

Remote Contesting at K3AJ

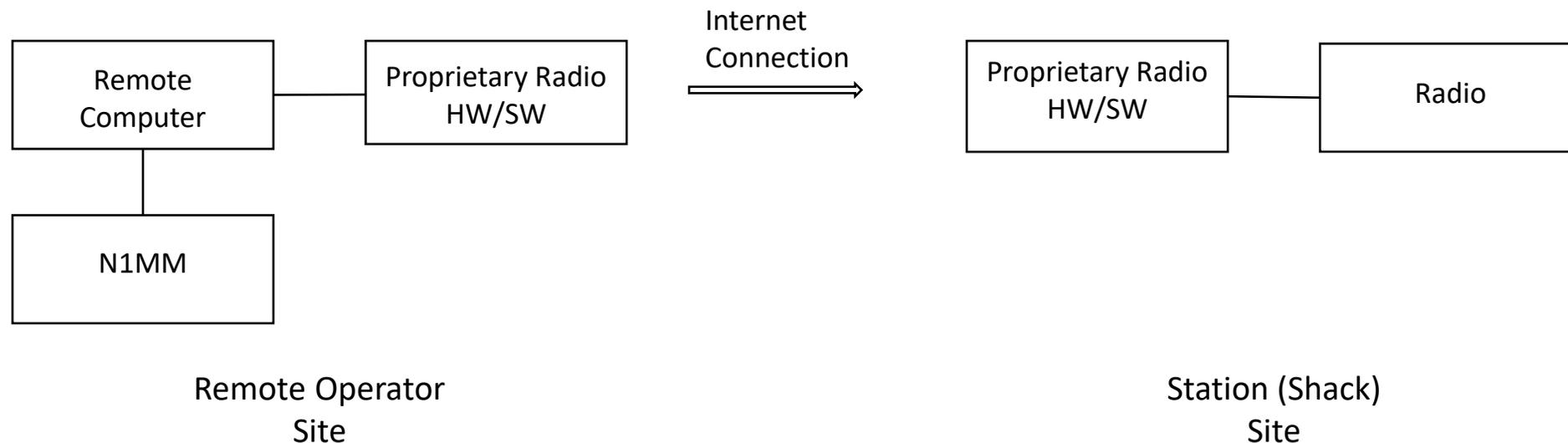
4 Years & 75,000+ QSO So Far!

Updated 9/2024



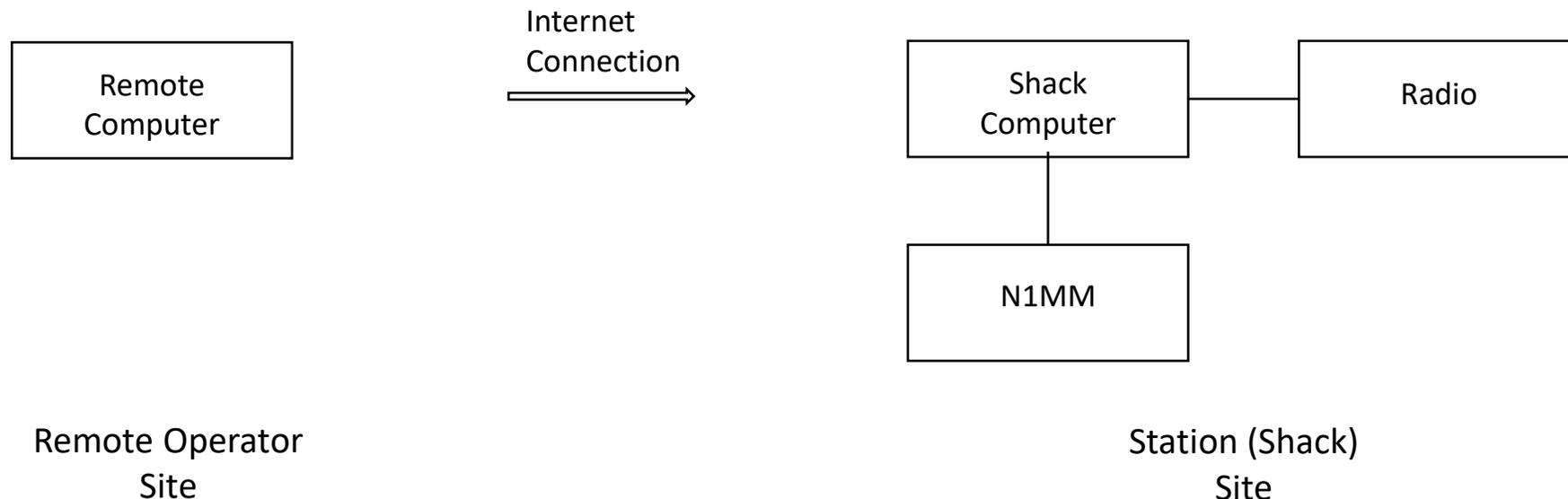
More than one way to approach remote contest operation – Remote the Radio

