



INEXPENSIVE SIMPLEX DMR/YSF/ AND D-STAR HOTSPOT WITHOUT A RASPBERRY PI

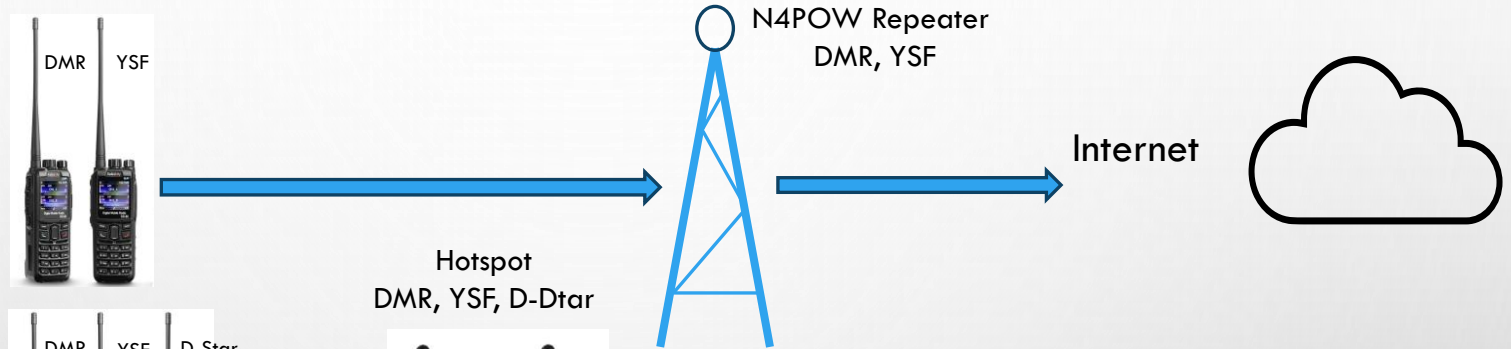
By
Ray Sommer (W2AUS)

THREE BASIC DIGITAL AMATEUR “RADIO” MODES

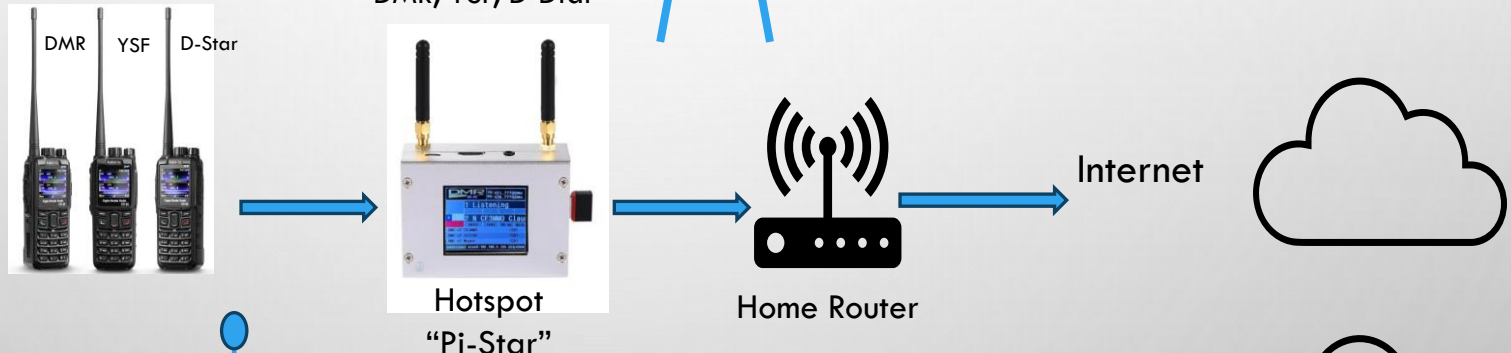
There are three popular digital radio technologies;

- 1) Digital Mobile Radio (DMR),
- 2) C4FM/Yaesu System Fusion (YSF),
- 3) Digital Smart Technology for Amateur Radio (D-Star)

