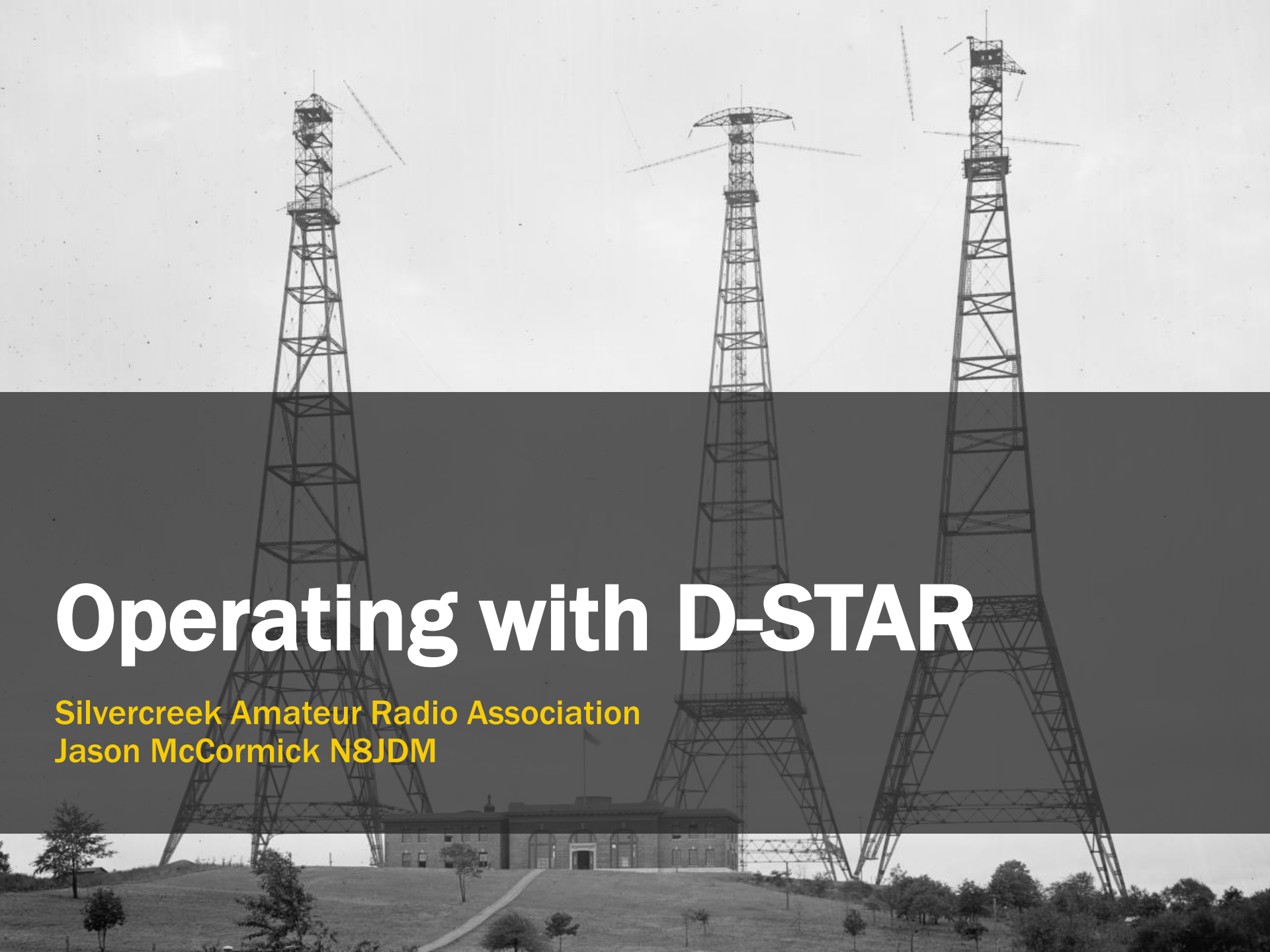

Operating with D-STAR

Silvercreek Amateur Radio Association
Jason McCormick N8JDM

What is D-STAR?

Digital Smart Technologies for Amateur Radio or D-STAR is a digital voice and data protocol specification for amateur radio. The system was developed in the late 1990s by the Japan Amateur Radio League and uses minimum-shift keying in its packet-based standard.

- Digital voice
- Text messaging
- Digital data
- Location and ID information

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Why D-STAR?

- It's fun!
- Programming is much simpler than DMR

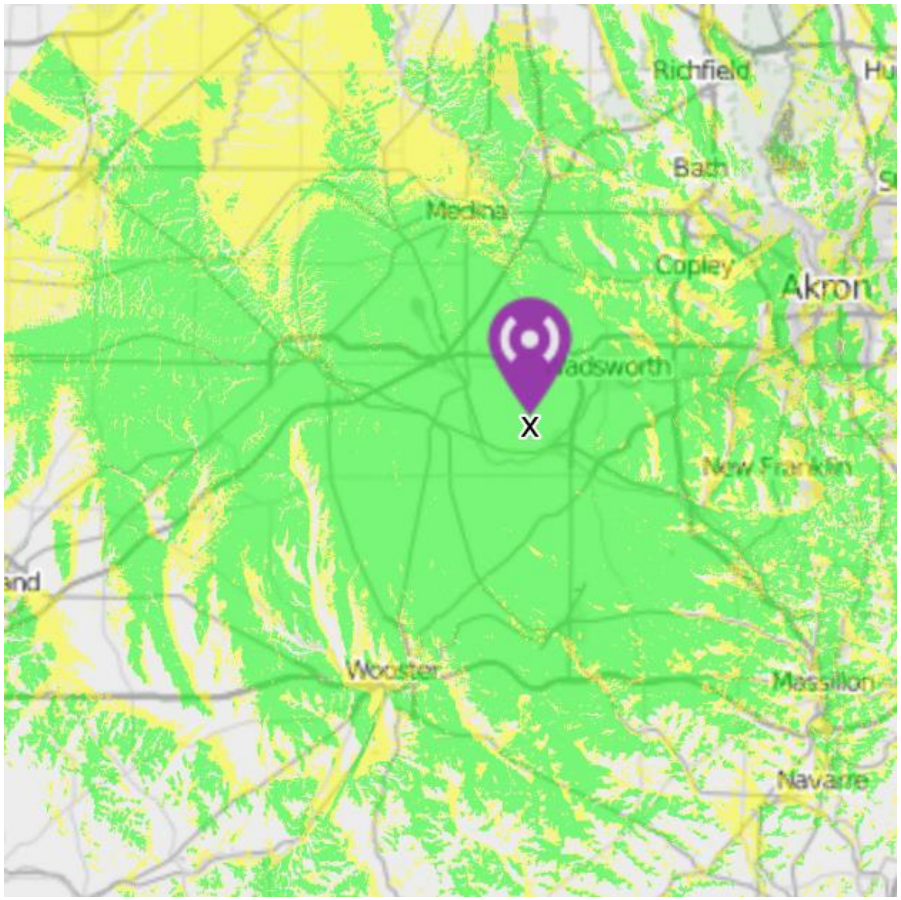
See *Digital Voice Modes* by John Wagner N8CD for a detailed look at how D-STAR works over the air.