- Access the radio via a remote hardware or software solution and run contest software at the remote site
 - If multiop, network the instances of N1MM via internet
 - Works with radios that can be remoted “out of the box” like the Flex or the K4
 - Works with hardware solutions like Remote Rig, K3-0, K4-K4, Yaesu SCU-LAN10, Icom RS-BA1



More than one way to approach remote contest operation – Remote the Shack Computer

- Run the radio and the contest software on the shack computer and access the shack computer remotely using a remote desktop app + a VOIP app for audio
 - No special remote hardware required
 - Radio agnostic
 - Simple software set up – Remote Desktop + Mumble for audio at the remote computer
 - Easy to incorporate station controls via shack computer
 - Standardized and promoted by “The Godfather” – Gerry W1VE (see appendix)



K3AJ approach



Overall approach:

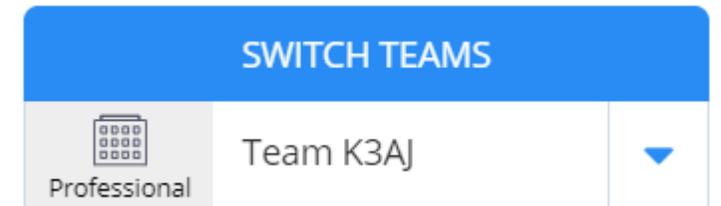
- Set the station up to be operated from the shack computer
- Run contest software (N1MM+) on the shack computer
- Remote ops use remote desktop software – VNC Server/Viewer - to take control of shack computer
- Remote ops get audio via Mumble
 - Mumble is the standard, go-to audio app used by the online gaming community

Compromises/limitations:

- Limited radio fiddling – Rely on N1MM+ for frequency control (no big knob, alas)
 - Use mouse wheel, Up/Down arrows, click in band map or in Spectrum Window to tune the radio.
- Define N1MM+ Band Map buttons for radio control functions as needed (RX bandwidth, XIT, whatever you need) using CAT commands
- We also run Win4Yaesu on the shack computer so the remote ops can make any radio adjustment they want
- Use N1MM function key messages and CTL-K for keyboard CW (no paddle for CW at K3AJ)

Software choices

- Remote Desktop
 - TeamViewer, AnyDesk, Rust Desk, Real VNC, many others should all work
 - Rust Desk is open source and free for the self-hosting option
 - K3AJ uses Real VNC (VNC Server Professional, VNC Viewer)
 - Currently \$50/year for server, Viewer is free. Similar cost to other paid services



Software choices

- Audio

- Reliable audio is critical – especially for CW
- K3AJ currently using Mumble - Provides reliable, high quality, low latency audio
 - Mumble is the “Industry Standard” for on-line gaming
 - Mumble has client/server architecture
 - Client is used at both the station end and the remote end – both communicate with a server in the cloud (it is possible to host a server on the station computer – but not necessary or recommended)
 - There are public servers, or you can pay to have your own via several available services
 - W1VE offers private Mumble servers hosted in a big data center for \$10/year – Current approach at K3AJ



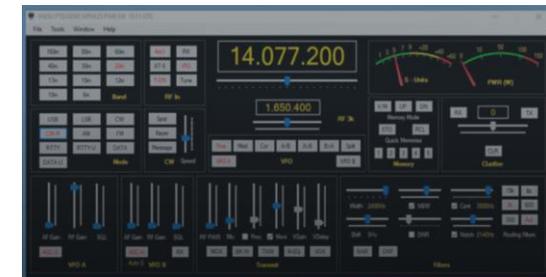
Software choices



- N1MM+ is our logging software
 - The N1MM+ Spectrum Window is driven by an SDR Play RSP1A
- PST Rotator is our automation/computer control solution for accessories
 - Drives two Green Heron RT-21 rotator controls
 - Automates SteppIR tuning and provides software front panel for SteppIR
 - Drives two USB relay boards to operate the K9AY RX antenna, power switches, 80M antenna selection



