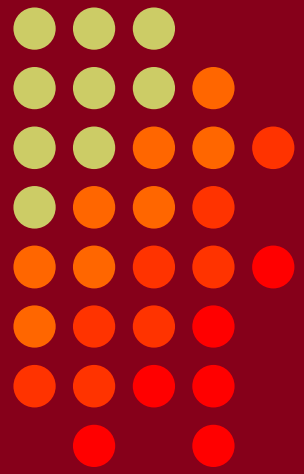
# CTU 2022 Presents

## Taking Digital Contesting to the Limit

*Ed Muns, W0YK*



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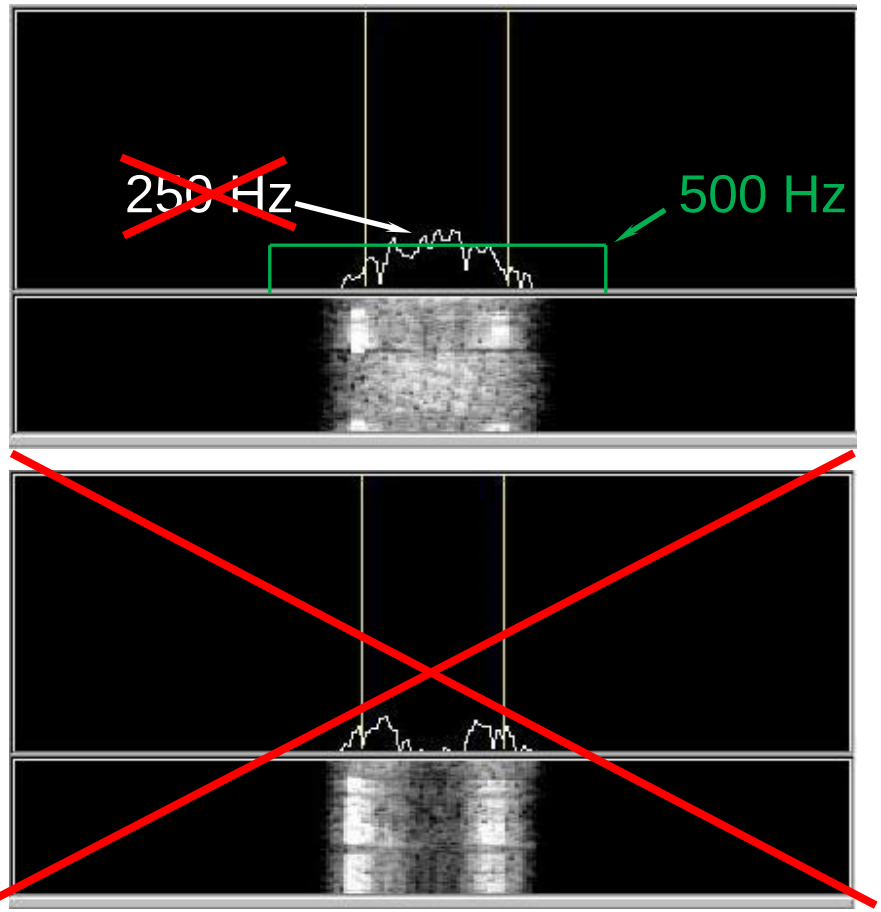
# Digital Contesting to the Limit

- RTTY Contesting
  - TX bandwidth
  - RX bandwidth
  - UOS and hyphen
  - Multiple decoders
  - SO2V
  - SO2R
- FT8/4 Contesting
  - CQ vs. S&P mode
  - FT8/4 & even/odd
  - Working non-contesters
  - Superfluous 2nd QSL

# RTTY Receive Bandwidth

## *radio IF filtering*




Narrow IF filters

- 500 Hz - normal
- 250 Hz - extreme QRM
- Tone filters – don't use!
  - Icom Twin Peak Filter
  - K3 Dual-Tone Filter

# RTTY Transmit Bandwidth

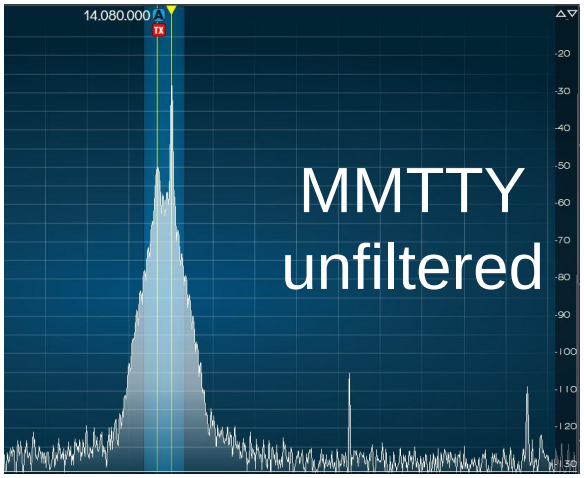
## *unnecessary QRM*

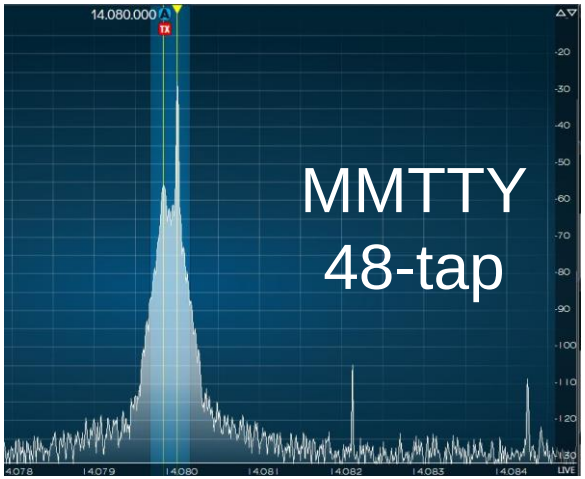
- Wasted power outside receiving decoder BW
  - Suitably narrow TX BW effectively amplifies signal
- Unnecessary QRM
  - Wide 1.5 KW RTTY can QRM 5-10 channels
  - Similar to CW key click problem of the past

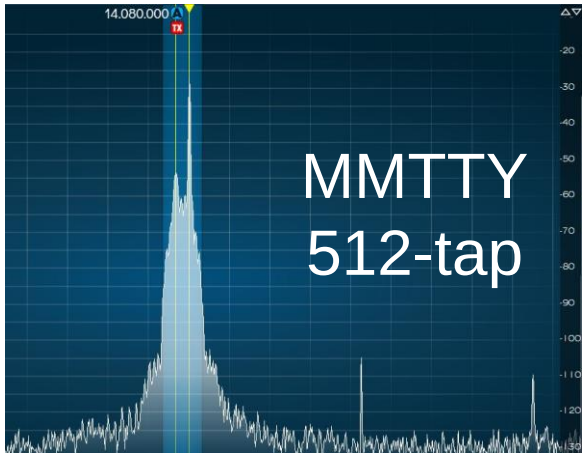
*Why hurt yourself AND QRM close-by stations?*