Ref: https://w8wky.org/presentations-talks/

Area D-STAR Activity

442.375+ WW8TF – Wayne Technical Fanatics

- Multimode repeater with D-STAR the primary mode supporting DPlus and DExtra traffic.
- Covers Rittman, western side of Wadsworth, north to Medina, south to just north of Wooster, west to the Wayne/Ashland Co. line



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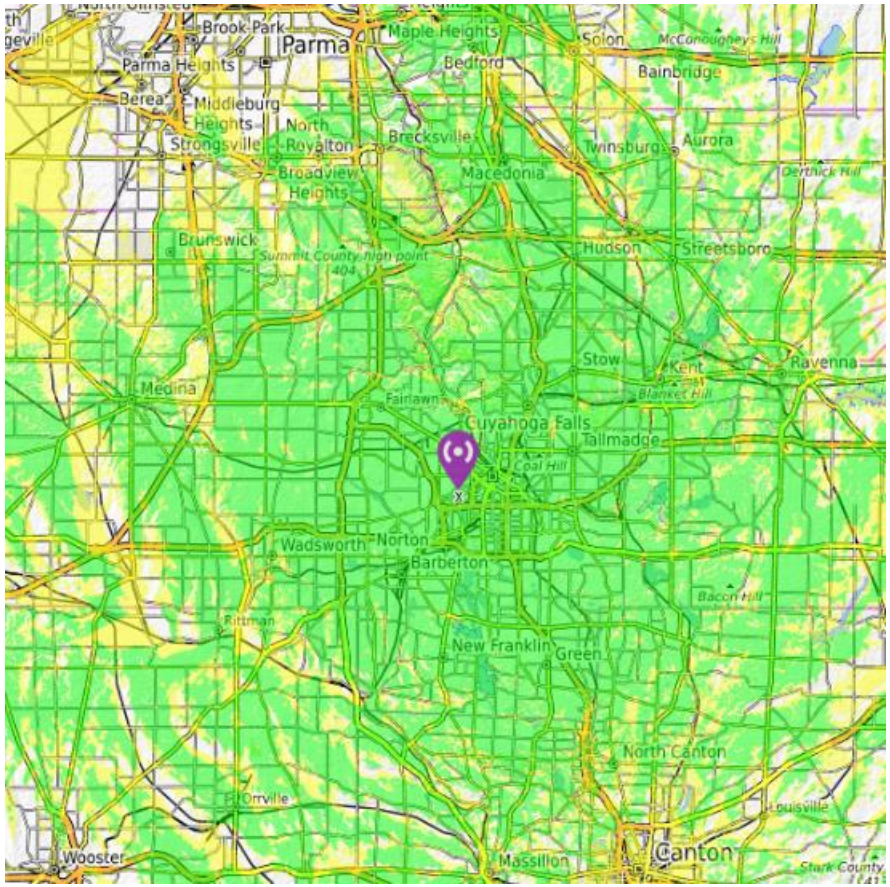
Area D-STAR Activity

442.5125+ KE8LDH – Wayne Technical Fanatics

- Multimode repeater with D-STAR the primary mode supporting DPlus and DExtra traffic.
- MOVING SUNDAY 3/24 to Spring Hill! Will cover Akron, west to Wadsworth, south to Green, east to Portage Co line, and north to Brecksville



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Area D-STAR Activity

146.985- N8DXE – DX Engineering

- Converting from analog FM in April to Icom D-STAR
- Supports at least DPlus reflectors (DExtra Ken??)
- High profile machine with great coverage across Summit and Portage counties

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D-STAR Gateway Annoyance

- D-STAR has a “gateway” registration requirement
- Gateways can only be operated by Icom repeater hardware owners (Boooo!)
- Registering to the D-STAR network is incredibly annoying, but it’s a one time annoyance
- Don’t fool around with the “local” repeater directions:
  - https://regist.dstargateway.org/ (DStarGateway Group)
  - https://w8heq.dstargateway.org/ (DARA)
- You don’t need a radio to register. If you think you’re getting a D-Star radio, go register in advance!

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Registration Steps

1. Register to the D-STAR network at a gateway
2. WAIT
3. Login to the gateway system and ensure that your profile is setup correctly