- Antenna selection is automated using a Unified Microsystems band decoder and a modified Ameritron RCS-10 switch
- Win4Yaesu provides full radio control
 - Similar products for ICOM/Elecraft
 - Incorporates reliable radio port sharing for N1MM+/Win4Yaesu



Shack/Remote Computer Screen via VNC Viewer - RTTY

PST Rotator
Relay Board
Controls

N1MM+
Buttons for
radio control

PST Rotator
Rotator, SteppIR
Controls

Win4Yaesu

The screenshot displays a complex interface for RTTY operation, including:

- Relays:** A window showing relay status for various stations like K3AY, K3AY2, and K3AY3.
- ARRL RTTY Roundup:** A window displaying a table of RTTY activity with columns for Call, Freq, Mode, Snt, Rcv, Exch, M1, and M2.
- Win4Yaesu:** A window showing the Yaesu software interface with frequency readouts (3.569.895 and 3.569.768) and various control knobs.
- Mumble Client:** A window showing connection status and chat logs.
- N1MM+:** A window displaying contest scores and call signs, with a score of 78,516 points.
- RTTY Engine 1:** A window showing the RTTY engine's status and settings.
- RTTY Engine 2:** A window showing the RTTY engine's status and settings.
- RTTY Engine 3:** A window showing the RTTY engine's status and settings.
- RTTY Engine 4:** A window showing the RTTY engine's status and settings.
- RTTY Engine 5:** A window showing the RTTY engine's status and settings.
- RTTY Engine 6:** A window showing the RTTY engine's status and settings.
- RTTY Engine 7:** A window showing the RTTY engine's status and settings.
- RTTY Engine 8:** A window showing the RTTY engine's status and settings.
- RTTY Engine 9:** A window showing the RTTY engine's status and settings.
- RTTY Engine 10:** A window showing the RTTY engine's status and settings.
- RTTY Engine 11:** A window showing the RTTY engine's status and settings.
- RTTY Engine 12:** A window showing the RTTY engine's status and settings.
- RTTY Engine 13:** A window showing the RTTY engine's status and settings.
- RTTY Engine 14:** A window showing the RTTY engine's status and settings.
- RTTY Engine 15:** A window showing the RTTY engine's status and settings.
- RTTY Engine 16:** A window showing the RTTY engine's status and settings.
- RTTY Engine 17:** A window showing the RTTY engine's status and settings.
- RTTY Engine 18:** A window showing the RTTY engine's status and settings.
- RTTY Engine 19:** A window showing the RTTY engine's status and settings.
- RTTY Engine 20:** A window showing the RTTY engine's status and settings.