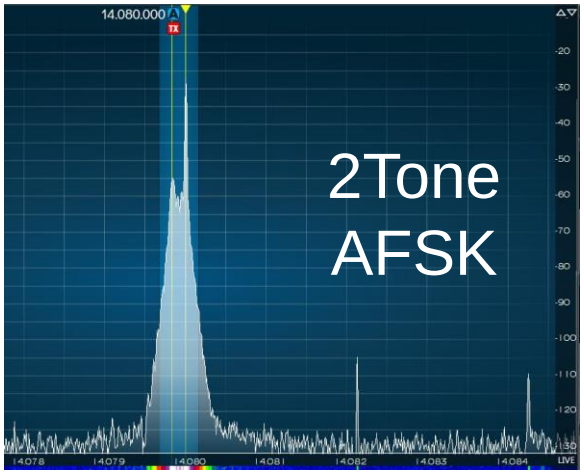
# RTTY Transmit Bandwidth

## *AFSK*



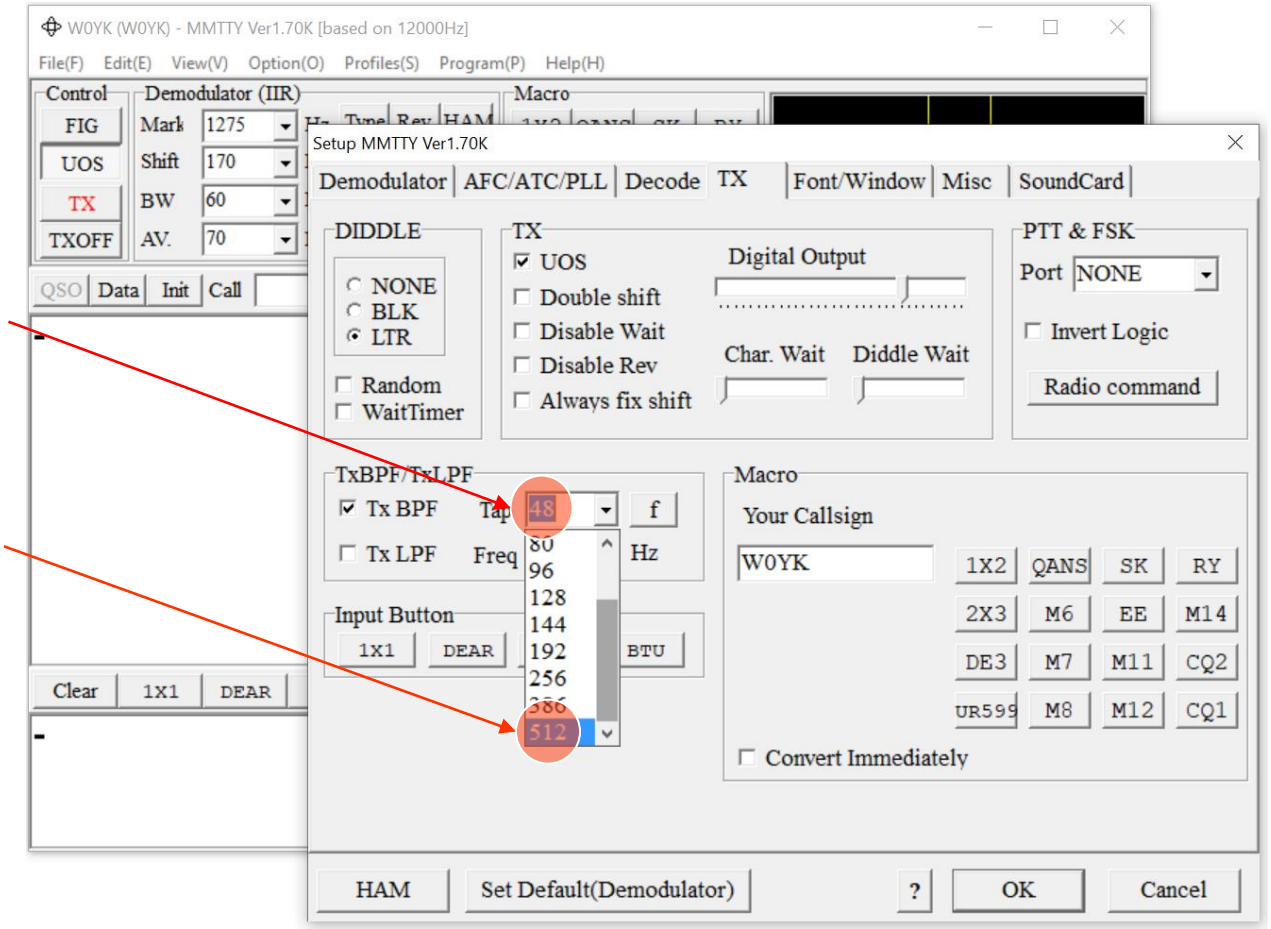



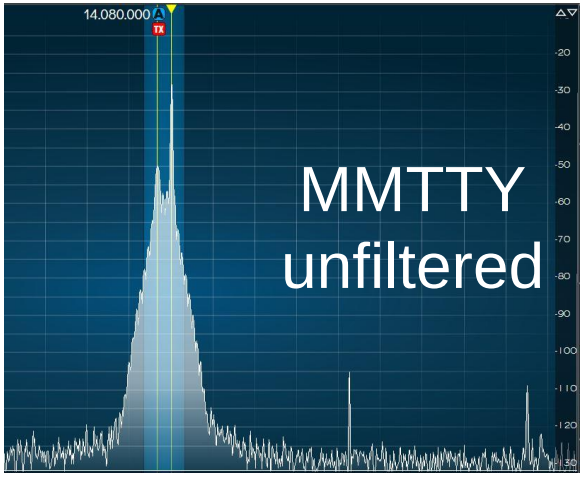
# Tx BPF Setting

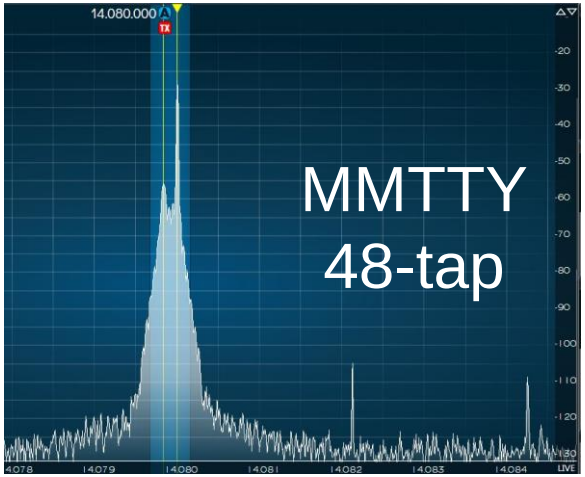
## MMTTY

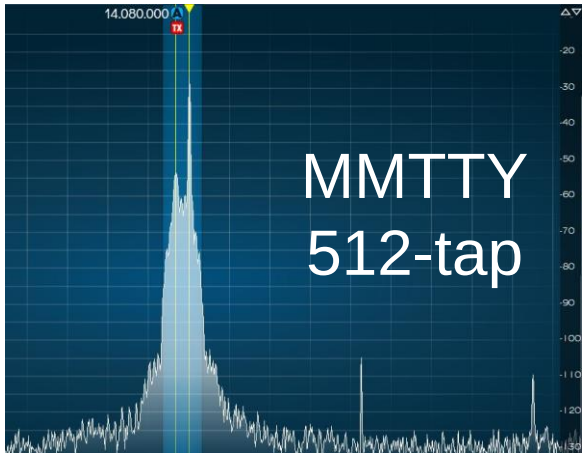


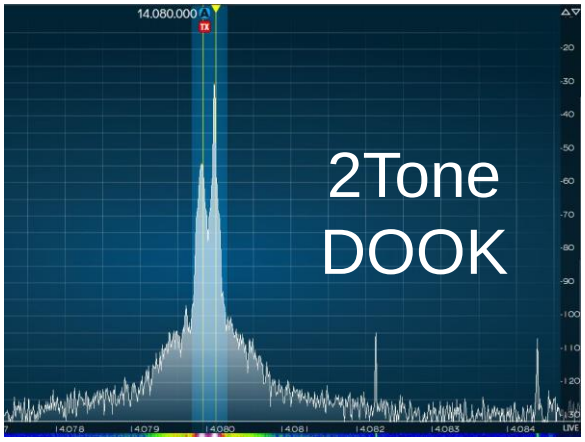
# RTTY Transmit Bandwidth

## *AFSK – 2Tone DOOK*



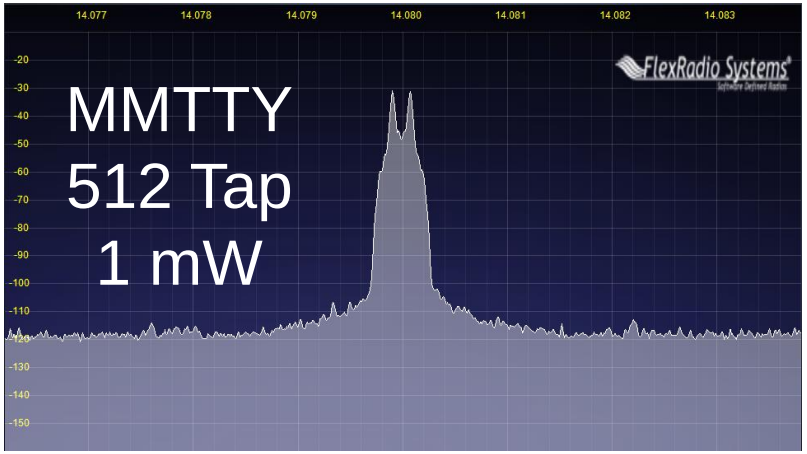



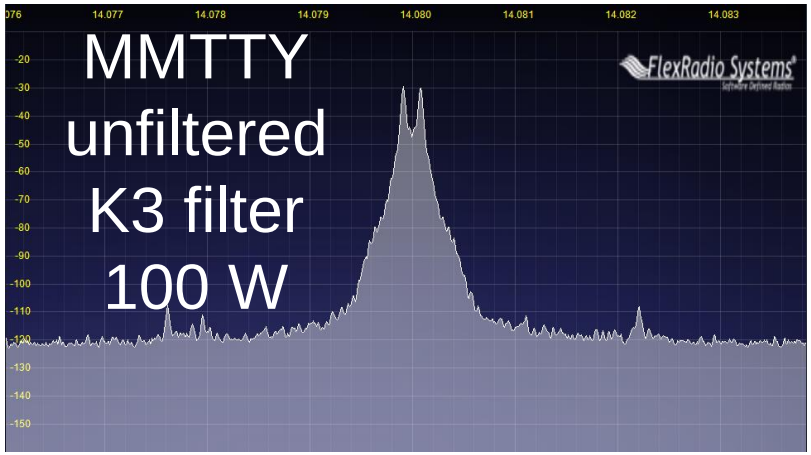



# RTTY Transmit Bandwidth

## AFSK - *PA IMD effect*



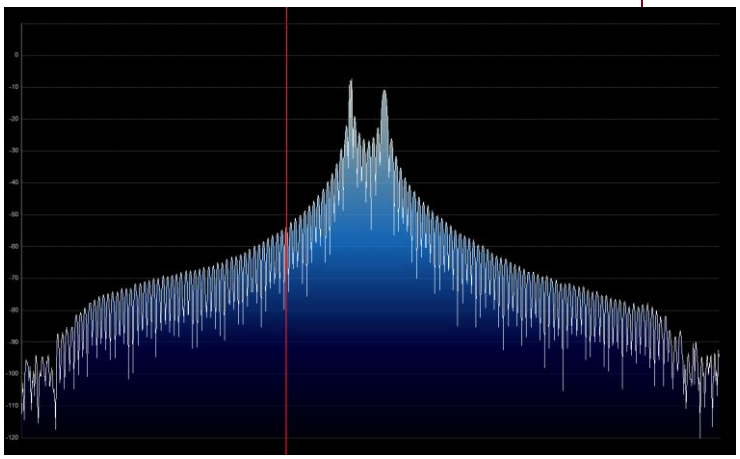




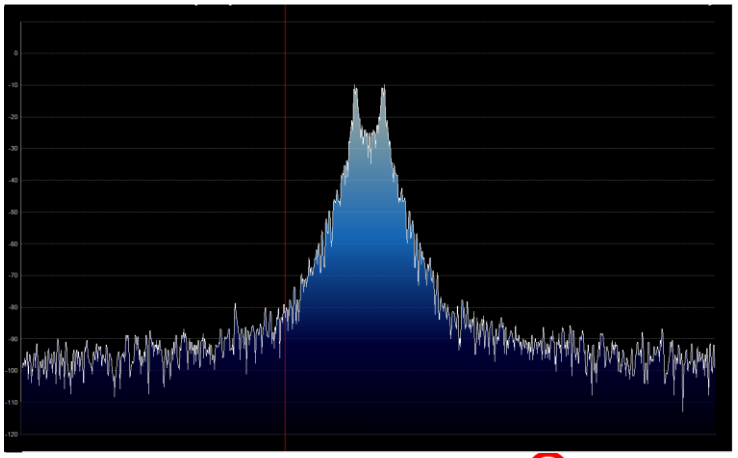
# RTTY Transmit Bandwidth

## *FSK*

- Old K3 FSK bandwidth
  - No waveshaping