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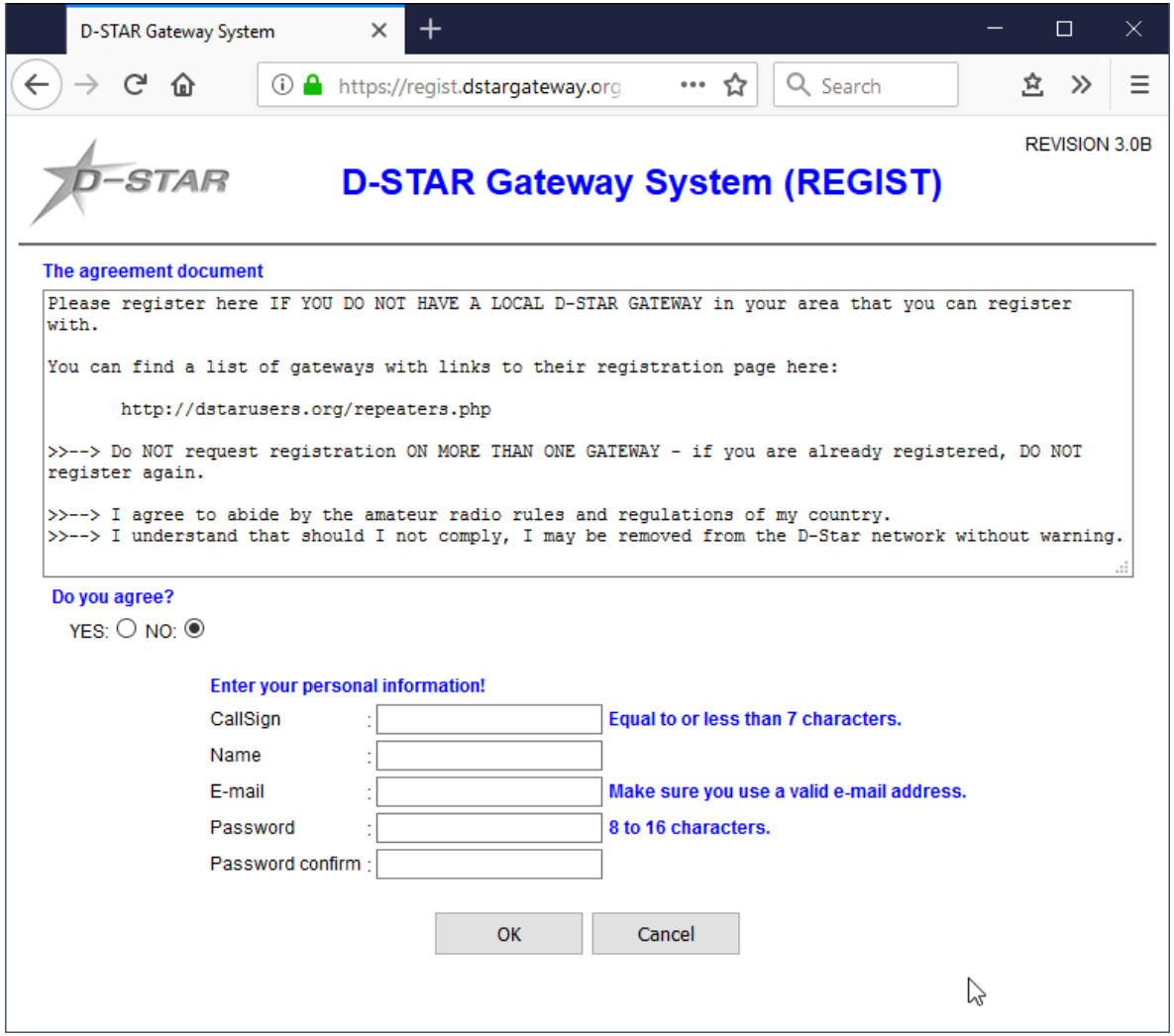
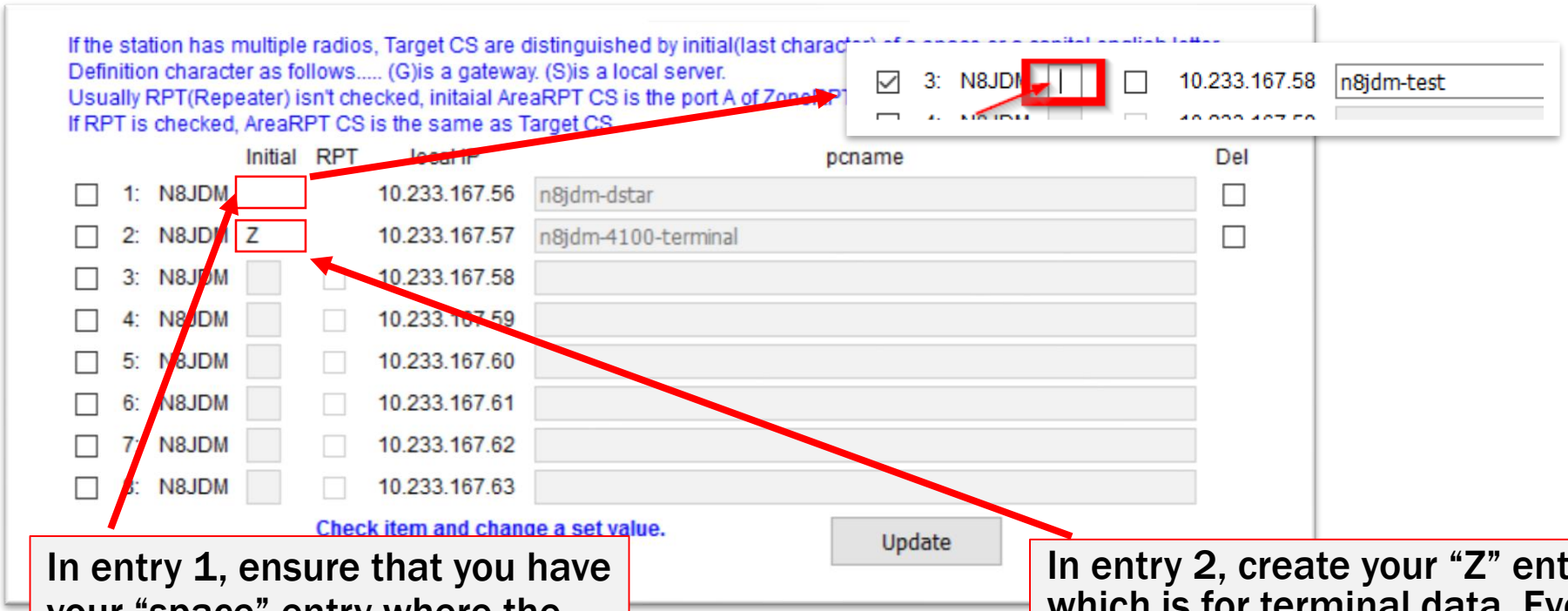
Registration Steps



- All D-STAR gateways are operated by volunteer individuals or clubs
- Choose your password wisely and write it down somewhere

D-STAR Station Setup

After receiving your registration approval notice, log in to the same gateway and click *Personal Information*



In entry 1, ensure that you have your “space” entry where the *Initial* field is a <u>single space</u>

In entry 2, create your “Z” entry which is for terminal data. Even if you don’t plan on using it, there’s no harm in creating it

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Key D-STAR Terms for Radios

Term	Purpose
Own Callsign 1	The transmitter's callsign - e.g. N8JDM. This field **must** be the callsign registered to the D-STAR Gateway Network.
Own Callsign 2	Any modifier to the callsign; transmitted as /TEXT. This is commonly used to send a name or location designator - e.g. /QTH, /M. (4 chars)
UR –or- URCALL	Where the transmission is directed
RPT1	The callsign and module of the local repeater
RPT2	The gateway exit for network traffic from the local repeater

UR / URCALL

The UR field is the ***Companion Callsign*** field in a D-STAR transmission. Think of this field as “Who am I telling to listen to this transmission?”

D-STAR transmissions <u>always</u> have a UR set, even when communicating simplex!

D-STAR-ese for “everyone” is the string CQCQCQ

The UR string is also how to issue commands to a D-STAR repeater

The UR string is eight characters wide and is **position dependent – spaces are important!**

RPT and UR/URCALL Writing Conventions

Depending on who wrote information you will see many conventions **that all mean the same thing:**

- **Quoted Spaces:** **“WW8TF B”**
- **Underscores:** **WW8TF_ _ B**
- **Carats:** **WW8TF^^B**
- **Monospace Type:** `WW8TF  B`

All try to be helpful, but at the end of the day, you have to remember that the RPT or URCALL has to be exactly 8 character long - 7 characters of identity with space padding and 1 character of command or module

Different Forms of UR/URCALL

Position in the URCALL Field								Meaning
1	2	3	4	5	6	7	8	
C	Q	C	Q	C	Q			General traffic (no command)
X	R	F	3	3	0	A	L	Link to reflector XRF330, module A
							U	Unlink current reflector
							E	Echo-back mode (“Parrot”)
							I	Play current repeater status
W	W	8	T	F			L	Link local repeater to the WW8TF Repeater directly (This is frowned upon unless you own/control both repeaters)

RPT1

Think of RPT1 as equivalent to a PL/CTCSS tone.

