Enter key on the keyboard to accomplish multiple tasks, depending on the context. While this is implemented differently in specific software, the general concept allows the user to press the Enter key at different stages to, say, start a CQ message, respond to a call by sending the exchange, or send one's own call, depending on the context in which the key is pressed. If a program does not enable ESM mode, then pressing a specific key always produces the same result.

Categories: operating software/hardware

#### **Exchange**

The information that is passed between stations in a contest (in addition to the call sign). In the CQ WW, for example, the exchange is RST and the two digit CQ zone number.

Categories: contest specific concept, operating software/hardware,

See Also:

#### Firmware

Computer code that controls a device. The code is generally resident in a chip, and can be updated using whatever communications protocols are set up for this purpose. Many contesting devices are now microprocessor controlled, and the ability to update firmware (generally made available by the manufacturer but sometimes customizable by the user) can greatly add to the capabilities and functionality of the device. The Elecraft K3 transceiver, for example, has a rich and vibrant community developing new firmware to improve its operation.

Categories: station hardware

See Also:

#### **Flutter**

A propagation phenomenon that is characterized by very rapid QSB (fading signal strength), often accompanied by Doppler shift in frequency, which can produce a warbling tone on CW. Signals displaying flutter are most often associated with paths that travel close to or through the auroral zones around each pole of the globe, but during periods of high auroral disturbances flutter can affect almost all signals. For this reason the presence of flutter on a signal gives a useful clue for the call sign of a (possibly weak) station.

Categories: general, operating technique

See Also:

#### **FSK**

Frequency Shift Keying is a RTTY mode where the transmitter is keyed directly, similar to CW.

Categories: general

See Also:

#### Gab

Gab is a feature of many contest software packages that allows computers setup at different operating positions in a multi-operator station to send and receive messages at the keyboard to/from each other.

Categories: operating software/hardware

See Also:

#### Gab file

Gab file is the record of gab messages recorded by the software during the contest.

Categories: operating software/hardware

See Also:

#### Gas

A derogatory term that refers to running more transmitter power than is allowed by the terms of your radio license. Some contests (e.g., the CQ WW) limit transmitter power to a maximum of 1500W output no matter what the rules for one's country say.

Categories: ethics

#### Golden Log

A log which survives the contest sponsor's log checking process with zero errors and no change to its claimed score. A golden log is the mark of a careful and skillful operator.

Categories: log checking and reporting

See Also:

#### **Gray Line**

The gray line, or daylight/darkness terminator, is a constantly moving circle around the earth where a daylight/darkness transition is taking place. When this circle is over your QTH, potentially enhanced propagation along the terminator is possible, especially on lower frequencies. The timing and potential for gray line propagation depend on a number of predictable (season of the year) and unpredictable (solar conditions) factors. Gray line QSO's can produce new multipliers and/or memorable contest experiences.

Categories: general, operating technique

See Also: long path

#### **Grid Square**

An alphanumeric geographical coordinate system, based on the Maidenhead Locator System developed by VHF enthusiasts in 1980, in which the entire globe is divided into equal-sized rectangles which are denoted by alphanumeric codes. E.g., the four digit grid square for N9RV (western Montana) is DN36. Four (or more) digit grid squares have found increasing popularity as contest exchanges, particularly for VHF contests, as they offer both an increased challenge for successfully completing contest QSOs with accuracy, as well as giving universal location information for all countries/states.

Categories: contest specific concept

See Also: exchange, http://en.wikipedia.org/wiki/Maidenhead\_Locator\_System

#### **Great Circle**

The bearing between two points on the globe which minimizes the physical distance is known as a great circle bearing. Thus the great circle bearing for working, say, India from the central U.S. is approximately due north. Great circle bearings can vary considerably from what might be suggested from the Mercator projection maps posted in most grade schools. During most openings on HF, great circle bearings are optimal for directional antennas. Long path (180 degrees different) or skew path (aiming towards the equator) are less frequent, but sometimes better, strategies for aiming antennas.

Categories: general

See Also:

#### **K3**

A popular HF transceiver available from Elecraft that is used by many contesters.