  - < DSP281 firmware
  - Typical of all radios
  - 50 watts

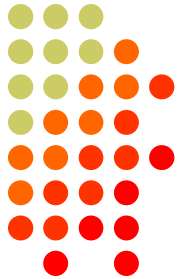


- New K3 FSK bandwidth
  - Optimal DSP filter
  - DSP281 firmware, March 2013



# UOS

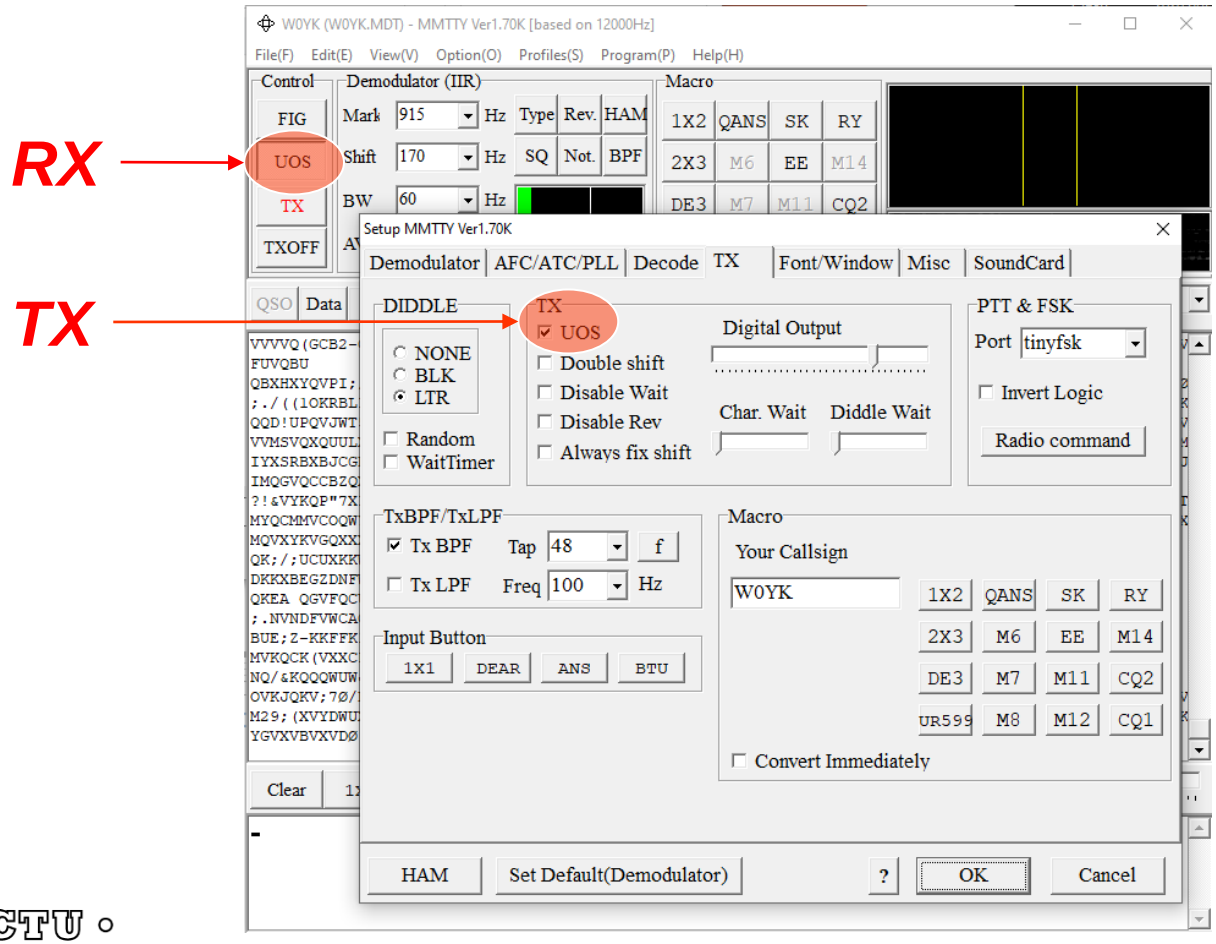
## *(Unshift-On-Space)*



- Receive UOS:
  - Space character forces a shift to the Letters set
  - Increases noise immunity for alpha text
- Transmit UOS:
  - Sends FIGS character after Space, before numeric “word”
- Contest exchanges are alpha and numeric
  - Should UOS be on or off?
  - Should Space or Hyphen delimit exchange elements?
    - 599 1234 1234 or 599-1234-1234
- *Recommendation:*
  - *Turn on both RX & TX UOS and use Space delimiters*