Mumble
Client

PST Rotator
K9AY
Direction

KPA1500
Controls

Shack/Remote Computer Screen via VNC Viewer - CW

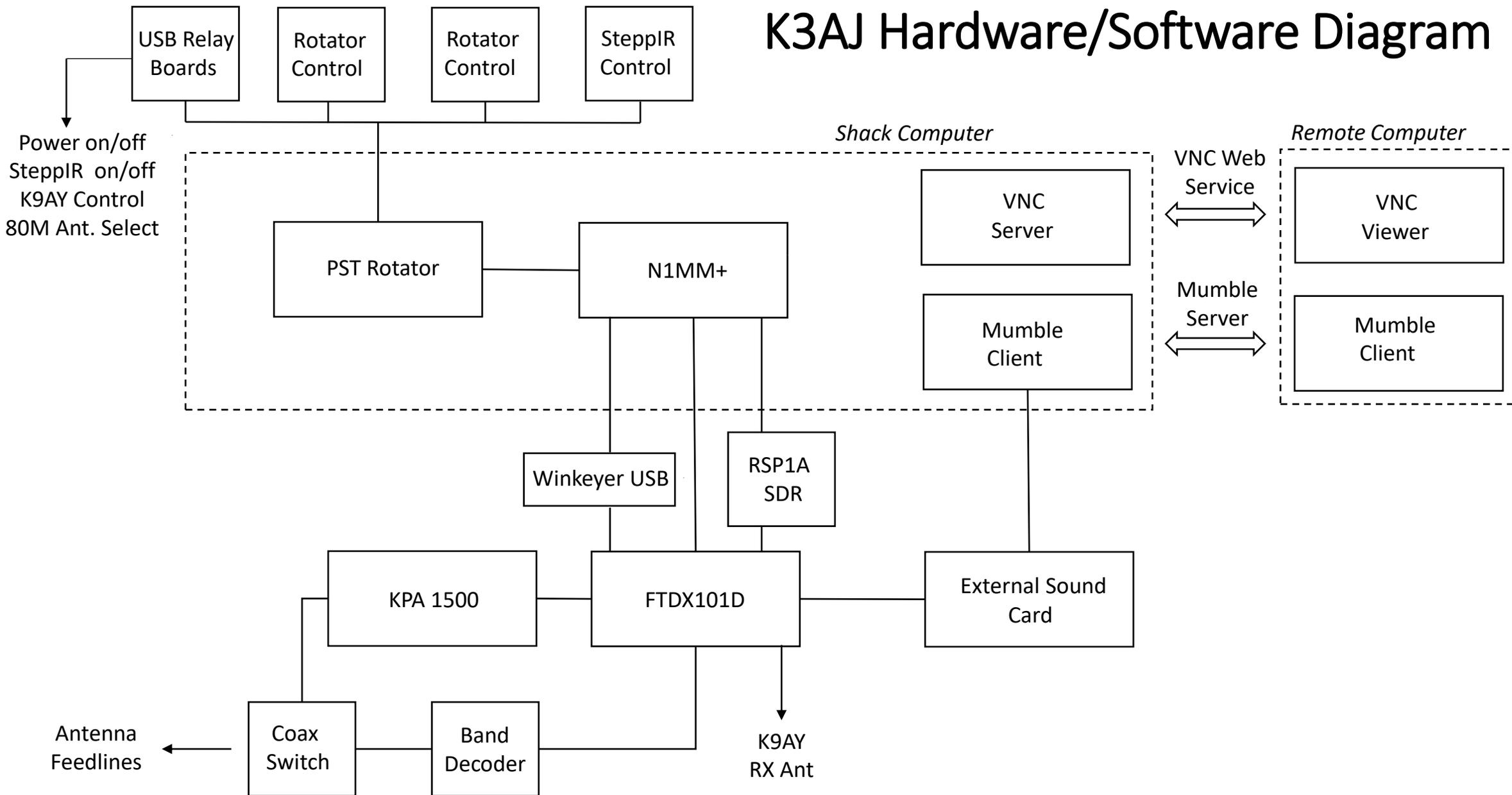
The screenshot displays a Windows desktop environment used for remote operation of a radio shack. The interface is divided into several functional areas:

- Top Left:** A 'Relays' window showing a list of relay stations (Station Power, Relay 2, SteppIR On/Off, Relay 4) and their corresponding call signs (KSAY K1, KSAY K2, KSAY Pre G=On, SDAP RV G=On).
- Top Center:** A 'Teletext' window displaying a list of stations and their frequencies, such as DX de W4KAZ-# 14032.0 W8DM CW 6 dB 22 WPM CQ.
- Top Right:** A 'Mumble' chat window showing a connection to the 'K3AJ Mumble Contest Server' and a welcome message from Tom, K3AJ.
- Right Side:** A 'YAESU FTDX101D WPM25 PWR35W' control panel with various knobs and buttons for frequency (14.019.445), VFO A/S, VFO B, and other settings.
- Center:** A large 'SDRplay' window showing a waterfall display of the radio spectrum around 14019.45 MHz.
- Bottom Left:** A 'SteppIR' control panel with a frequency display showing 28.040 and 28.018 MHz, and buttons for 'Auto', 'Home', and 'Relay'.
- Bottom Center:** A 'Contest Log' window with a table of log entries:

HH:MM	Call	Freq	Snt	Rcv	Sect	Wpx	M1	Pfx	M2	Pts
18:33	YT2ISM	1403...	599	599	EU	YT2	YU	HA	3	3
18:35	HG5D	1401...	599	599	EU	HG5	HA	3	3	3
18:36	UV1IX	1401...	599	599	EU	UV1	UR	DL	3	3
18:37	DK2AT	1401...	599	599	EU	DK2	DL	3	3	3
18:38	SP5LST	1401...	599	599	EU	SP5	SP	3	3	3

- Bottom Right:** A 'Score' window showing contest statistics for CQWIDX, including a table of band scores and a total score of 293,352.
- Other Windows:** A 'Gray Line' map window, a 'Check Log/Master' window, and a 'Commands' window with a list of commands like 'KSAY NE', 'KSAY NW', etc.

K3AJ Hardware/Software Diagram



How well does it work?



- Must have good internet connection at both ends
 - High speed cable/fiber-based internet
 - Use ethernet connection to routers at both ends – WiFi is much less reliable (but I have operated successfully using hotel WiFi at times)
- Depends on mode:
 - FT8/FT4 is a no-brainer. Only need remote desktop app. No audio stream required
 - RTTY is easy. Audio stream for situational awareness and timing, but quality is less critical
 - CW is usually reliable. The operation is only as good as the audio stream quality which in turn depends on internet connection quality
 - SSB is more difficult
 - Requires the audio to be set up correctly in two directions
 - Use of audio recordings and voicing is a viable option – cuts the total latency in half



How does it work?

What about the latency?



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- Remote desktop latency = trip to web service + processing time at web service + trip back to the remote desktop.
 - KU7T measured this using Anydesk and reported 50-60 ms
- Audio latency = trip from shack to Mumble server + trip from Mumble server to remote computer
 - W1VE measured total audio latency between a control point in New England and ZF5T at 127 mSec – about 1 CW character at 40 WPM
- The remote op hears everything as a continuous audio stream (the other guy and the TX monitor), just delayed a little more than 100 mSec CW or RTTY. The delay that the other guy might hear in us answering is the same. Not noticeable.
- SSB requires audio to travel both ways, so the latency is doubled – maybe 200 mSec. Use of recordings cuts that in half since they are sent from the shack.

How does it work?

What about the latency? – Connection Stats from Mumble

Good
Connectivity

The screenshot shows the 'Connection Information' window for a Mumble client. The 'Ping Statistics' table shows low latency and deviation. The 'UDP Network statistics' table shows 0% packet loss. Red circles highlight the 'Average ping' and 'Ping deviation' columns in the Ping Statistics table, and the '% Lost' column in the UDP Network statistics table.

Connection Information						
Version	1.5.255 (1.5.634)					
Warning: The server seems to report a truncated protocol version for this client. (See: Issue #5827)						
OS	Windows (Windows 10 Home 2009 19045.4780 [x64])					
Certificate	Mumble User	<input type="button" value="Details"/>				
IP Address	69.143.151.18					
Opus	Supported					
Ping Statistics						
	Pings received	Average ping	Ping deviation			
TCP (Control)	35	33.57	4.24			
UDP (Voice)	35	33.09	4.39			
UDP Network statistics						
	Good	Late	%	Lost	%	Resync
From Client	8993	0	0.00	0	0.00	0
To Client	35	0	0.00	0	0.00	0
Bandwidth						
Connection time 2m 59s online (0s idle)						
Bandwidth	55.6 kbit/s					

House of Pain

The screenshot shows the 'Connection Information' window for a Mumble client. The 'Ping Statistics' table shows high latency and deviation. The 'UDP Network statistics' table shows 0.32% packet loss. Red circles highlight the 'Average ping' and 'Ping deviation' columns in the Ping Statistics table, and the '% Lost' column in the UDP Network statistics table.

Connection Information						
Version	1.5.255 (1.5.634)					
Warning: The server seems to report a truncated protocol version for this client. (See: Issue #5827)						
OS	Windows (Windows 10 Home 2009 19045.4651 [x64])					
Certificate	Mumble User	<input type="button" value="Details"/>				
IP Address	69.143.151.18					
Opus	Supported					
Ping Statistics						
	Pings received	Average ping	Ping deviation			
TCP (Control)	113	207.35	221.65			
UDP (Voice)	113	207.82	223.29			
UDP Network statistics						
	Good	Late	%	Lost	%	Resync
From Client	28230	0	0.00	91	0.32	0
To Client	113	0	0.00	0	0.00	0
Bandwidth						
Connection time 9m 24s online (0s idle)						
Bandwidth	54.0 kbit/s					

How does it work?