Categories: station hardware

See Also:

#### **LCR**

An acronym for Log Checking Report. A report from the contest sponsor to each individual competitor that details the scoring adjustments to their submitted contest log, reflecting dupes, busted calls, NIL's and other errors. The LCR is very useful as a means of improving your accuracy in future contests.

Categories: general, ethics, See Also: bust, dupe, NIL

#### Lid

A lid, generally, is someone whose operating behavior shows a lack of awareness, competence or consideration for other amateurs.

Categories: general, ethics,

See Also:

#### Lockout

A means of preventing two transmitters from keying or transmitting simultaneously. A hardware lockout accomplishes this task by inhibiting the transmit/key line on the different radios with a lockout circuit. A software lockout does the same thing using software. This prevents the station from violating the rules of the contest. E.g., it could prevent a multi/multi station from having more than one transmitted signal on the same band, or it might prevent a single operator station from transmitting simultaneously on multiple bands.

Categories: operating software/hardware, ethics

See Also:

#### **Long Path (CW abbreviation LP)**

A situation where HF propagation exists between two stations in the inverse direction of the great circle heading. "Beaming long path" means pointing your antenna 180 degrees different from the "short path," or great circle heading, for a particular station. Long path propagation, for example, might allow a North Carolina station to work a station in Hong Kong on 10 meters in the morning by beaming southeast. Depending on the season of the year and the propagation on any particular day, this can be an extremely effective event in a DX contest, allowing for long distance QSOs not possible during short path openings. Gray line QSOs, for instance, are frequently long path. Learning and checking the long path openings, in terms of times, bands and geographies, from your QTH can be very valuable for increasing your multipliers and contest scores in DX contests.

Categories: general, operating technique See Also: gray line, short path, skew path

#### **M2**

Shorthand for the multi-operator, two-transmitter category offered in some contests. This is a relatively new category that was intended to allow greater flexibility that older single transmitter categories, but with less hardware requirements than the open ended multi transmitter category.

Categories: operating classification

See Also: MS, MM

#### Master.dta

The master.dta, or "master database" file is a collection of so-called "known good calls" – e.g., call signs of stations that have been worked in previous contests. It can be used as an operating aid with most contest software to suggest complete calls when only partial information is copied over the air.

Categories: operating software/hardware

See Also:

#### MM

The multi-operator, multi-transmitter category involves an unlimited number of operators and transmitters, with only one transmitted signal allowed per band.

Categories: operating classification

See Also: M2, MS

#### **Moving Multipliers (aka Passing Multipliers)**

An operating technique where one asks over the air for a station who is a multiplier (e.g., a new country, state or section) to move (QSY) to a different band so that an additional multiplier can be added to one's score. To be done successfully, there must be propagation between the stations on the new band, and the asking station must be able to move quickly. It is not good contest etiquette to ask a CQ-ing station with a pileup to move bands, but even rare DX that comes back to your own CQ's is fair game for this technique. For contests like SS and WPX that only count multipliers once (instead of once per band) this does not apply.

Categories: operating technique

See Also:

#### MS

The multi-operator, single-transmitter category found in many contests has evolved to have different definitions in individual contests. Once understood as a "one transmitted signal" category, its exceptions and specific band change rules make it among the most complex, yet most popular, categories.

Categories: operating classification

See Also: 10-minute rule, band change rule

#### Multipliers (aka Mults)

Most, but not all, contests compute the final score as the product of (i) QSO points and (ii) a tally of zones, countries, prefixes or other unique characteristics. Since they impact the score multiplicatively, this second item is called the multiplier. For example, in the SS contest, the multiplier is the number of unique ARRL sections worked (maximum of 80). Thus when a new (e.g., unique) section is worked, it has a greater impact on the final

Categories: contest specific concept, operating technique,

See Also:

#### **Mult station**

The station in a multi-transmitter environment that is working only multipliers – new countries, zones, or prefixes, depending on the contest. This usually entails tuning and answering others who are calling CQ.

Categories: contest specific concept

See Also: S&P, Run station

#### **Multiplier**

See the discussion under mult above.

#### **Multiplier Bell**

A frequently used motivational device for multioperator contests. The sound of a bell going off in a room of operators when a new multiplier is worked by one of them manning different radios is familiar to many successful multi-operator stations.