# UOS

## MMTTY

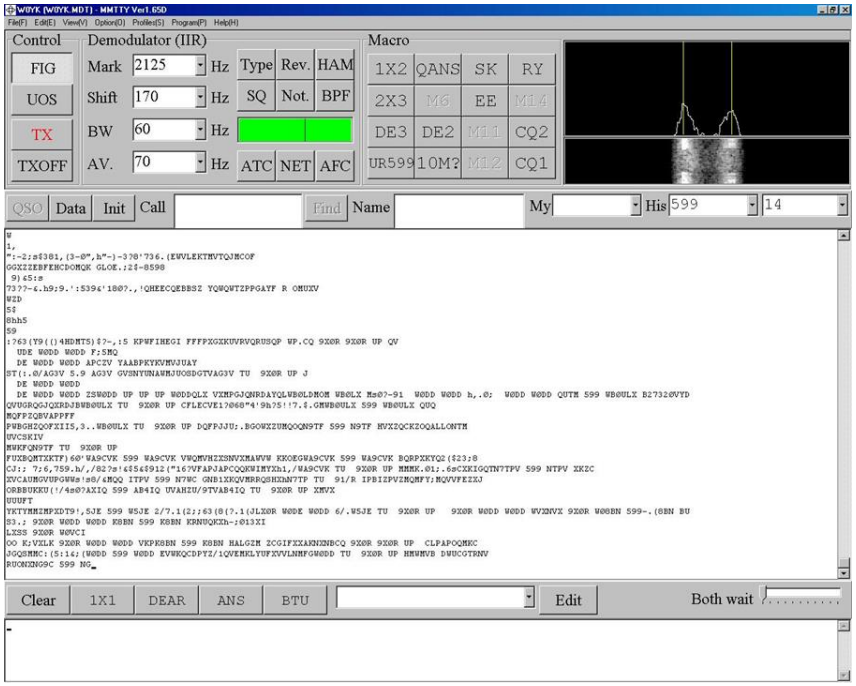

RX
TX
W0YK (W0YK.MDT) - MMTTY Ver1.70K [based on 12000Hz]
File(F) Edit(E) View(V) Option(O) Profiles(S) Program(P) Help(H)
Control
FIG
UOS
TX
TXOFF
Demodulator (IIR)
Mark 915 Hz
Shift 170 Hz
BW 60 Hz
Type Rev. HAM
SQ Not. BPF
Macro
1X2 QANS SK RY
2X3 M6 EE M14
DE3 M7 M11 CQ2
QSO Data
Setup MMTTY Ver1.70K
Demodulator AFC/ATC/PLL Decode TX Font/Window Misc SoundCard
DIDDLE
NONE
BLK
LTR
Random
WaitTimer
TX
UOS
Double shift
Disable Wait
Disable Rev
Always fix shift
Digital Output
Char. Wait
Diddle Wait
PTT & FSK
Port tinyfsk
Invert Logic
Radio command
TxBPF/TxLPF
Tx BPF
Tap 48
f
Tx LPF
Freq 100 Hz
Input Button
1X1 DEAR ANS BTU
Macro
Your Callsign
W0YK
1X2 QANS SK RY
2X3 M6 EE M14
DE3 M7 M11 CQ2
UR599 M8 M12 CQ1
Convert Immediately
Clear
HAM
Set Default(Demodulator)
?
OK
Cancel

# Multiple Decoders

- Parallel decoding with
  - Different decoders
  - Different decoder “profiles”
  - Different RX IF bandwidths (dual receivers)
- Reduces repeats
- Almost “free”
  - Screen space for multiple decoder windows
    - Can be relatively small
  - CPU performance

# Multiple Decoders

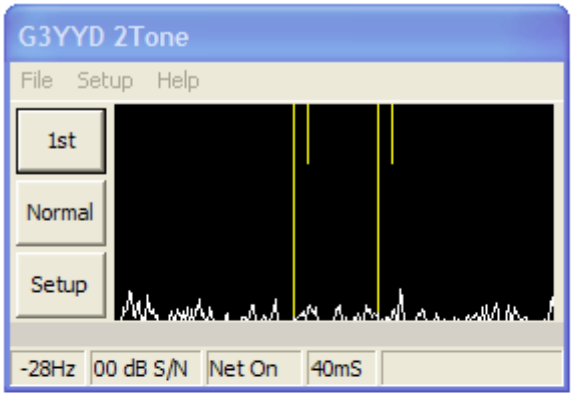
## *MMTTY*

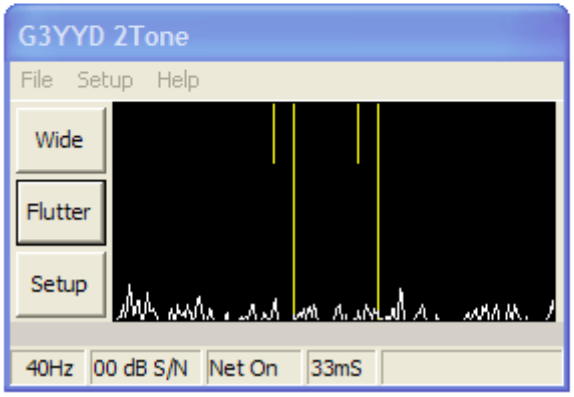



- Dominant SC MODEM
- Standalone, or …
- Contest loggers:
  - N1MM Logger+
  - WriteLog
  - Win-Test
- Introduced June 2000
- Mako Mori, JE3HHT

# Multiple Decoders

2Tone

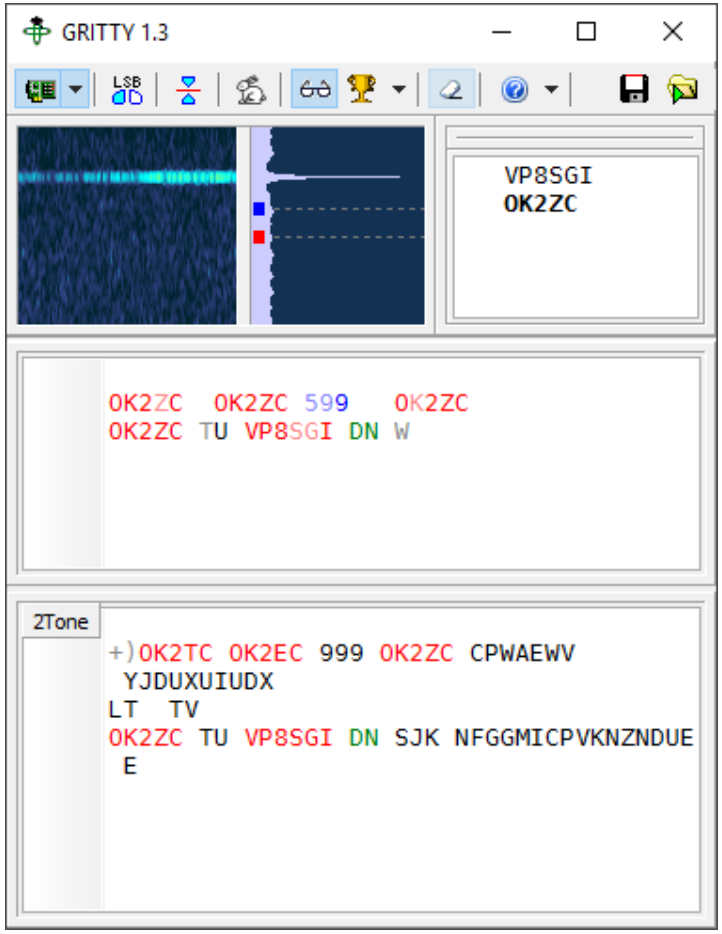



- Outperforms MMTTY ?
- Uses less CPU cycles
- Contest loggers:
  - N1MM Logger+
  - WriteLog
  - Win-Test
- Introduced late 2012
- David Wicks, G3YYD