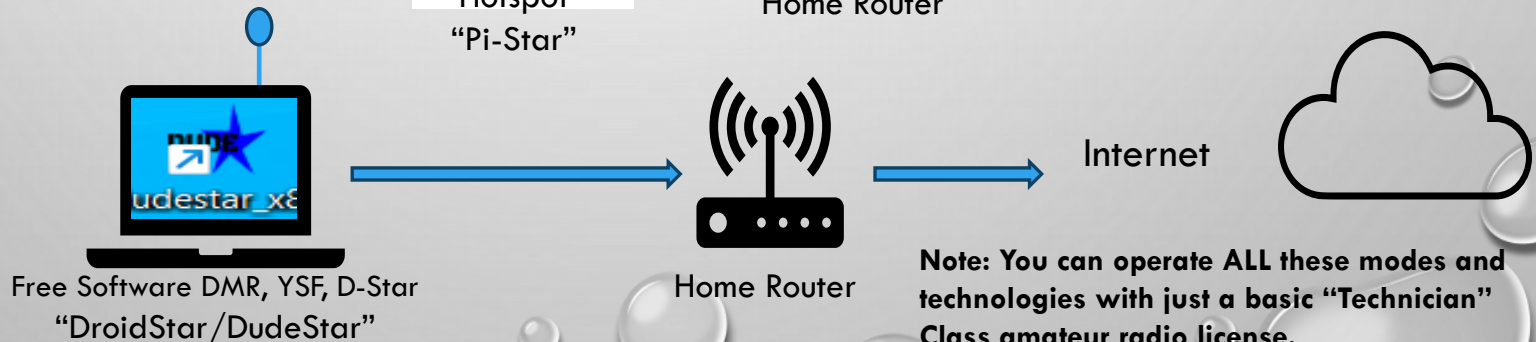
1) Regional Repeater Option



2) Local Hotspot Option



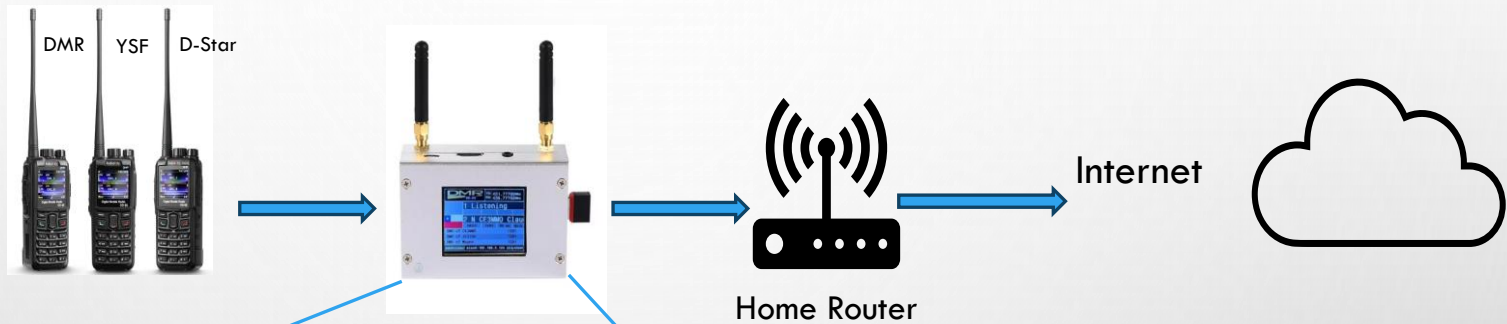
3) Local Computer Option



Note: You can operate ALL these modes and technologies with just a basic “Technician” Class amateur radio license.

OUR FOCUS WILL BE ON THIS 2ND OPTION

2) Local Hotspot Option



Typical Hotspot Components

- Raspberry Pi Computer
- MMDVM Hat - WIFI Interface*
- Pi-Star/WPSD Software
- Custom Linux OS
- Robust Case

* (a.k.a. Multi-Mode Digital Voice Modem)

TYPICAL SETUP: RASPBERRY PI AND MMDVM HAT(S)



Raspberry Pi Computer

- Relatively Cheap Processing Platform
 - Higher Learning Curve
 - Requires Updates and Maintenance
 - Many Models and Options to Choose
- \$ 30-\$150



MMDVM Simplex HAT

- Relatively Cheap Modem
 - Suitable for All Primary Digital Modes
- \$25-\$40



MMDVM Duplex HAT

- Higher Price Point Modem
 - Suitable for All Primary Digital Modes.
- (BUT Only Offers Performance Increase and Versatility in DMR Mode)
- \$40-\$60

SUMMARY TABLE OF MMDVM HAT

Mode	Simplex Hat	Duplex Hat	Benefit of Duplex?
DMR	Works but imperfect	Ideal	★ Critical (TDMA)
C4FM / YSF	Works perfectly	Works perfectly	Minor (RF isolation)
D-Star	Works perfectly	Works perfectly	Minor (cleaner switching)



- DMR uses the TDMA (Time Division Multiple Access) signaling standard. Hence it provides TWO time slots for communication on a single channel. To take advantage of this feature, DMR users often implement dual hat (Duplex) MMDVM Hats
- C4FM uses 4-Level Frequency Shift Keying (4-FSK) -- a form of FDMA
- D-Star uses GMSK (Gaussian Minimum Shift Keying) -- a form of FDMA

THE RASPBERRY PI – COMPUTER PLATFORM

- FOR AT-HOME DIGITAL HOTSPOT COMMUNICATION PURPOSES, THE RASPBERRY PI COMPUTER IS ONLY NEEDED AS A HOST AND WEB CONFIGURATION INTERFACE FOR THE MMDVM HAT. IT DOES THIS VERY WELL BY RUNNING AN OPEN-SOURCE VERSION OF THE LINUX OPERATING SYSTEM THAT IS SPECIFICALLY COMPILED FOR THIS PURPOSE.