To talk on a repeater, you must set the RPT1 field to the callsign of the repeater and its module. D-STAR supports a concept of “modules” to support the same controller directing radios on multiple bands.

In general, a 70cm repeater is “B”, 2m is “C”, and 23cm is “A”. Usually “D” refers to a data-only access module. Standard repeaters use this convention; hotspots may vary but are often “B” or “D”.

The field is 8 characters wide and position dependent – follows the same rules as URCALL

RPT1

Position in RPT1 Field								Meaning
1	2	3	4	5	6	7	8	
W	W	8	T	F			B	Repeater is WW8TF, module B
K	E	8	L	D	H		B	Repeater is KE8LDH, module B
W	8	W	K	Y			C	Repeater is W8WKY, module C
N	8	C	D				D	N8CD digital access module D

Most D-STAR repeaters are listed at http://www.dstarusers.org/repeaters.php and list the module(s) available by frequency.

Frequency Information

2 Meters (Usually "C" Node): N/A

70 Centimeters (Usually "B" Node): 442.51250MHz +5.000

23 Centimeters Voice (Usually "A" Node): N/A

23 Centimeters Digital Data N/A

Frequency Information

2 Meters (Usually "C" Node): 145.39000MHz -0.600

70 Centimeters (Usually "B" Node): 442.65000MHz +5.000

23 Centimeters Voice (Usually "A" Node): 1285.00000MHz -12.000

23 Centimeters Digital Data 1298.00000MHz

RPT2

RPT2 (in it's common use) is essentially saying that the traffic into the repeater should be delivered to the worldwide D-STAR network.

Leaving RPT2 blank will cause the local repeater to work but traffic will not be sent through the gateway, including any commands. For repeaters linked to a reflector, you can hear remote sites but they can't hear you.

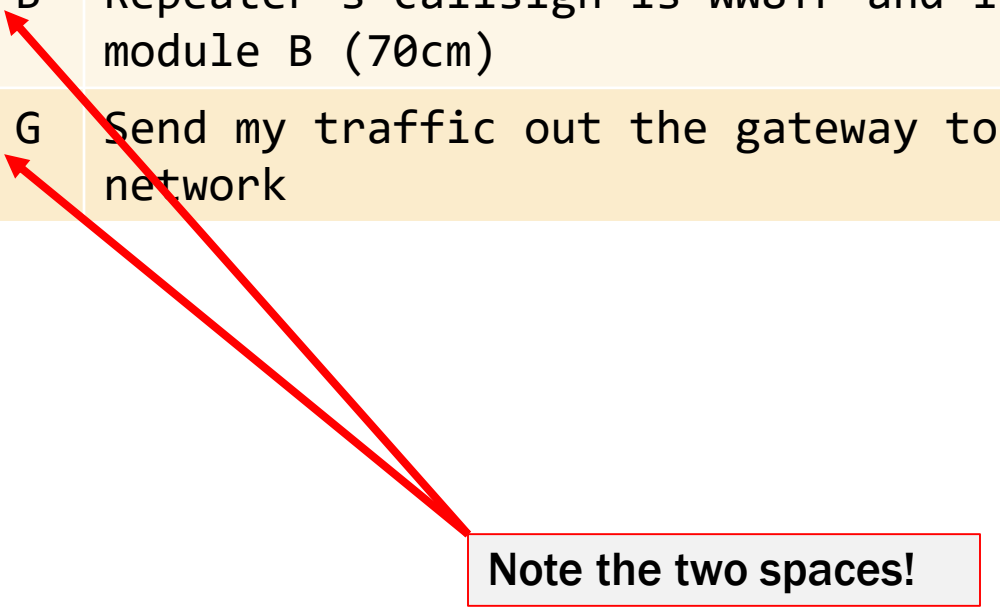
Unless there is compelling need and it's clear what you're doing, always match RPT1 and RPT2 - swapping the module letter A, B, C, or D with a G.

RPT2

Position in RPT2 Field								
1	2	3	4	5	6	7	8	Meaning
W	W	8	T	F			G	Repeater is WW8TF
K	E	8	L	D	H		G	Repeater is KE8LDH
W	8	W	K	Y			G	Repeater is W8WKY
N	8	C	D				G	Hotspot N8CD

Putting it all Together – An Example

Item	Setting	Meaning
Own Call 1	N8JDM	I am N8JDM
Own Call 2	QTH	“This is my QTH radio”
UR	CQCQCQ	Traffic is destined for all listeners
RPT1	WW8TF B	Repeater’s callsign is WW8TF and is on module B (70cm)
RPT2	WW8TF G	Send my traffic out the gateway to the network