# Multiple Decoders

GRITTY

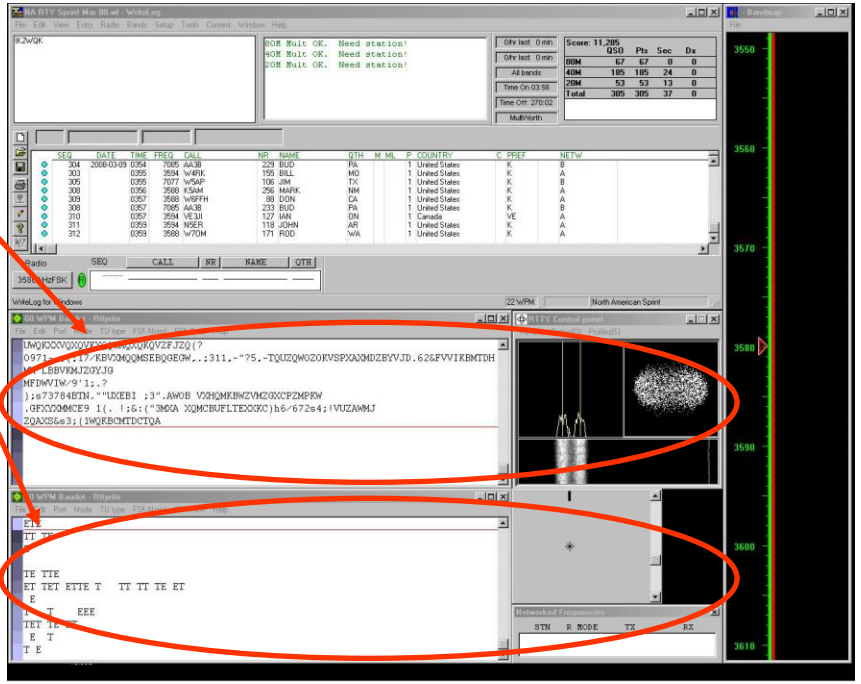



- Best accuracy ?
- Bayesian statistics
- Standalone, or …
- Contest loggers:
  - N1MM Logger+ only
- Introduced late 2015
- Alex Shovkoplyas, VE3NEA

# Multiple Decoders

## *MMTTY & DXP38*

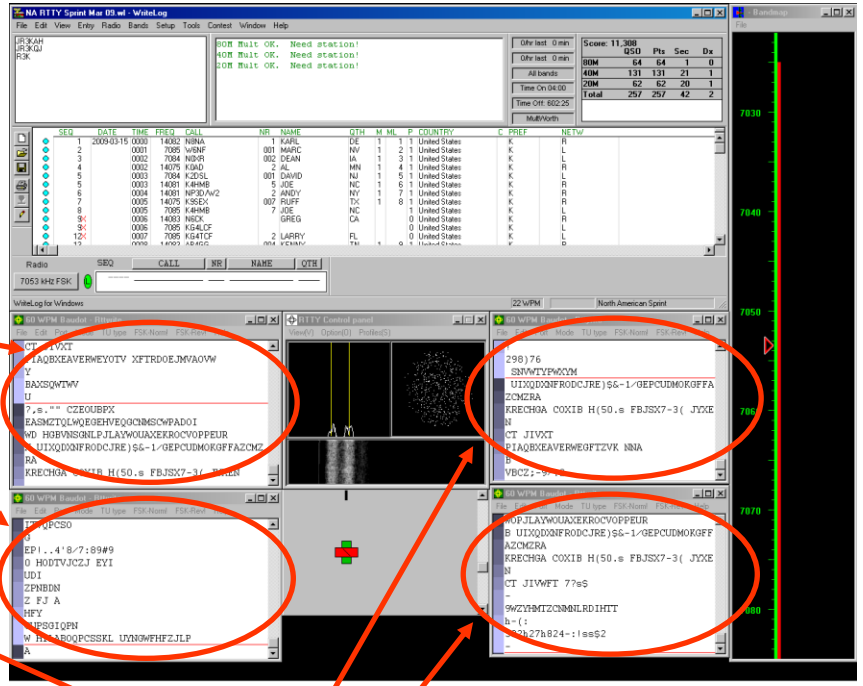
- Parallel decoding
  - Software, e.g., MMTTY
  - Hardware, e.g., DXP38
- Diverse conditions
  - Flutter
  - Multi-path
  - QRM, QRN
  - Weak signals
  - Off-frequency stations



# Multiple RTTY Decoders

## *multiple MMTTY profiles*

- Parallel decoding
  - same audio stream
  - switching takes too long
- Multiple profile windows
  - Standard
  - Fluttered signals
  - Fluttered signals (FIR)
  - Multi-path
  - hyper sensitive
  - EU1SA
  - AA6YQ-FIR-512
    - weak signals in QRN



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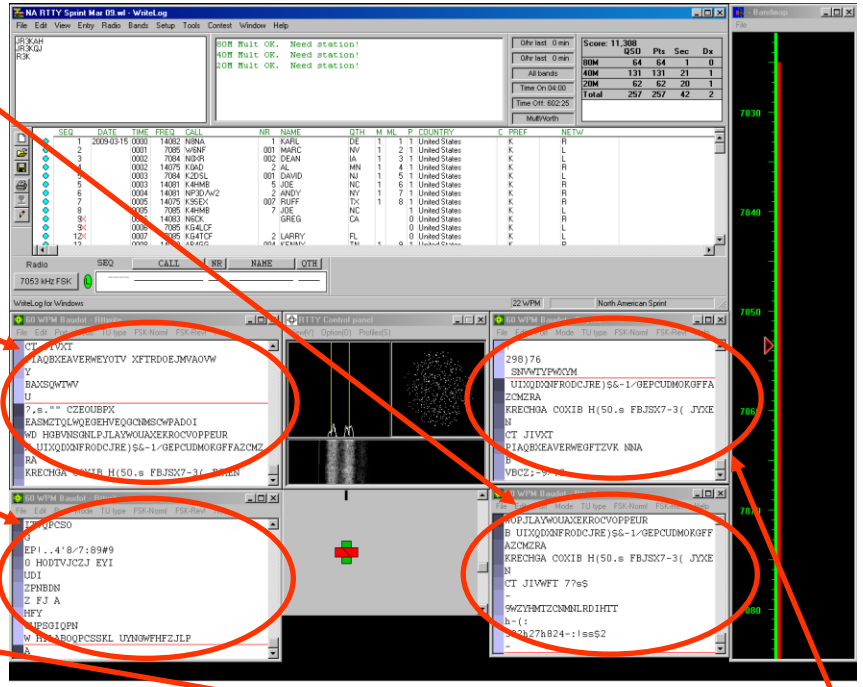
# Multiple Decoders