Categories: operating technique

See Also:

#### NIL

Not-in-log. A deduction made by the contest sponsor that refers to the situation where a contact claimed by one station is not confirmed by a record in the second station's log. In most cases an NIL results for you when there is nothing even "close" to your call in the other station's log at the time you claimed the contact.

Categories: log checking and reporting

#### Off-by-1

A "one off" call is a call that differs by one character – W9RV, N7RV, and N9RE are all one off calls for N9RV.

Categories: log checking and reporting

See Also: SCP

#### Off-time

Off-time is the amount of time during the contest period that a station is off the air – no listening or transmitting taking place. Some contests (e.g., Worked All Europe, ARRL SS) require that single operator entrants take a minimum amount of off time. Off time lengths are usually restricted to a minimum block size (30 minutes in SS, for example).

Categories: contest specific concept, operating technique,

See Also: Rubber clocking

#### **Packet**

Packet originally referred to packet radio spotting networks, which were an application of (typically) VHF packet radio networks that were created in the late 1980's as a means of exchanging real-time spot information during contests. The rise of high speed internet since that time has caused almost all of these networks to migrate to the net, greatly increasing their speed and scope. Although no real connection to packet radio networks still exists, the term "packet" has survived, referring to spotting networks in general.

Categories: operating software/hardware, operating technique

See Also: spot

#### **Panadaptor**

A band scope that displays signals on a band visually, usually as a line or area graph, allowing for a view of activity across an entire band at once. The display show signal strength on the vertical axis and frequency on the horizontal, and is sometimes combined with a waterfall display which presents a brief historical view of activity on a frequency instead of an instantaneous view. This can be a standalone piece of hardware, integrated into a radio, or software produced by a product like a skimmer.

Categories: contesting hardware/software

See Also: skimmer

#### **Partial**

Partial calls are bits and pieces of full call signs. They contain valuable information but cannot be logged until they are complete.

Categories: operating software/hardware, operating technique,

See Also: SCP, Super Check

#### **Partner Mode**

Partner mode is a contest software configuration available on many packages that is designed to make effective use of multiple operators listening to the run frequency (for multi-op categories) to pick calls out of a pileup faster and more efficiently. In partner mode a second operator can type in calls he/she hears which then appear as selections on the control operator's display. Partner mode can be effective either in situations where pileups are present, or when signals are weak and receiver antenna diversity is available.

Categories: operating technique, operating software/hardware,

See Also: MS, M2, MM, diversity reception

#### **Pass**

Passing is an action where a station worked on one band is requested to QSY to a second band, typically in order to obtain additional multiplier credit. Proper contest etiquette holds that only stations who respond to your CQ can be passed – it is not good manners to ask a station who has established his or her own running frequency to QSY to another band.

Categories: operating technique, operating software/hardware,

See Also:

#### **Penalty**

Penalties are additional deductions made for unverified or inaccurate information submitted as part of one's claimed score. For example, a NIL in the ARRL SS contest results in the loss of the claimed QSO as well as an additional penalty QSO deducted. Penalties and other score reductions are incurred by all contest competitors, both new and experienced, and are generally nothing to be ashamed or fearful of. Part of contest competition is acquiring operating habits that minimize these deductions.

Categories: log checking and reporting

See Also:

#### **Pileup**

Multiple stations calling a CQing station at the same time. Modest pileups are concentrated on a single frequency. Rare DX might result in a pileup that is spread out across multiple frequencies. The skill of picking calls out of a pileup, or alternatively, successfully breaking through a pileup to get a CQing station to respond to your call, is a critical contest skill.

Categories: operating technique

See Also:

#### **Poach**

Poaching is when a third station strays onto the frequency of a station who is running in order to make contact with one of the responding stations. If N9RV is running stations on 14024, say, and you attempt to call one of the stations that he has just worked, you are poaching. As the term implies, this is aggressive and unethical contest behavior.