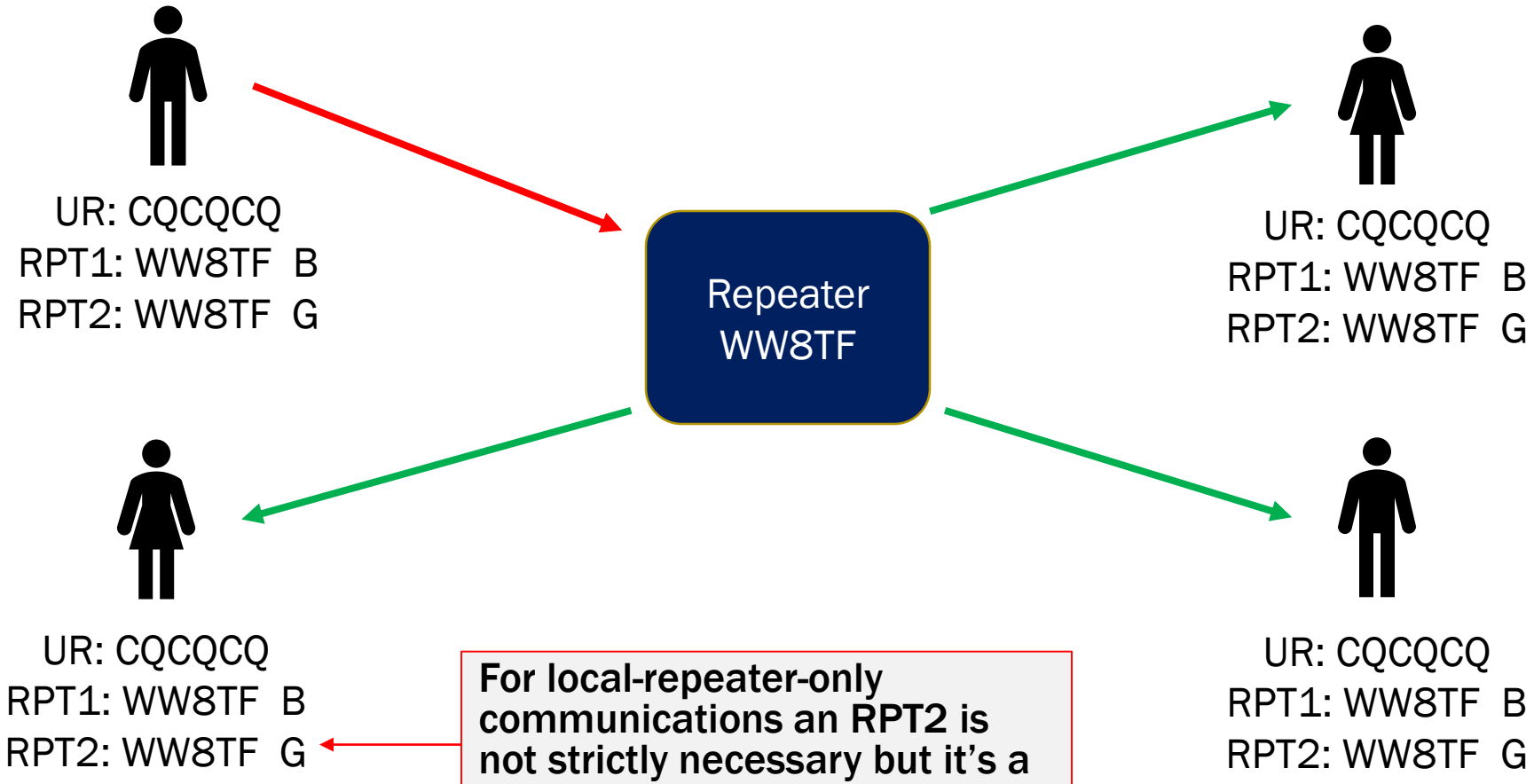
Radio Operation

Radio programming practice is to store one memory with “CQCQCQ”, one with each of the commands (i.e. ‘E’, ‘I’, ‘U’), and then linking commands for various reflectors.

If the repeater is already in the mode you want (or you don’t care), just transmit on the “CQCQCQ” memory setting. This is equivalent to talking on a standard analog repeater.

If you want to test your audio quality or your RF strength, transmit into the ‘E’ command memory, unkey, and your transmission will be played back.

Basic D-STAR Operations



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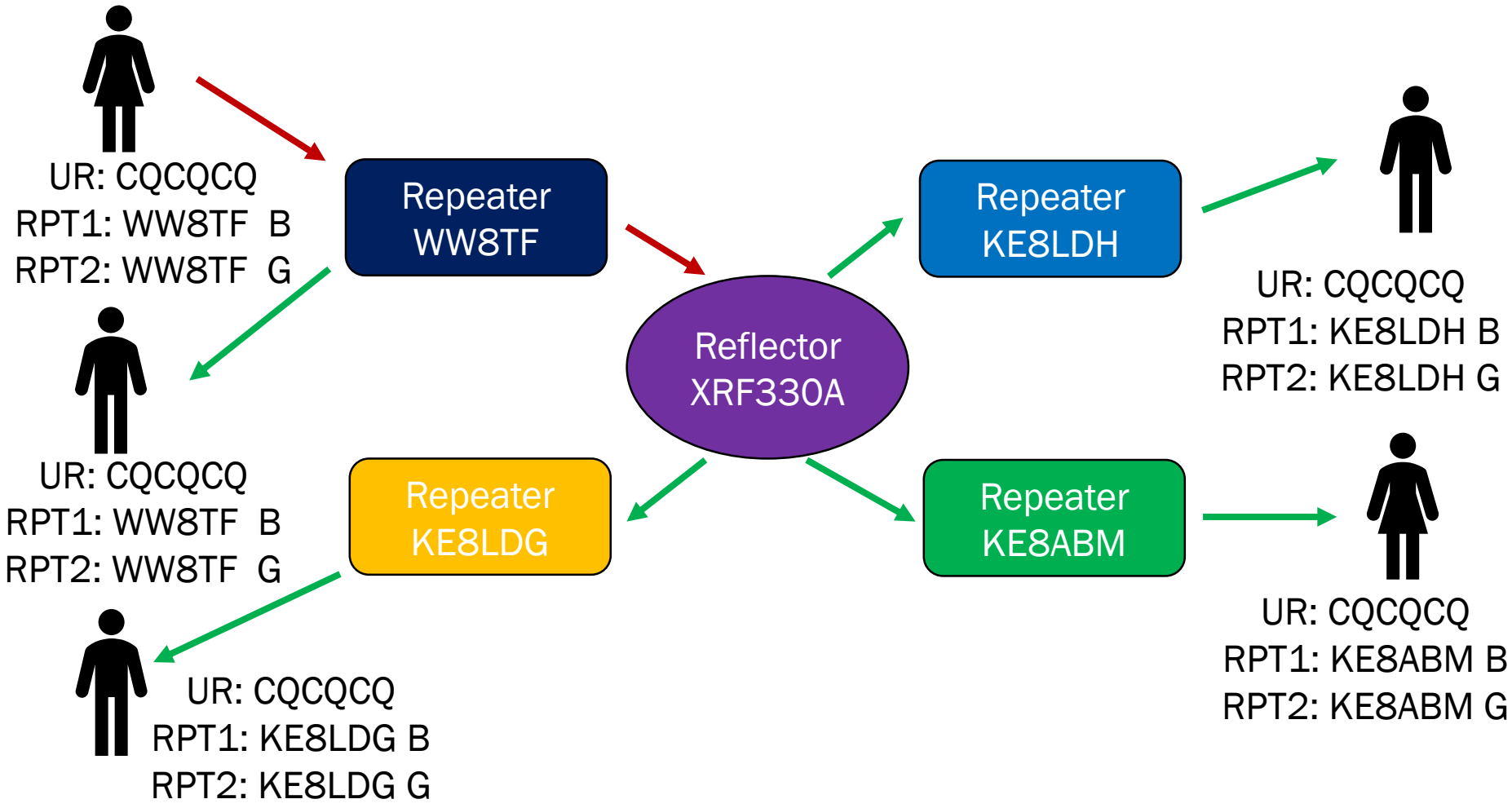
Reflectors

A reflector is exactly what it sounds like – it reflects back out the transmissions sent to it.