- PERHAPS YOU'VE HEARD OF THEM? THEY'RE CALLED PI-STAR AND WPSD

[HTTPS://WOCHP.RADIO/WPSD/](https://wochp.radio/wpsd/)

WPSD = WOCHP-PISTAR-DASHBOARD

[HTTPS://WWW.PISTAR.UK/](https://www.pistar.uk/)

- PI-STAR IS OLDER AND RUNS ON MOST OF THE OLDER, SMALLER, BUT LESS POWERFUL RASPBERRY PI COMPUTERS
- WPSD IS FAIRLY NEW AND HAS MANY ELEGANT OPTIONS AND CAPABILITIES THAT PI-STAR WAS NEVER DESIGNED TO SUPPORT. BUT IT REQUIRES MORE POWERFUL RASPBERRY PI COMPUTERS

THE RASPBERRY PI – COMPUTER PLATFORM

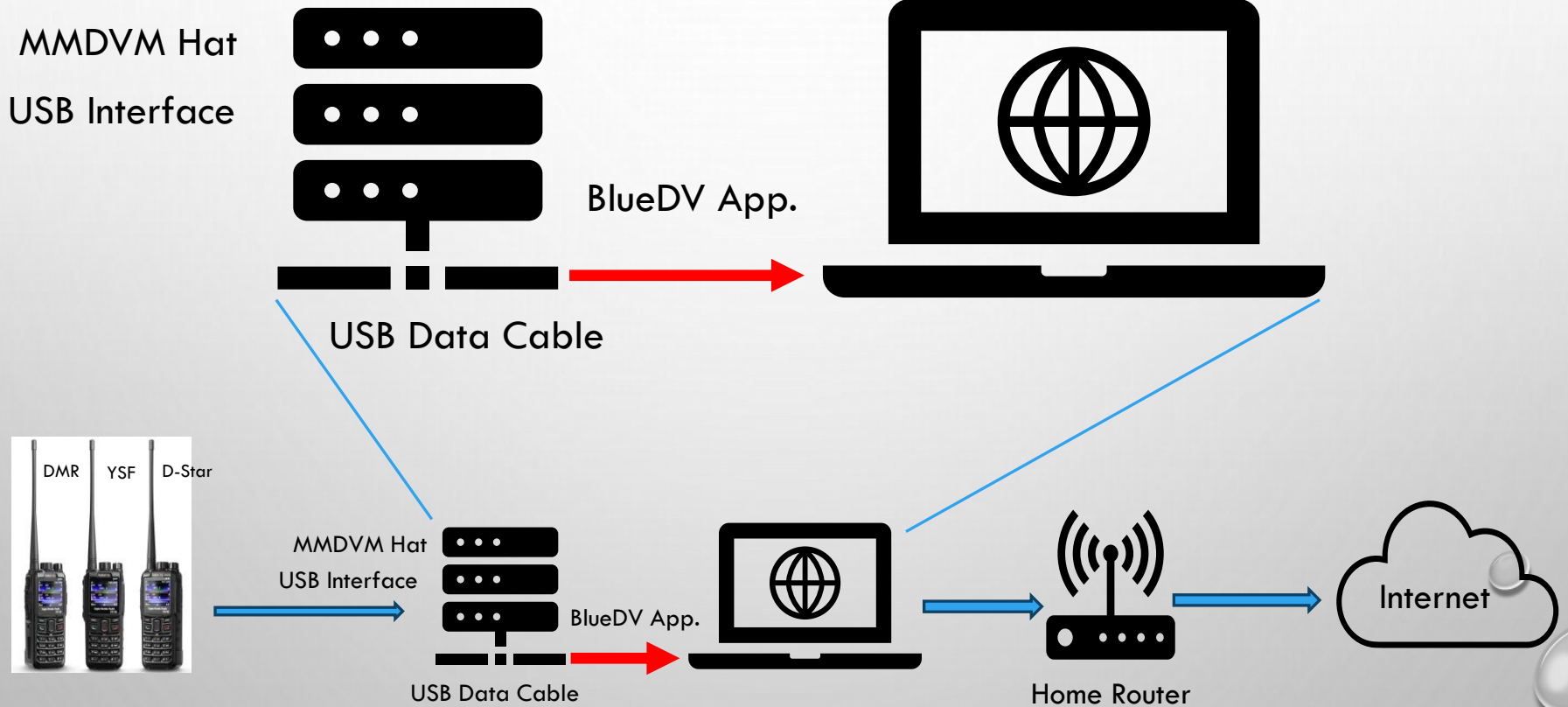
- SIMPLE DESIGN, BUT MANY DIFFERENT INTERFACE, PROCESSOR, MEMORY, AND CONFIGURATION OPTIONS AVAILABLE.
- FOR THE “NEWBIE” IN THE DIGITAL MODE AMATEUR RADIO SPACE THIS ASPECT CAN BECOME VERY OVERWHELMING.
- TOO MANY CHOICES IN CONFIGURATION AND MANAGING HARDWARE.
- LEARNING CURVE IS QUITE HIGH, AND.....
- HARDWARE/SOFTWARE FAILURES ARE QUITE COMMON (EVEN WHEN PURCHASING COMMERCIAL HOTSPOT SOLUTIONS)

.....IS THERE AN EASIER PATH?

YES, YOU ALREADY OWN A VERY POWERFUL WIFI CONNECTED COMPUTER LAPTOP. WHY NOT USE IT AS THE INTERFACE TO THE MMDVM HAT AND ELIMINATE THE HASSLE OF THE ADDITIONAL RASPBERRY PI COMPUTER CONFIGURATION?