## *two IF bandwidths*

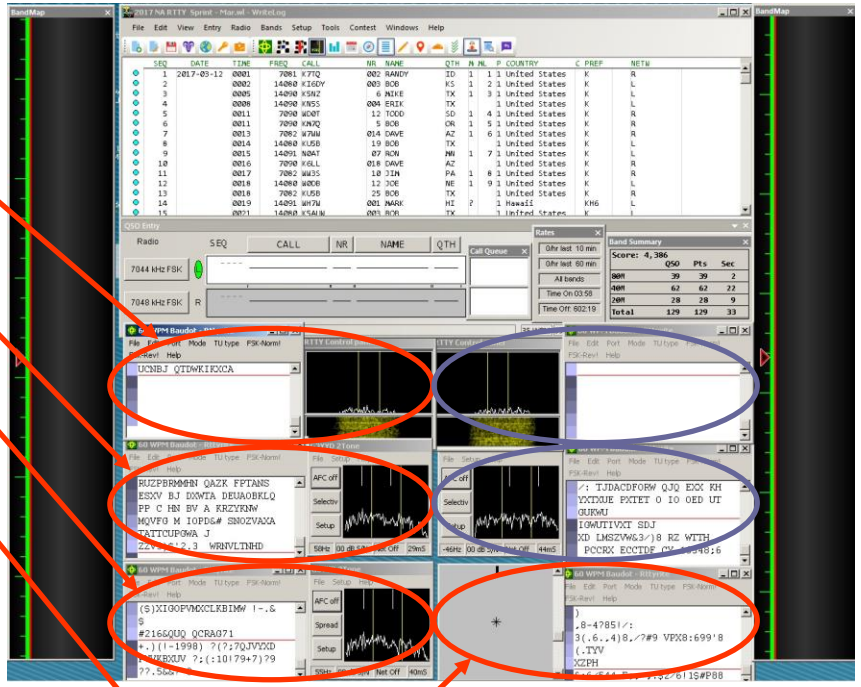
- Narrow IF filtering (main RX)
  - Hardware modem, i.e. DXP38
  - MMTTY profiles:
    - Standard
    - Fluttered signals
    - Fluttered signals (FIR)
    - Multi-path
    - hyper sensitive
    - EU1SA
- Wide IF filtering (sub RX)
  - MMTTY profile:
    - AA6YQ-FIR-512
      - Dual Peak Filter
      - “Matched filter”



# Multiple Decoders

SO2V

- VFO-A (main RX)
  - MMTTY Standard profile
  - 2Tone Flutter profile
  - 2Tone Selective profile
  - DXP38
- VFO-B (sub RX)
  - MMTTY Standard profile
  - 2Tone Flutter profile
- 6 decoders
  - A→B



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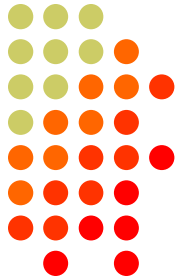
# Multiple Decoders

## *Tone choices for monitoring*



- Low tones are less fatiguing
  - Use high tones for secondary audio stream(s)
- Low/High tones can be mixed to put two audio streams in one ear:
  - SO2R plus SO2V per radio (4 streams)
  - SOnR (3+ streams)

# SO2V

## *"1BSIQ"*

1. [single rcvr] If Assisted and running on VFO-A, then
   - A<>B, click spot, tune, ID station, work station
   - A<>B, resume running

   } Toggle as needed
2. [dual rcvr] Set up decoder windows on VFO-A and VFO-B
   - Radio must have two true receivers
   - Monitor both frequencies simultaneously with right/left channels of sound card and separate RTTY windows
     - Left-click call from 2nd RTTY window into VFO-B Entry Window
   - Two ways to transmit on VFO-B:
     1. A<>B, work the mult, A<>B *(but, mixes print from two frequencies)*
     2. SPLIT, work the mult, un-SPLIT, resume running
        - Requires "wire-OR'd" FSK or AFSK and two transmit RTTY windows
          - WriteLog Shared Com Port obviates the wire-OR
        - K3/WriteLog invokes SPLIT when VFO-B call is clicked

# SO2R

- Eliminates SO1R RTTY “boredom”
- Think beyond run and S&P:
  - Dueling CQs; run on two bands simultaneously ***(2BSIQ)***
  - S&P on two bands simultaneously, esp. w/Packet
  - SO2V on one or both radios (SO4V!)
- [optional] Two networked computers:
  - Eliminates swapping radio-focus
  - Display room for more decoder windows per radio
  - RTTY doesn’t require much typing; mini-keyboards
  - 2 x SO2V=SO4V for picking up mults on both run bands
  - Easily extendible to SOnR

*No time to watch TV or read spy novels!*

# SO2R

## *"M2" configuration*

Left-hand Trackball

Right-hand Trackball

Right-sized Keyboards

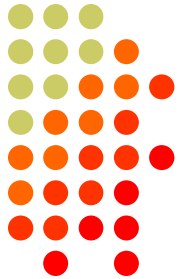
# SO2R in the NA Sprint

## *maximize TX duty cycle*

- 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 before the CQ finishes, find a clear frequency and duel CQ
- After a QSO, swap VFOs on that radio, search during other transmission, 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 3rd (or 4th) 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 (per ear) provides radio A, radio B or both