Reflectors are network-based and can either be private networks or public/Internet networks.

D-STAR operates exclusively on a “star” topology model – all repeaters are connected to exactly one reflector at a time and all communication travels to the reflector and then back out from it.

Reflector Diagram



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Reflector Types

Just like DMR with DMR-MARC vs. Brandmeister, D-STAR has multiple “networks” but unlike DMR, they are not mutually exclusive on the repeater:

- REF – uses the DPlus protocol for repeater-reflector communications; original reflector type
- DCS – uses the DCS protocol for repeater-reflector communications; country-centric organization for D-STAR/DMR transcoding
- XRF – uses the DExtra protocol; very decentralized community model

Basically you need to find the organization you want to talk on/to and use their published reflector information

Reflectors Aren't Needed for D-STAR

D-STAR originally had no concept of reflectors! D-STAR was designed for digital voice and text

D-STAR provides for site-to-site connectivity and callsign-to-callsign connectivity

- Site-to-site is rarely used in practice but is an option for hotspot and small repeater users
- Callsign-to-callsign routing is almost never used because it leads to poor amateur practice by not knowing the remote station's location and repeater status. IRCDDB-based hotspots make this okay for cross-hotspot comms – but know first!

Reflector Linking Process

‘ I’	• Test the repeater configuration with the ‘I’ command
‘XRF330AL’	• Assuming the repeater is not linked to a reflector, transmit briefly on the memory slot for the reflector you want. • Repeater will usually state when it connects.
‘CQCQCQ ‘	• Switch to your ‘CQCQCQ’ memory slot and transmit a normal QSO. Do not keep transmitting on the reflector memory slot – you’ll keep sending link commands!
‘ U’	• When finished, transmit the unlink command from that memory slot. It is considered polite to re-link to any reflector you disconnected. If the repeater is know to be usually connected to the reflector you selected, don’t unlink it.

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Other Neat Features of D-STAR

- Most radios can transmit your location (GPS or fixed config). Depending on type and need, you can also send elevation, antenna type, etc.
- Most radios will transmit a “message” along with your audio text – e.g. “Jason in NE Ohio”
- May repeaters and most reflectors have a status board to show their linking state and who is talking:
  - https://ww8tf.ww8tf.club
  - https://ke8ldh.ww8tf.club
  - http://hub.megalink.network/xlx

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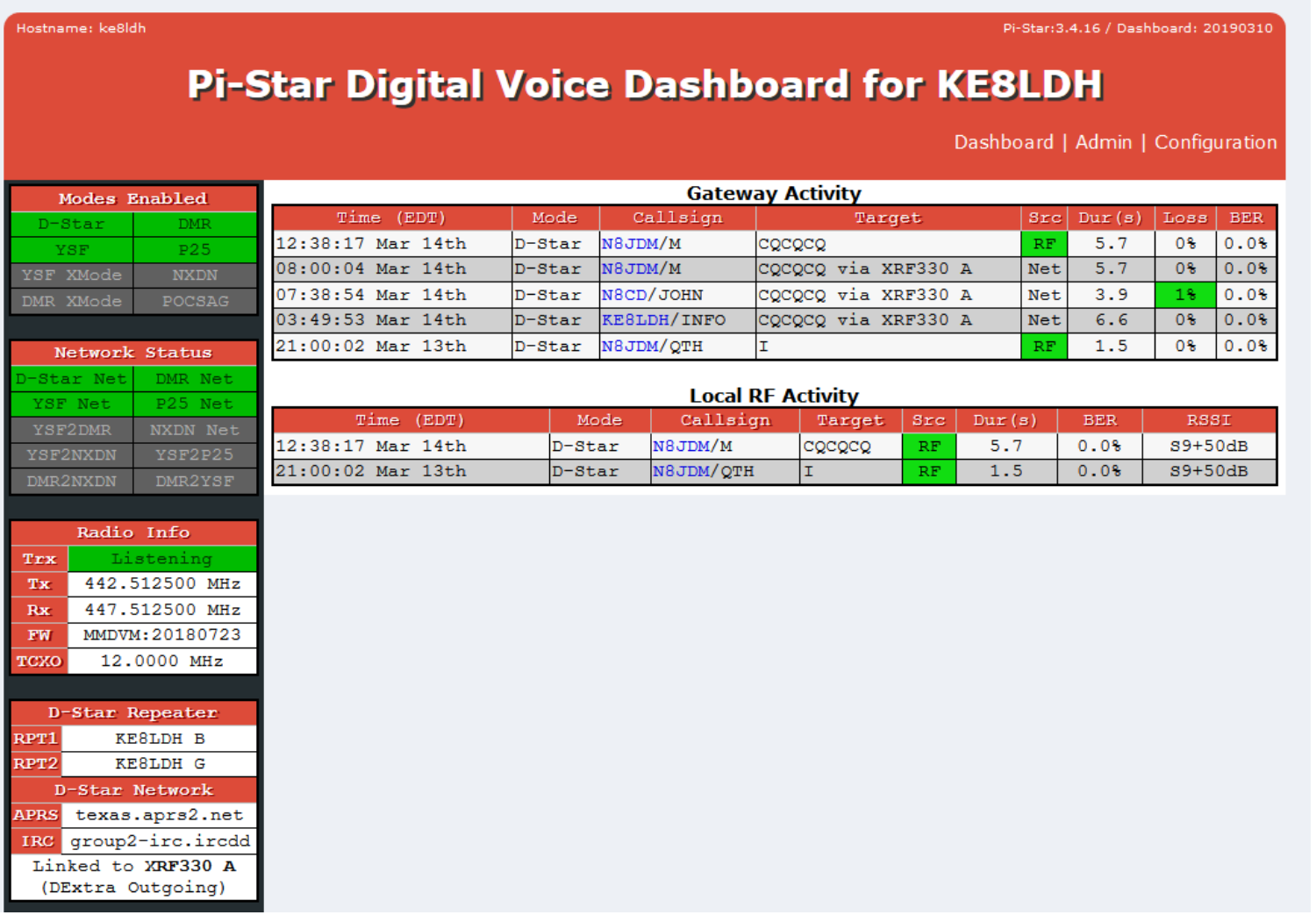
Pi-Star-based Dashboard



Hostname: ke8ldh

Pi-Star:3.4.16 / Dashboard: 20190310

Pi-Star Digital Voice Dashboard for KE8LDH

Dashboard | Admin | Configuration

Modes Enabled	
D-Star	DMR
YSF	P25
YSF XMode	NXDN
DMR XMode	POCSAG

Network Status	
D-Star Net	DMR Net
YSF Net	P25 Net
YSF2DMR	NXDN Net
YSF2NXDN	YSF2P25
DMR2NXDN	DMR2YSF