Categories: operating technique, operating software/hardware, ethics

See Also:

#### Point and shoot

Also known as point and click. A refinement of the search and pounce operating method which is supported by most major logging software programs. With this method, the operator clicks on calls presented in a window on the monitor, so that the frequency of the radio is immediately changed to the frequency of the call which is listed. Thus one may quickly hop around the band, each time landing on the frequency of a CQing station who can be called. The technique is only allowed for operating categories which allow access to packet/internet spotting networks. The technique, while very attractive, has two major difficulties: (i) calls which are spotted may be incorrect – unless one independently verifies the call one runs a very high risk of incurring penalties for busted QSOs, and (ii) when dozens or hundreds of stations in a contest use this technique simultaneously, it results in big pileups calling on exactly the same frequency, which are hard for CQing stations to disentangle.

Categories: operating technique, operating hardware/software

See Also: S&P, spot, bust, skimmer

#### Points per q

The number of QSO points that any particular contest contact contributes. In some contests, for example the NA Sprint or ARRL SS, the points per QSO is constant. Most DX contests employ points per q rules that give more credit for contacts outside your continent. Some give zero points for contacts within your own country.

Categories: contest specific concept, operating technique,

See Also:

#### Precedence (CW abbreviation Prec)

Part of the exchange in the ARRL SS contest. It consists of a single letter, once solely based upon your transmitter power: Q = 5 watts or lower, A = 5-100 watts, B = more than 100 watts. Recently additional Prec's were added for multi-operator and assisted categories. See rules for ARRL SS contest.

Categories: contest specific concept

See Also: Exchange

#### **Prefill**

Prefill refers to the features of some software packages which automatically fill in exchange information based upon information obtained either before or during the contest. Prefill software might enter "Pat" in the name field for the NA Sprint, for example, if you work N9RV, either based upon previous contests, or based on working N9RV on a different band in the current contest. If the prefill information is different from what the station actually changes, of course, it is up to the operator to manually correct it.

Categories: operating software/hardware, operating technique,

See Also: Exchange

#### **Prefix**

The portion of a call sign that contains the beginning of the all, up to, and including, the number. The prefix of N9RV is N9. The prefix of 3DA0X is 3DA0. Prefixes count as multipliers in some contests – e.g, the WPX contest. In most cases, prefixes also reveal the geographical location of the station as well.

Categories: general

See Also:

#### **ORP**

QRP in contesting is generally where one's maximum output power is no more than 5 watts. In many contests, power is an overlay category. E.g., you can be QRP and SOAB.

Categories: operating classification

See Also:

#### **Q**-signals

A three letter code beginning with the letter Q. In theory, each code has a slightly different meaning when used with a ? appended. ARRL and other groups publish the codes and their text meaning. In contesting only a few of these codes are used, sometimes in ways that have evolved from their "official" meaning.

Categories: general

See Also:

#### Qso b4

QSO b4 is the CW message sent to tell responding stations that they have been worked for point credit previously in the contest and no second QSO is necessary/desirable.

Categories: operating technique

See Also: Dupe

#### Rate

Rate refers to the speed of making contest QSOs. It is typically measured in QSOs per hour, even when the time span referred to is longer or shorter than 60 minutes. E.g., if N9RV's 10 minute rate is 70.4, it means that if he continued to make QSOs at the same rate for 60 minutes as he just made in the last 10, he would have 70.4 QSOs in the log. The rate statistics provided by most contest software give valuable information on operating

Categories: operating technique, operating software/hardware,

See Also:

#### **RBN**

Reverse Beacon Network is a internet-based network of dedicated wide band receivers around the world which decode CW signals in real time and generate "spots" which contain frequency, signal strength and other information. The effect is that of a traditional beacon in reverse – instead of checking propagation by tuning one's receiver to a transmitting beacon at a particular frequency, one merely transmits (usually by calling CQ on CW) while connected to a RBN to see which of the receivers on the network hears you.

Categories: operating software/hardware

See Also: spot, skimmer, skimmer network, beacon

#### **Receive Antenna**

Generally refers to an antenna that is used for receive purposes only - e.g., not the same as the transmitting antenna. These include specialized antennas, such as loops, short verticals, pennants or beverages. Receive antennas can be used singly or in combination - e.g., fed into separate receivers simultaneously - the latter is used for what is known as diversity reception. Most modern receivers allow for this. Receive antennas are often non-resonant, and are of particular advantage on lower frequencies to improve directivity and the signal to noise ratio.