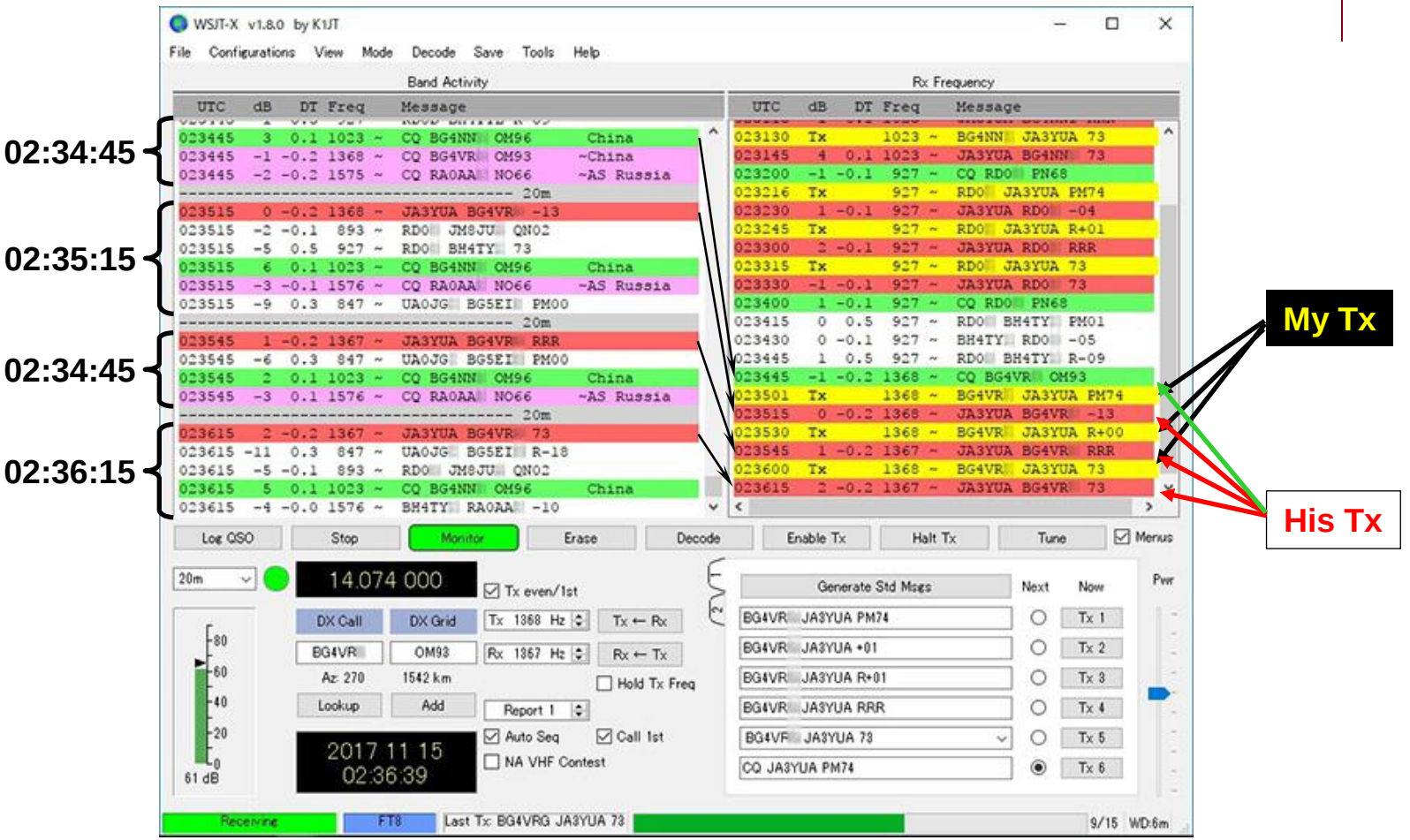
# SOnR

## *Multi-Multi configuration*

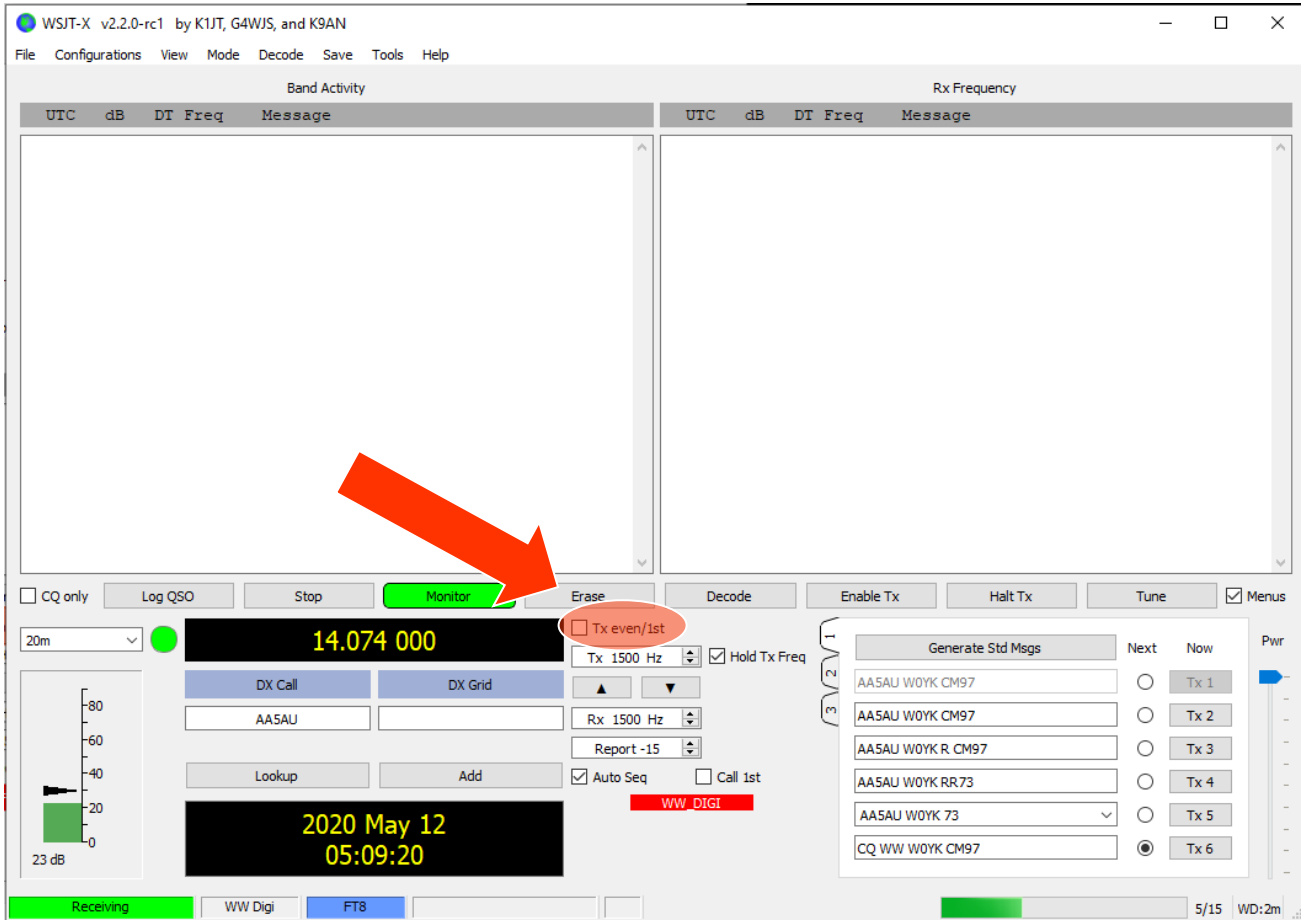

**dedicated to 10 meters**

# FT8 Multi-Channel Reception

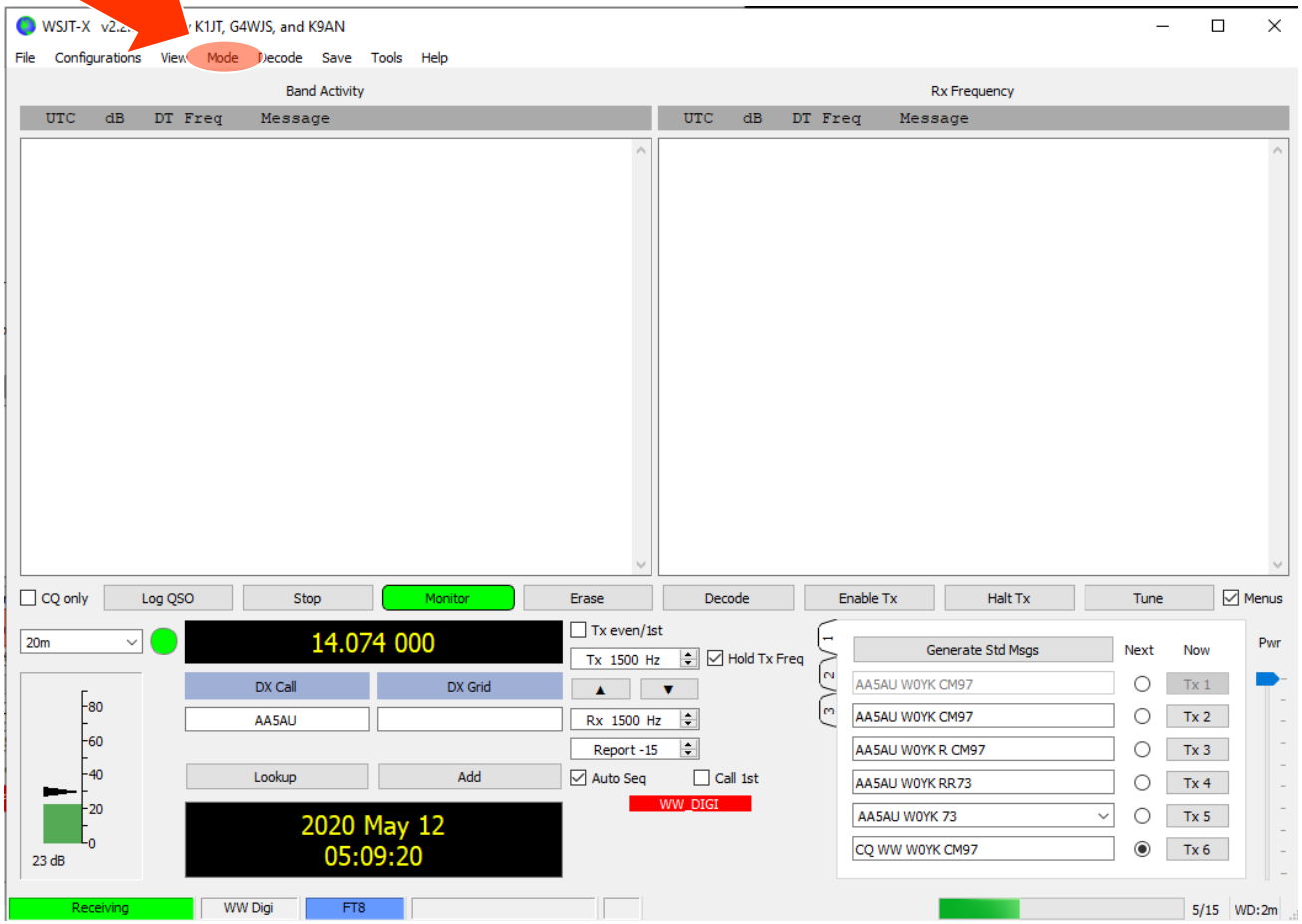
## *Run vs. S&P is irrelevant*



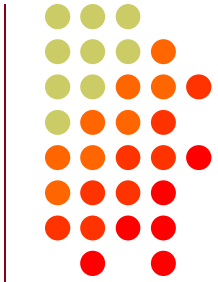
# Rotate Odd/Even Cycles



# Rotate FT8/FT4 Modes



# Working Non-Contesters



- Depends on contest
  - Grid Square exchange
  - QTH, serial number, name, etc.
- Transparant … unless
  - Non-contester skips Tx2, answering with Tx3
- ***Recommendation: Don't call CQ, only answer CQs or messages with Grid Square***