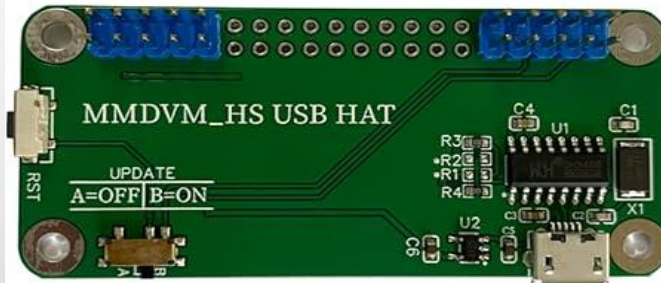
THIS IS WHERE THE BLUEDV APPLICATION SOFTWARE AND AN INEXPENSIVE DIRECT USB TO MMDVM HAT INTERFACE COME INTO PLAY.

SIMPLIFIED SETUP USING USB INTERFACE W/O RASPBERRY PI



DIRECT MMDVM USB INTERFACE CHOICES

USB/MMDVM Hat Board



Easiest – Plug 'n Play USB Board

- MMDVM hat simply plugs in and connects to PC with USB-2 cable.

Potential Problems

- Driver problems with Win10/11
- Getting Expensive \$25-\$35

CP2102 USB Converter



Almost Easiest – Must physically connect wire outputs from USB CP2102 to MMDVM hat. Potential Problems

- Incorrect wiring may short CP2102
- Delicate chip electronics (handling)
- Very inexpensive (get a four-pack from Amazon for \$10)

WHAT'S A “USB 2.0 TO TTL UART SERIAL CONVERTER” INTERFACE?

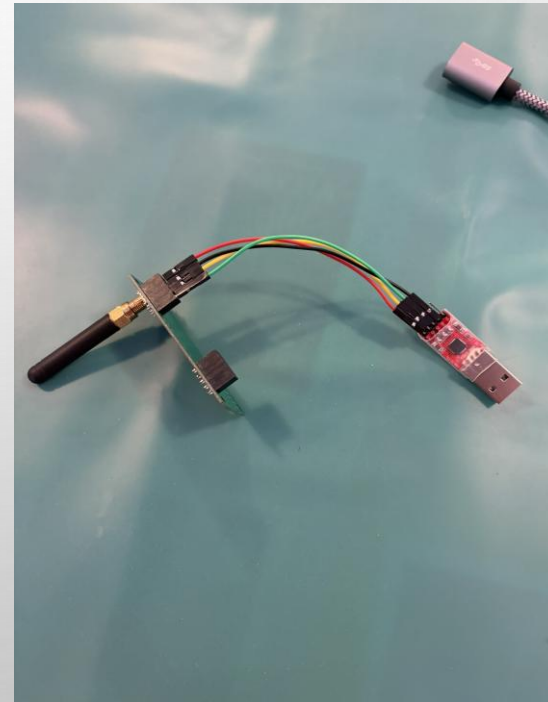
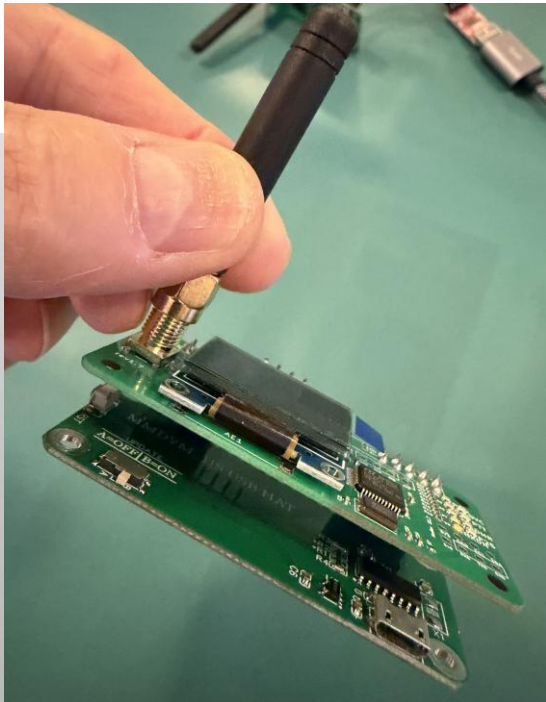
- THESE TWO PIECES OF HARDWARE (THE CP2102 AND USB HAT BOARD) CONVERT ONE SIGNALING STANDARD (USB) INTO ANOTHER (UART/TTL)
- TTL - TRANSISTOR-TRANSISTOR LOGIC (VOLTAGE LEVEL STANDARD)
 - TTL REFERS TO A **LOGIC-LEVEL VOLTAGE STANDARD**, ORIGINALLY FROM 1960/70S DIGITAL LOGIC FAMILIES.
- UART - UNIVERSAL ASYNCHRONOUS RECEIVER/TRANSMITTER (ORIGINALLY INVENTED AS THE DIGITAL SAMPLING STANDARD FOR THE DEC PDP-1 COMPUTER)
- USB IS A PROTOCOL. UART IS A PROTOCOL. TTL IS A VOLTAGE LEVEL SPECIFICATION. UART IMPLEMENTATIONS OFTEN USE THE TTL VOLTAGE LEVEL STANDARD.
- A MMDVM USB HAT INTERFACE BOARD IS FUNCTIONALLY THE SAME THING AS A CP2102 USB-TO-TTL CONVERTER:

BOTH INTERFACES CAN CONNECT TO A MMDVM HAT

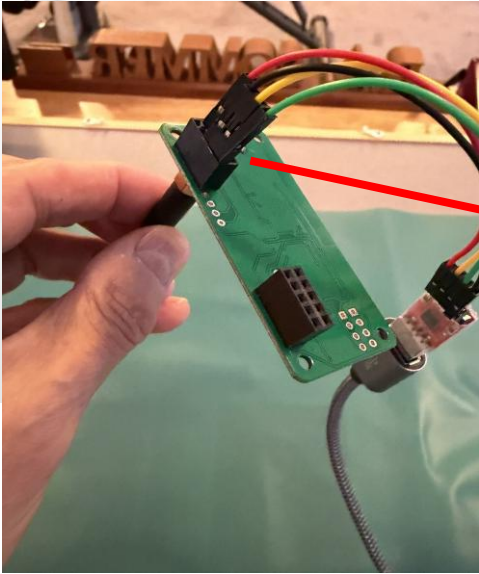
USB/MMDVM Hat Board



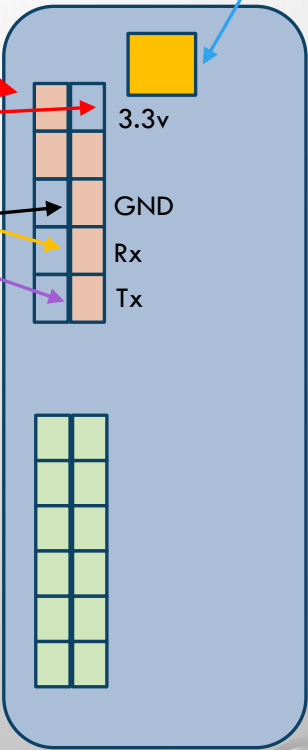
CP2102 USB Converter



UNDERSTANDING THE USB/MMDVM PIN-OUTS



MMDVM Hat
Antenna Port Bottom View



- 3.3V Pin
- Transmit Data (TXD)
- Receive Data (RXD)
- GND Pin
- 5V Pin



- Wire Legend:**
- Red = 3.3v
 - Black = GND
 - Yellow = TXD
 - Green = RXD

USB 2.0 Port

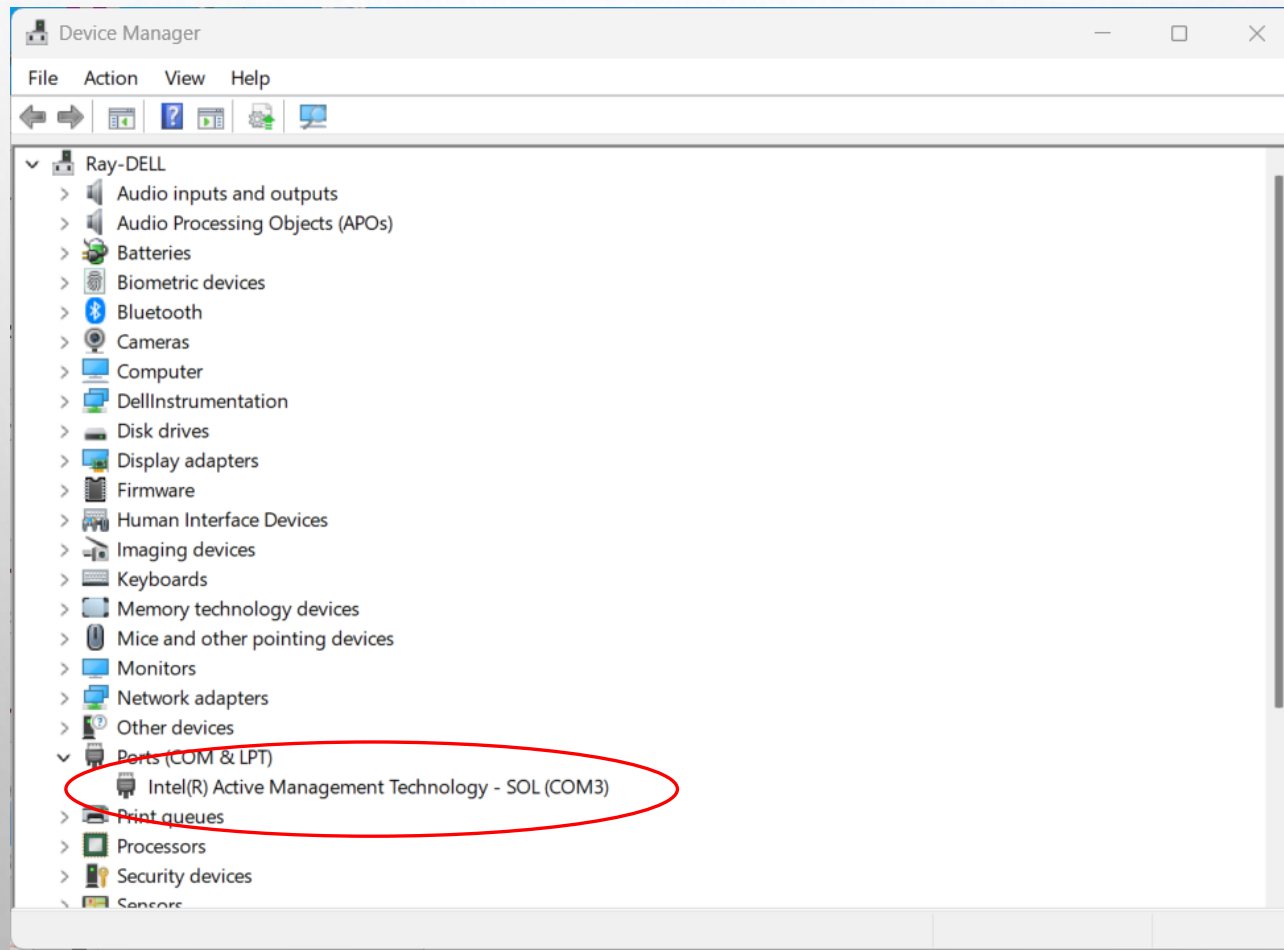
CP2102 USB to TTL
Converter IC

POTENTIAL USB INTERFACE ISSUES

- THE USB INTERFACE BOARD IS “PLUG ‘N PLAY” WITH THE MMDVM HAT.
 - PLUG THE HAT INTO THE GPIO PINS AND CONNECT A USB **DATA** (USB-2) CABLE FROM THE INTERFACE BOARD TO YOUR COMPUTER.
 - ISSUES – SOME WIN11 COMPUTERS DON’T RECOGNIZE OR BLOCK THE GENERIC DRIVERS THAT COME HARD CODED ON THIS BOARD.
- THE CP2102 USB CONVERTER IS ALMOST “PLUG ‘N PLAY” BECAUSE YOU MUST MAKE THE PHYSICAL CONNECTIONS WITH A SET OF GPIO DUPONT MALE/FEMALE WIRES.
 - PLUG THE MALE ENDS OF THE WIRES INTO THE HAT GPIO PINS AND THE FEMALE ENDS INTO THE CP2102.
 - I HAVE HEARD OF NO USB DRIVER ISSUES WITH THIS SETUP