Categories: station hardware

See Also: 4-square, 8-circle, diversity reception

#### **Remote Operation**

This generally describes a situation where the physical location of the transmitter/receiver is different from that of the controlling operator. This can be supported by software that allows receiver audio and other information to be sent to a remote computer (possibly located thousands of miles away) that also controls transmit, rotor, and other station functions. Contest and DX rules are still evolving on the validity of this configuration. Most seem to allow remote operation as long as the transmitters and antennas are in a single physical location.

Categories: station hardware, ethics

See Also:

#### Repeat CQ

Auto-repeat of a CQ message, with a user-specified delay. Repeat CQing can be useful when the band is only marginally open and the operator wants to dedicate more concentration to the second radio (in SO2R). Repeat CQing is cancelled in most software packages when a key is pressed.

Categories: operating technique, operating software/hardware,

See Also: SO2R, duel-CQ

#### Robot

The contest robot, or simply "robot," refers to the automated process that examines contest logs that are submitted to contest sponsors (either via email or a web page) for proper syntax and formatting. Most contest robots will "bounce," or reject with error messages, logs which fail to conform to the proper Cabrillo format, fail to include required information, or which contain other errors.

Categories: log checking and reporting

See Also: Cabrillo

#### Rover

A rover is a mobile station that travels during a contest to activate multiple geographic locations (typically grid squares) during the course of a contest. Rover stations are especially common in VHF contests, and often involve sophisticated setups that can activate multiple bands as well as high profile (elevation) locations. Rovers can make the contest more fun for everyone by making more multipliers available and thus adding to contest scores. The so-called "captive" rover refers to a rover whose express purpose is to work only a single competitor. The ethics of this variant to the rover concept is dubious at best.

Categories: operating classification, ethics

See Also:

#### **Rubber Clocking**

A slang term used to refer to the adjusting of times in the contest log to make QSOs appear to conform to the rules of a category and contest. This includes, for example, to make reported off-times in time-limited contests such as the ARRL SS conform to rules that require them to be at least 30 minutes in length, or making times of QSOs appear to obey the 10-minute rule for multi-operator categories in DX contests. Such changes are unethical and not allowed by contest rules and are grounds for disqualification.

Categories: ethics, log checking and reporting, contest specific concept

See Also: DQ, red card, yellow card, 10-minute rule

#### Run

Running refers to staying on one frequency and calling CQ to solicit new contacts. Running may, or may not, be the fastest way to make QSOs and/or build your score at any given time. Whether or not to run is a fundamental decision made during the entire duration of a contest.

Categories: operating technique

See Also: Run station

#### Run station

The station in a multi-transmitter environment that is "running" stations – e.g., calling CQ and taking all who Categories: contest specific concept

See Also: Running

#### S&P

Search & Pounce is the operating method where one tunes a band and responds to other stations who are running (e.g., calling CQ). The "traditional" tuning by spinning the receiver knob has been augmented by contest software that allows one to jump instantly to a spot frequency (for categories which allow this) and more recently through the use of panadaptors and other visual displays that allow operators to jump to a frequency based on visual

Categories: operating technique See Also: spot, point and shoot

#### Schedule

Schedules are advance arrangements to make QSO's with specific stations at specific frequencies and times. Schedules are often made during a contest to try to work additional multipliers on times and frequencies when propagation is favorable. E.g., N9RV may work NH2T on 15 meters at 0100z and set up a schedule for 40 meters on 7030 kHz at 0700z. When 0700z rolls around, if NH2T and N9RV remember to go to 7030 kHz and they hear each other, a new QSO (which may be a new multiplier for one or both) can be made. Schedules made on the air during the contest can be an important and effective contest tactic. Schedules made via non-amateur means (e.g, email) and/or schedules made before the contest starts are not allowed by most contest rules. Even if rules do not explicitly forbid it, such practices are not considered ethical and should be avoided.

Categories: operating technique, ethics

See Also: mult

#### SCP (aka Super Check or Super Check Partial)

This refers to the process of checking a call sign (or a partial call sign) that a user has typed into the entry screen of a contest program against a database of calls. The database typically consists of call signs already worked in the contest as well as an externally generated database of (supposedly) known good calls that are active in contests. SCP is an extremely valuable tool that can help a user guess or verify that a call he/she is entering is correct or incorrect. An SCP window will show U+1 calls, and if wildcard characters are used in the middle of a call sign it can suggest potential call signs that "fit" what is heard. SCP should be used with care, as logging what is actually heard is always preferable to database "guesses."