# Two Generals Problem [1]

## *unreliable communication*

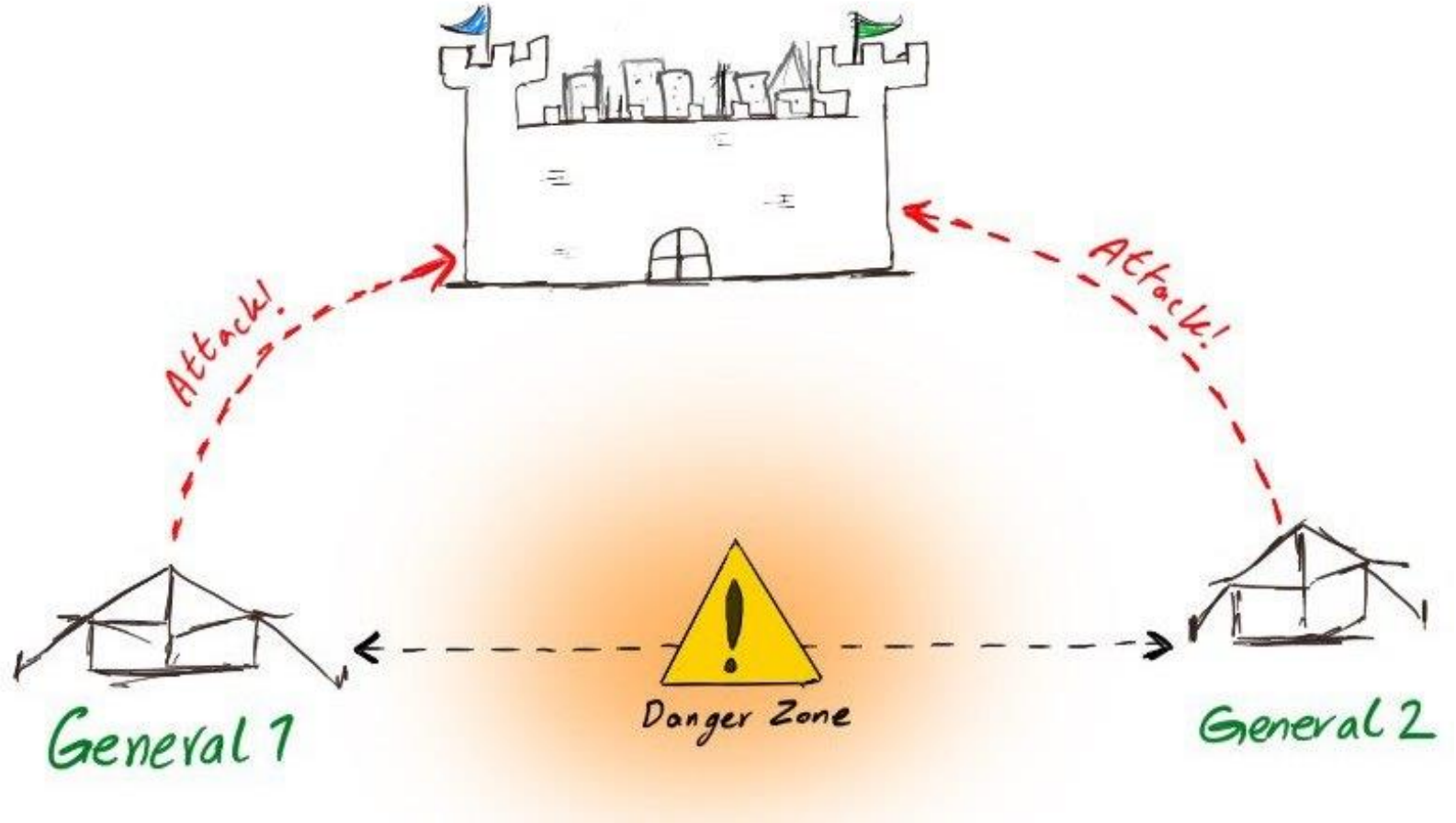
[1] E. A. Akkoyunlu, K. Ekanadham, and R. V. Huber, 1975
"Some Constraints and Trade-offs in the Design of Network Communications", page 73

- 1975 computer science thought experiment
- Communication over an unreliable link
  - eg., TCP
- ACKs could theoretically be infinite
- Solution
  - Accept some uncertainty; don't try to eliminate
  - Mitigate to reduce consequence(s)

# Two Generals Paradox [1]

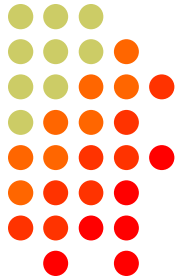
## *unreliable communication*

[1] Jim Gray, 1978
"Notes on Data Base Operating Systems", page 465



# Radiosport Solution

## *CW, SSB & RTTY*



- Each QSO partner QSLs the exchange ***once***
- Context reduces uncertainty
  - Other station doesn't repeat their last message
  - Other station doesn't ask for a repeat
  - Other station rolls into their next QSO

# Radiosport Solution

## *FT8 & FT4*

- One QSO partner QSLs the ***QSL***
- Implied by default WSJT-X logging behavior
- Defacto expectation
  - Many FT ops won't log the QSO without this superfluous QSL of the final QSL
  - Thus, NIL rate increases
    - CW, SSB & RTTY = 1-2%
    - FT = 4-5%

# WW Digi QSO

**CQ W0YK CM97**

**W0YK AA5AU EL92** ←*AA5AU calls with exch*

**AA5AU W0YK R CM97** ← *W0YK QSL with exch*

**W0YK AA5AU RR73** ←*AA5AU QSL*

**AA5AU W0YK 73** ← *W0YK QSLs AA5AU's QSL!*

*This wastes time because W0YK could have used the message to CQ or answer another caller.*

# WW Digi Alternative QSO

## *context*

***CQ W0YK CM97***

***W0YK AA5AU EL92*** *←AA5AU calls with exch*

***AA5AU W0YK R CM97*** *← W0YK QSL's with exch*

***W0YK AA5AU RR73*** *←AA5AU QSL's*

***CQ W0YK CM97*** *← W0YK calls CQ,*

*or*

***AC0C W0YK R CM97*** *← W0YK rolls into next QSO*

*AA5AU then knows, by context,*

*that W0YK received his QSL message*

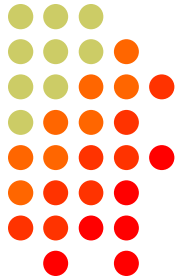
# WW Digi Alternative QSO

## *message repeat*

| | |
|---|---|
| ***CQ W0YK CM97*** | |
| ***W0YK AA5AU EL92*** | *←AA5AU calls with exch* |
| ***AA5AU W0YK R CM97*** | *← W0YK QSL's with exch* |
| ***W0YK AA5AU RR73*** | *←AA5AU QSL's* |
| ***AA5AU W0YK R CM97*** | *← W0YK missed QSL msg* |
| ***W0YK AA5AU RR73*** | *←AA5AU repeats QSL* |

# Minimizing NILs

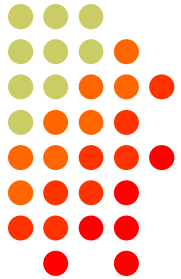
## *Recommendation #1*



- Develop skill to dynamically change message
  - e.g., use the Alternate F1-F6 keys in WSJT-X
- Always log the QSO when receiving a RRR, RR73 or 73 message.
- Always log the QSO when sending RRR, RR73 or 73 message.
  - Look for a clue that your message was not received, e.g., your QSO partner re-sends his report.

# Minimizing NILs

## *Recommendation #2*



- Give in!
  - Send the superfluous QSL, but
  - Don’t require it from your QSO partner
- Yes, it’s unnecessarily slower, but
  - FT contesting is currently slow enough to absorb it

ROOM 2 – Digital and RTTY Contesting – W0YK

# 3:15 OPEN DISCUSSION Q&A