- W4RN has been doing this a long time, starting at W4BVV with ops as far away as Korea and has scored some very high finishes and category wins in M/2 and M/S with a competitive station and operator team
- W1VE has set this up on some big stations (K1LZ, ZF5T) and achieved winning results
- Successful remote contesting requires some patience and a flexible mindset on the part of the remote operator
- At K3AJ:
 - We mostly do M/S entries
 - The station is loud enough for us to have fun
 - Most of our regular ops have very limited home stations
 - We do mostly CW and RTTY but have done a little Digi and some SSB
 - We recently did our first ever M/2 in NAQP CW. Used an FT-991A as second radio with a laptop for the second radio computer. Our Mumble server has two channels.

Appendix – Useful Links (AKA W1VE’s Greatest Hits):

Contest University 2023 – “Understanding Remote Contesting” Gerry Hull, W1VE <https://www.contestuniversity.com/wp-content/uploads/2023/05/Understanding-Remote-Contesting-2023.pdf>

Contest University 2024 – “Success Strategies for Remote & Hybrid Multiop Contesting” Gerry Hull, W1VE <https://www.contestuniversity.com/wp-content/uploads/2024/05/Pg-34.-W1VE-CTU-Presentation-2024.pdf>

Groups.io, “Contesting with Mumble”

RadioSport-Network-Support-Group@groups.io

The Mumble Radiosport Network for Amateur Radio Contesting (details on setting up Mumble)

<https://blog.radiosport.network/>

Low Latency Remote Audio Worldwide

<http://remote.radio>



Appendix – K3AJ Station

Radio: Yaesu FTDX101D

Amplifier: Elecraft KPA 1500

Antennas:

160M - Inverted L

80M – Inverted V at 45 ft./68 ft. Vertical

40M – 2-el Yagi at 70 ft.

20M – 4-el Yagi at 70 ft.

15M/10M – 3-el SteppIR at 50 ft.

RX – K9AY

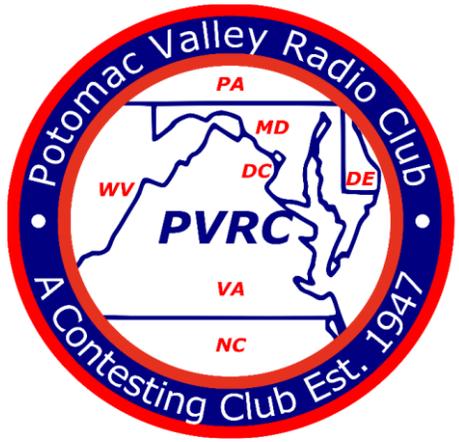
Appendix – Ancient History/Evolution of K3AJ Remote

Remote Desktop

- We started out using TeamViewer as our Remote Desktop, but very quickly discovered it would not support the usage we needed with the free version.
- Looked briefly at Chrome Remote Desktop, but it only supports one user account.
- We then moved to the (then available) Home version (free) of VNC Sever/Viewer. It would only support a few users, and then VNC discontinued its free version
- Currently using VNC Server in the shack (paid, Professional subscription approx. \$50/year per computer) with VNC Viewer at remote computers (free). Allows many users.

VOIP Applications for Audio

- First attempt was with Skype. Not good enough.
- Next attempt was with RemAud, a free VOIP app specifically developed for amateur radio. It never worked reliably for us and there is no support.
- For several years we used the Remote Hams RCForb app. It is free and there is an active user group. It requires a port forwarding set up at the server (shack) end. It worked well and provided audio reliable enough for effective contesting. It is a very complicated application, as it also incorporates a full radio control panel and can also support auxiliary equipment.
- Finally, we moved to Mumble. In its architecture, you run the Mumble client at both ends (shack and remote computers). The clients connect to a server in the cloud. We have a private server provided by Gerry, W1VE housed in a big data center for \$10/year which provides two channels of audio. It is very simple to set up and use. It has proven to be reliable and provides high quality, low latency audio. Mumble is free.



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