Categories: operating technique, contest software, ethics

See Also: Unique+1, Partial

#### Section (CW abbreviation Sec)

A section is the geographical area defined by the ARRL as well as the RAC (Radio Amateurs of Canada) for their respective field organizations. For some states this is the same as the state (e.g., Montana), but larger entities (e.g., New York or California) are divided, resulting in more sections than states. The same is true for RAC, except that RAC sections sometimes represent a combinations of smaller provinces/territories as well. Sections count as multipliers for some ARRL contests. Currently there are 83 possible sections.

Categories: contest specific concept

See Also: Mult

#### Serial Number (CW abbreviation NR)

A counter that begins at 1 for the first contest QSO, and increments by 1 for each successive contact. The serial number is part of the exchange for some contests (e.g., the CQ WPX, the Worked All Europe contest).

Categories: contest specific concept

See Also: Exchange

#### **Sherwood Receiver Comparison**

The long-running publication of receiver performance information produced and reported by well known receiver guru Rob Sherwood. These measurements can be very important in assessing the value and utility of any given receiver. The measurements are particularly important to contesters, since we often operate in environments that present significant challenges to receiver front ends.

Categories: general, contest software/hardware

#### **Short Path (CW abbreviation SP)**

The propagation path which follows the great circle heading between two stations, in the direction of the shortest distance. Short path propagation can be thought of as "normal" propagation, and the phrase is usually used to distinguish it from the more unusual situations where signals propagate long path or skew path.

Categories: general, operating technique See Also: gray line, skew path, long path

#### **Single-Band**

Competitors in the single band categories restrict their competitive efforts to one frequency band (e.g., 40 or 20). In some contests they are allowed to make contacts on other bands, but only their "single" band OSOs count towards their score.

Categories: operating classification

See Also:

#### Six-Pack

A six pack is a relay controlled matrix coax switch with two inputs and six outputs. It is used by many stations who use SO2R as a means of allowing either station to have access to any antenna. Newer variants of matrix switches allow for more than six outputs, but the term has stuck.

Categories: station hardware

See Also:

#### **Skew Path**

A propagation phenomenon where the ionosphere does not support direct-line propagation (along a great circle heading) between two stations, but contacts can be made by aiming closer to the equator (due east or west) so that the path is skewed, so that the first hops travelling in a more southerly direction (for northern hemisphere stations). For a North American station, for example, a skew path opening to Japan might make signals peak due west or even south of west. Skew path openings can take place at frequencies below the MUF, or maximum usable frequency, between two points on the globe, which is often the case under poor propagation conditions. Turning your antenna to explore skew path propagation is a very useful technique that can make a previously inaudible signal suddenly appear and make a QSO possible.

Categories: general, operating technique

See Also: : short path, long path

#### Skimmer

A Skimmer is a product developed by VE3NEA which combines a CW code reader with a broadband receiver, providing real time spotting information without the use of a spotting network. It has recently been enhanced to perform the same function with RTTY signals.

Categories: station hardware, operating software/hardware, ethics

See Also: skimmer network

#### **Skimmer Network**

The global network of internet-connected skimmer stations which continuously copy and post call sign, frequency information and signal strength data for ever station they decode (CW and digital modes). The data stream can be used in real time by a variety of applications and contest programs to allow "point and shoot" operating during contests. Note that unassisted categories are not allowed to access skimmer networks.

Categories: station hardware, operating software/hardware, operating technique, ethics

See Also: skimmer, point and shoot

#### SO<sub>1</sub>R

Single operator single radio is not a formal category in most contests, but describes the less complex hardware/software setup where the operator tunes and transmits on one radio at a time.

Categories: operating classification, operating technique,

See Also:

#### Snow/rain static

QRN caused by electrically charged precipitation hitting antennas. Low antennas and quads are usually less susceptible than high yagis.

Categories: general

See Also:

#### SO2R

Single operator two radio operation involves using audio feeds from two radios simultaneously (but with only one transmitted signal at a time allowed), which enables an operator to tune and listen on a second radio (usually on a second band) while the primary radio is transmitting.