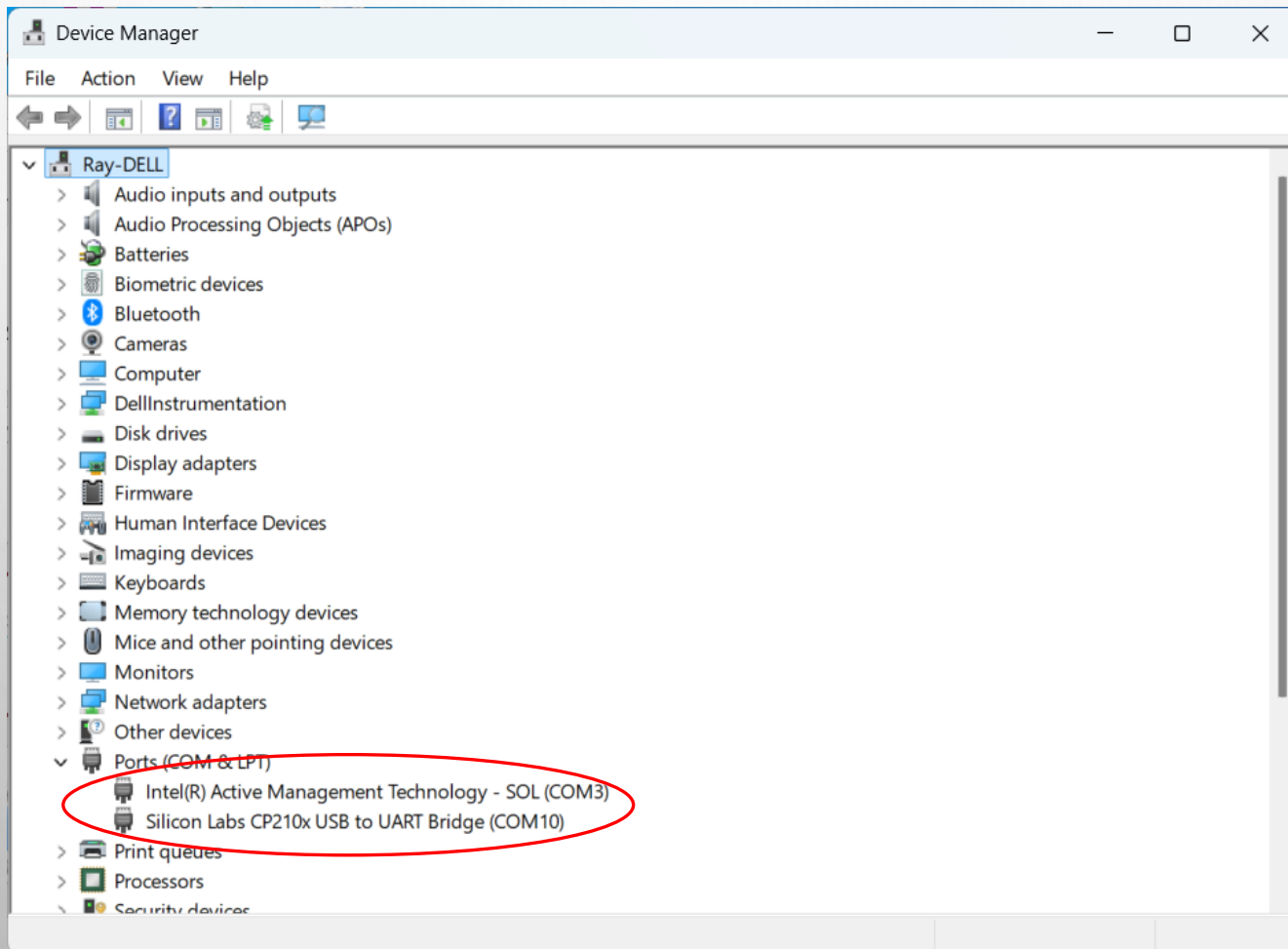
FIRST STEP: OPEN WINDOWS DEVICE MANAGER

- BEFORE PLUGGING IN THE USB CONNECTION, OPEN DEVICE MANAGER AND SCROLL DOWN TO “PORTS (COM & LPT). YOU SHOULD SEE SOMETHING LIKE THIS



...NOW PLUG IN YOUR USB INTERFACE BOARD.

- NOW YOU SHOULD SEE ANOTHER COM PORT APPEAR ALONG WITH HEARING A WINDOWS CONNECTION TONE. **WRITE DOWN THE NEW COM PORT #**



BLUEDV SOFTWARE FOR WINDOWS

- BLUEDV WAS WRITTEN MANY YEARS AGO BY DAVID GROOTENDORST (PA7LIM)
- OVER THE YEARS HE'S LOST INTEREST IN THIS PROJECT AND STOPPED SUPPORTING IT.
- BEST WE HAVE IS AN OLDER BETA-VERSION, BUT THAT'S GOOD ENOUGH FOR OUR PURPOSE.
- [HTTPS://SOFTWARE.PA7LIM.NL/BLUEDV/BETA/WINDOWS/](https://software.pa7lim.nl/bluedv/beta/windows/)
- DOWNLOAD, EXTRACT, AND INSTALL **BLUEDV-9641-BETA.ZIP**
- GO TO THE BLUEDV DIRECTORY ON YOUR COMPUTER AND INSTALL THE FILE **BLUEDV-9641-BETA.MSI**
- OPEN BLUEDV AND BEGIN THE INITIAL CONFIGURATION.

BLUEDV SETUP SCREEN

The screenshot shows the BlueDV for Windows application window. The title bar reads "BlueDV for Windows". The menu bar includes "Menu", "Update", and "About". The "Menu" dropdown is open, showing "Setup" and "Exit..".

On the left side, there are five toggle switches for "SERIAL", "DMR", "DSTAR", "FUSION", and "NXDN", all of which are currently turned off. Below these is a yellow "Donate" button.

The main display area is a large blue rectangle with a digital display. It shows the following information:

- Frequency: DMR master
- Firmware: Not detected
- Dest TG: (blank)
- LISTENING BER: (blank)
- CALL NAME: (blank)
- CITY: (blank)
- CNTRY: (blank)
- INFO: (blank)
- Idle
- Status: (blank)

On the right side of the main display, there are two vertical sliders labeled "TX" and "RX".

At the top right of the main display area, it says "By David PA7LIM" and "Version 1.0.0.9641".

Below the main display is a table with the following columns: "Lastheard", "AMBE", "BM lookup", and "APRS chat". The "Lastheard" column has sub-columns for "Time", "Call", "Name", and "Mode". The table is currently empty.

At the bottom of the window, there are four status boxes for "DMR", "DSTAR", "FUSION", and "NXDN". Each box shows "Call Status" and "Not Connected" or "Not Linked". To the right of these are four small indicator lights for "DMR", "DSTAR", "FUSION", and "NXDN". Further right is a "Mute spk" checkbox and a "Mute" button. On the far right, there is a "Mute" button and a "Mute spk" checkbox.

BLUEDV SETUP SCREEN

Pull down to find the CP2102 "COM" port number (the # you wrote down)