Radio Info	
Trx	Listening
Tx	442.512500 MHz
Rx	447.512500 MHz
FW	MMDVM:20180723
TCXO	12.0000 MHz

D-Star Repeater	
RPT1	KE8LDH B
RPT2	KE8LDH G
D-Star Network	
APRS	texas.aprs2.net
IRC	group2-irc.ircdd
Linked to XRF330 A (DExtra Outgoing)	

Gateway Activity

Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	Loss	BER
12:38:17 Mar 14th	D-Star	N8JDM/M	CQCQCQ	RF	5.7	0%	0.0%
08:00:04 Mar 14th	D-Star	N8JDM/M	CQCQCQ via XRF330 A	Net	5.7	0%	0.0%
07:38:54 Mar 14th	D-Star	N8CD/JOHN	CQCQCQ via XRF330 A	Net	3.9	1%	0.0%
03:49:53 Mar 14th	D-Star	KE8LDH/INFO	CQCQCQ via XRF330 A	Net	6.6	0%	0.0%
21:00:02 Mar 13th	D-Star	N8JDM/QTH	I	RF	1.5	0%	0.0%

Local RF Activity

Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	BER	RSSI
12:38:17 Mar 14th	D-Star	N8JDM/M	CQCQCQ	RF	5.7	0.0%	S9+50dB
21:00:02 Mar 13th	D-Star	N8JDM/QTH	I	RF	1.5	0.0%	S9+50dB

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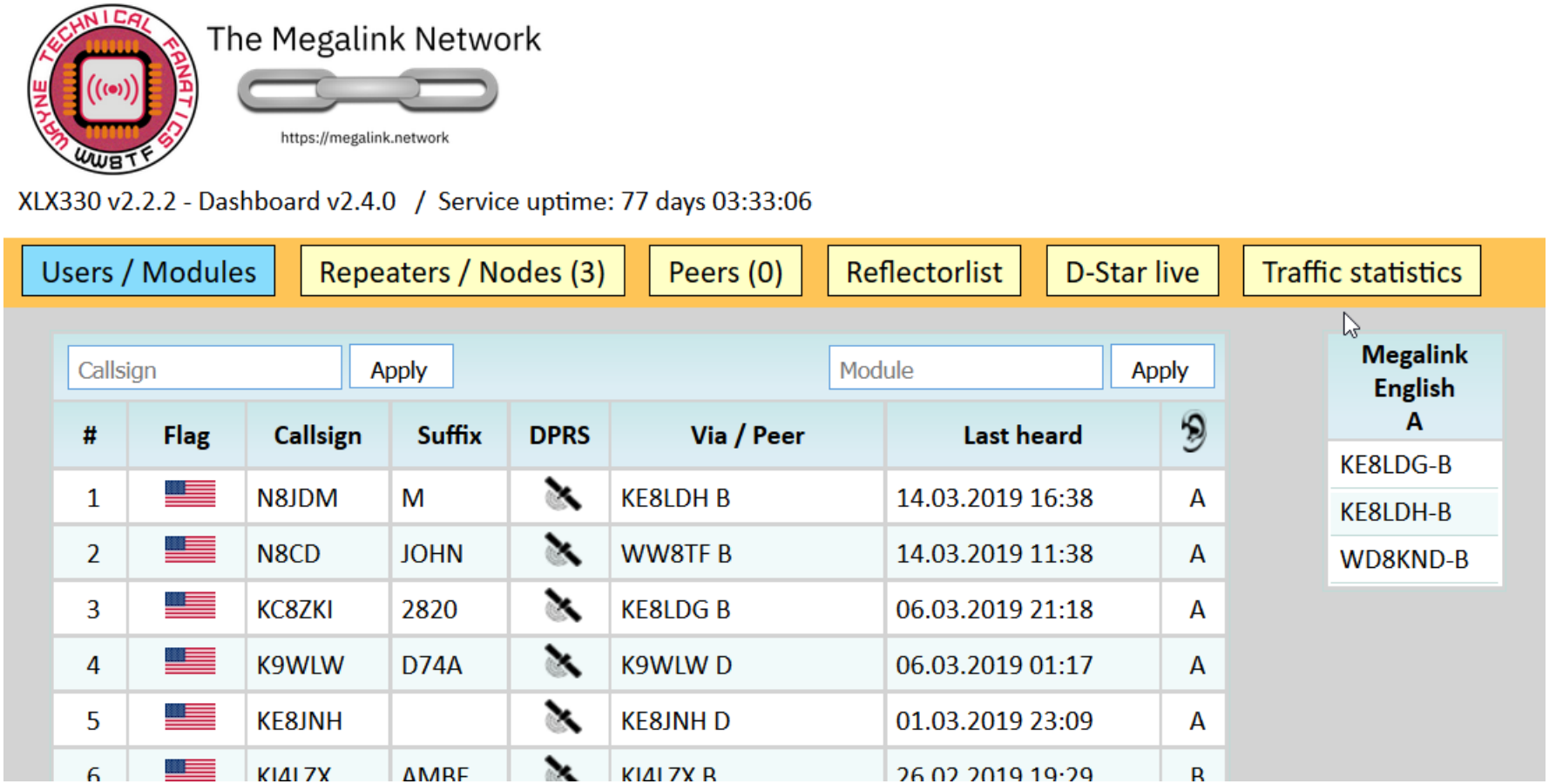
XLX-Based Reflector



Programming Radios

All current-model Icom radios use versions of the same “CS” software, each model with its own version

- You cannot copy configurations between software
- You CAN export most of the important pieces as CSV files, manipulate them, and re-import them into the CS software – including across versions
- I have an ID-51A, ID-4100A, and an ID-5100. All three have the same memory configs thanks to CSV file imports

Kenwood obviously has different software.