Categories: operating classification, operating technique,

See Also: Dual-CQ, Dummy CQ

#### **SO2R Controller**

A homebrew or commercially made accessory which automates the switching of station peripherals (e.g., headphone audio, key paddle input, microphone) between two radios to enable more effective and efficient two radio operation. These accessories typically integrate with contest software to manage two radio operation as seamlessly as possible.

Categories: station hardware, operating software/hardware

See Also: SO2R

#### SO2V

Single operator two VFO. This describes the increasingly common technique of using the second VFO of a single radio, usually on the same frequency band as the run frequency, to line up new stations or multipliers and to instantly QSY to interleave QSOs during the main run. Recent advances in contest software, often in conjunction with data arriving from Skimmer spots or other spotting assistance, can make this a powerful technique for adding to your score. Note that use of spots put the operator using this (or any other) technique into the Assisted category in many contests.

Categories: operating classification, operating technique,

See Also: SO2R

#### **SOA**

Single operator assisted is a single operator category where packet/internet spotting assistance is allowed (see Assisted).

Categories: operating classification

See Also: Assisted

#### SOAB

Single operator all band is an operating category common to most contests. In most contests, packet/internet spotting assistance is not allowed, but the WAE and some other contests allow it. Due to the popularity of internet assistance, and the difficulty in detecting the (intentional or unintentional) use of this assistance by contest sponsors judging the results, this situation is changing. This category is sometimes referred to as "SOAB Classic" to reflect its legacy to the pre-spotting era. In all cases a single person is responsible for all operating and logging during the contest.

Categories: operating classification

See Also:

#### **SOHP**

Single operator high power refers to a SOAB, SOA, or SOSB station that runs more than 100 watts output from the transmitter.

Categories: operating classification

See Also:

#### **SOLP**

Single operator low power is a single operator who runs a maximum of 100 watts output.

Categories: operating classification

See Also:

#### **SOORP**

Single operator QRP stations run a maximum of 5 watts from the transmitter.

Categories: operating classification

See Also:

#### **SOSB**

Single operator single band is a single operator station who operates a single band. It also may mean unassisted, although this is ambiguous.

Categories: operating classification

See Also:

#### SOU

Single operator unlimited is used interchangeably with single operator assisted as described above. Unfortunately, both terms "unlimited" and "assisted" have connotations (especially when translated form English) that are inconsistent with their intended meaning. They both are supposed to denote a single operator who receives spotting assistance via packet radio or internet.

Categories: operating classification

See Also: SOA, Assisted

#### **SPG**

Single point ground is a lightning protection practice that physically binds all of the entry wiring into a house/shack to a single ground – e.g., RF, AC power, water pipes, telephone.

Categories: station hardware

#### **Split**

Describes the situation where a CQing station is listening on a frequency that is different from his/her transmit frequency.

Categories: operating classification, operating technique,

See Also:

#### Sporadic E

Propagation that utilizes the E layer of the ionosphere. Since this layer is inconsistently ionized and is lower than the F layers that support more reliable HF propagation, such propagation is more rare. When it occurs (usually in the summer months) it can support long distance QSOs especially on 10 and 6 meters.

Categories: general

See Also:

#### Spot

A spot generally refers to a posting of information on the frequency and call sign of a station in the contest, usually received from an internet or packet radio network.

Categories: operating software/hardware, operating technique,

See Also: Assisted

#### **Sprint**

A short contest that emphasizes frequency agility. The original Sprint contest is the North American Sprint, held in February and September of each year, sponsored by the National Contest Journal. The most unique aspect of Sprint contests is the QSY rule – when a CQing station receives a response, they must QSY and leave the frequency to the calling station at the end of the QSO. Thus sprint contests do not allow the "running" of stations on a single frequency that is characteristic of most other contests.

Categories: operating classification, operating technique,

See Also:

#### **Stack**

A stack generally refers to two or more yagi antennas which are pointed in the same direction, aligned vertically on a tower or mast, and fed (typically) in phase to increase gain and better control the take-off angle of the antenna system's forward lobe.