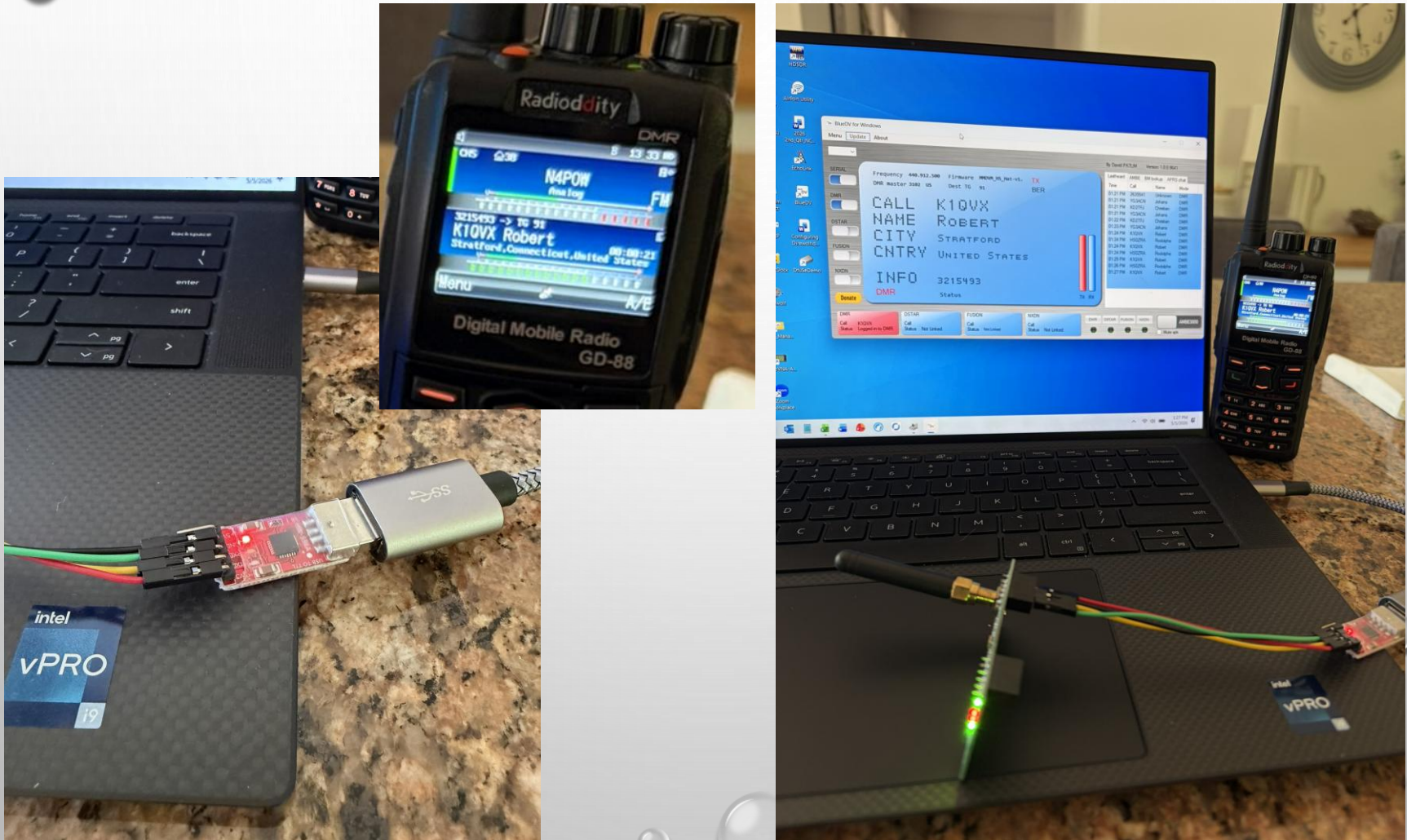
The screenshot shows the BlueDV for Windows configuration window. The 'General' tab is active. The 'Serial Port Radio' dropdown is circled in red, with an arrow pointing to the instruction above. The 'DSTAR' section has 'D' selected for the module. The 'NXDN' section has '9999' entered for the ID. The 'DMR' section has '320229505' for the hotspot ID, '3202295' for the simple ID, and '3102 US' for the brandmaster. The 'Master Password' field is empty and circled in red, with an arrow pointing to the instruction 'Enter your BM passwd'. The 'PTT keying' section has 'Enable' checked, 'RX Indicator' checked, and 'RTS' selected for both RX and PTT buttons. The 'Save' button at the bottom left is circled in red.

Enter your DMR ID Twice

Enter your BM passwd

Save Cancel

COMPLETED USB/MMDVM INTERFACE



ONLY A FEW DRAWBACKS

- BLUEDV **ONLY** SUPPORTS SIMPLEX MMDVM HATS AND OPERATION (I.E. NO DUPLEX CAPABILITY AS WOULD BE THE CASE WITH A RASPBERRY PI-BASED SYSTEM)
- WITH THIS USB INTERFACE SETUP YOU DON'T GET ANY SCREEN OUTPUT FROM YOUR MMDVM HAT (EVEN THOUGH IT HAS ONE BUILT INTO THE BOARD). IT'S JUST A "DUMB" INTERFACE
- BLUEDV IS NO LONGER SUPPORTED – HENCE IF THERE ARE ANY MAJOR CHANGES TO THE CURRENT DIGITAL PROTOCOLS, THEN THE APPLICATION MAY NOT WORK ANYMORE.
-BUT UNTIL THEN THEN, THIS IS A SLICK LITTLE SOLUTION.



THANK YOU!! & QUESTIONS

JOIN US THIS COMING SATURDAY AT 9:00AM AT THE POWHATAN COUNTY PUBLIC LIBRARY. WE'LL BUILD THE CP2102 USB INTERFACE VERSION AND GET THE BLUEDV SOFTWARE CONFIGURED ON YOUR PERSONAL COMPUTERS.

73, RAY