Categories: station hardware

See Also: Bip/Bop

#### Stacked call signs

Some contest software has the ability to load call signs of stations calling into a "stack," or queue, which can be quickly selected to call the next station instead of calling "QRZ" at the end of a QSO. This technique is extremely effective for RTTY contests, where multiple decoders may be used and can harvest callers even when the operator's attention is on something else. In a stacked call sign situation, instead of saying (or sending) "QRZ" and going back to the pile at the end of a QSO during a run, the running station may instead say "Now N9RV 59914" to initiate the next QSO immediately, where N9RV was recorded in the call sign stack.

Categories: operating technique, operating software/hardware,

See Also: run

#### **SteppIR**

A commercially manufacturer yagi which works on multiple bands. The antenna elements consist of hollow fiberglass tubes which support a conductive ribbon that is adjusted in length with microprocessor controlled motors.

Categories: station hardware

See Also Yagi

#### **Stubs**

Coax stubs are segments of coax cable which are inserted into an RF transmission line to attenuate harmonics or other unwanted emissions. They are an alternative (or addition) to bandpass filters. Simple stubs are either terminated in a short or left open, and are generally cut to either ¼ or ½ wave length. More complex stubs are cut to other fraction.

Categories: operating software/hardware

See Also: bandpass filter

#### Super check

Super check is another term for super check partial (SCP), as described above.

Categories: operating software/hardware

See Also: SCP

#### **SWL**

A station that only listens and does not transmit. This may be because the operator is not licensed to transmit. There is a long tradition of short wave listening (SWL) enthusiasts who compete for awards in a manner very much like amateur radio.

Categories: general

See Also:

#### **Triplexer**

An engineered system of filters which allows a single, multi-band antenna (e.g., a tribander or similar resonant antenna) to be used simultaneously by up to three different transmitter/receivers. This can be useful in either a multi-transmitter or a SO2R environment when such sharing is useful. They can be constructed or purchased from commercial vendors.

Categories: station hardware

See Also: SO2R

#### **UBN**

An acronym for "unique, bad, not-in-log" which became slang for a log checking report.

Categories: log checking and reporting

See Also: LCR

#### Unique

A claimed contact that is unique to all of the submitted logs in a particular contest. Such calls are much more likely to have been incorrectly copied.

Categories: log checking and reporting

#### Unique+1

A unique+1 is a call that is (i) "one off" from a unique call and (ii) is a call of someone who was active in the contest. If you claimed contact with N9RU, and no one else in the contest worked N9RU, it is a unique. If N9RV was active in the contest, that is a unique+1. (N9RD might also be a U+1 if he was active).

Categories: log checking and reporting

See Also:

#### **Unlimited**

Unlimited means the same as assisted – e.g., spotting network assistance is allowed.

Categories: operating classification See Also: Assisted, SOA, SOU

#### **Waterfall Display**

A useful mode of a panadaptor which gives an animated depiction of band activity over the chosen frequency range. In a waterfall display, received signals show up as solid points at a spot on a horizontal display that indicates their frequency. The pattern of the points gives visual information about what kind of signal it is – e.g., a carrier, a station sending CW or some other mode.

Categories: station hardware

See Also: Panadaptor

#### WRTC

World Radio Team Championship. Begun in 1990 at the World Cup Games in Seattle, the WRTC is a unique competition that occurs approximately every four years in July coincident with the IARU contest. WRTC assembles the competitors – two-person teams drawn from the top operators worldwide – in a single physical area, using identical antennas and power levels, to present a more level playing field in the competition. WRTC's have been held on three continents and in five different countries. WRTC 2014 will be held in New England in the United States.

Categories: general

See Also:

#### **WWR0OF**

The World Wide Radio Operators Foundation is an independent organization committed to supporting radio contesting worldwide.

Categories: general

See Also:

#### Yagi

A directional antenna typically consisting of a dipole element that is directly fed by the transmitter and a number of closely spaced "parasitic," or indirectly energized, elements which re-radiate RF energy to produce a directional pattern.

Categories: station hardware



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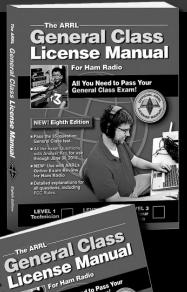
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