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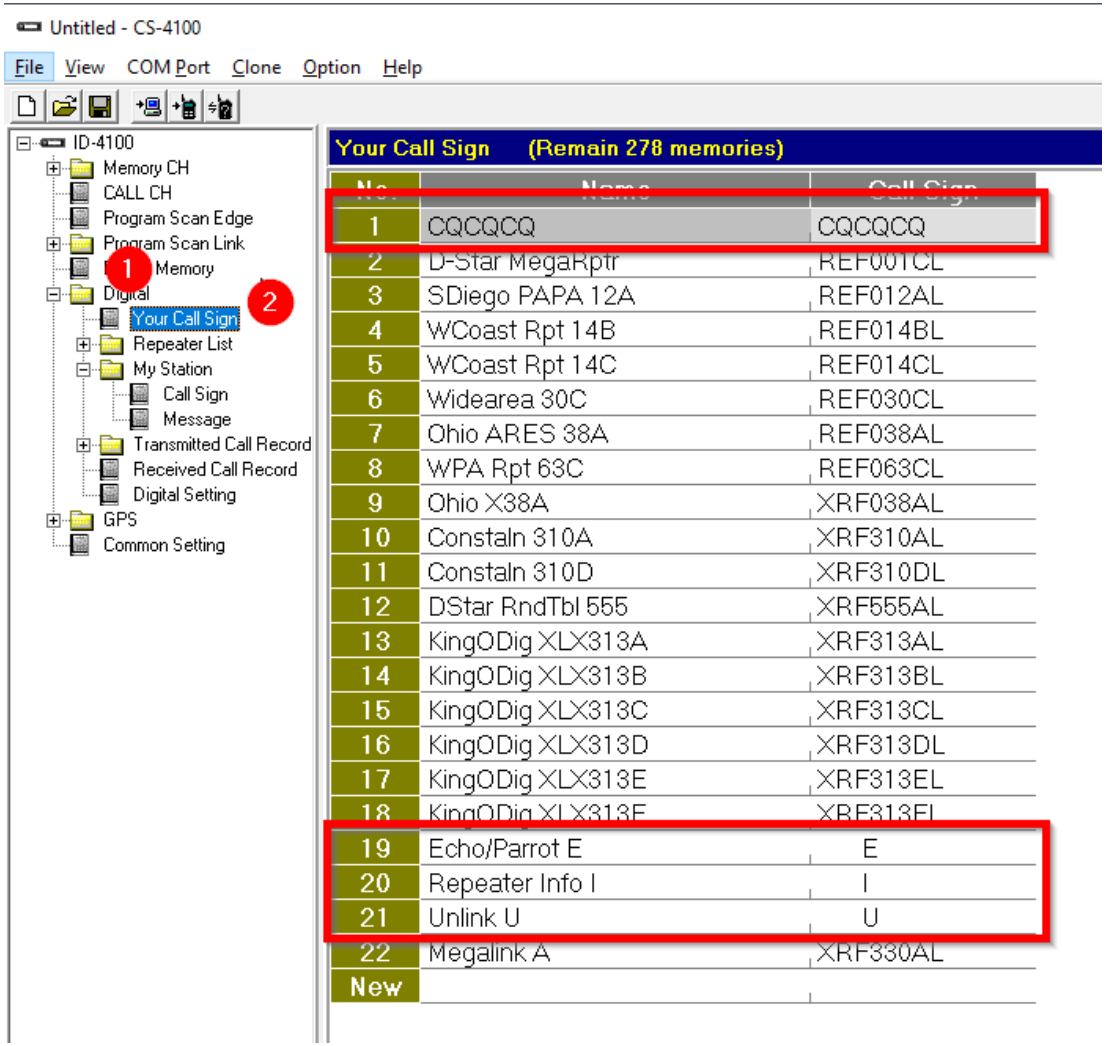
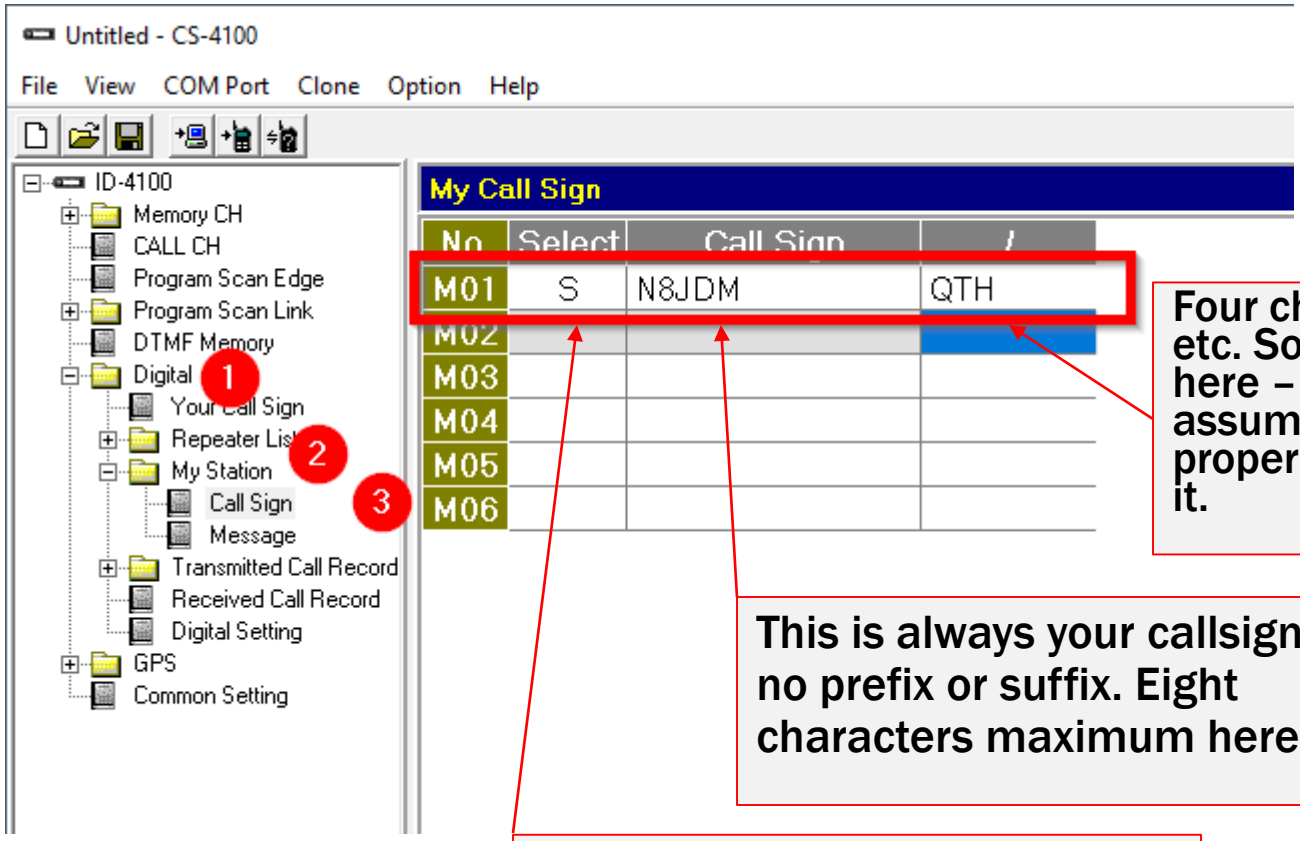
General D-STAR Programming

- Setup Own Callsign
- Setup UR Callsigns
- Setup Repeaters
- Create memory items using the above
- Create banks (as desired)

URCALL Programming



Callsign

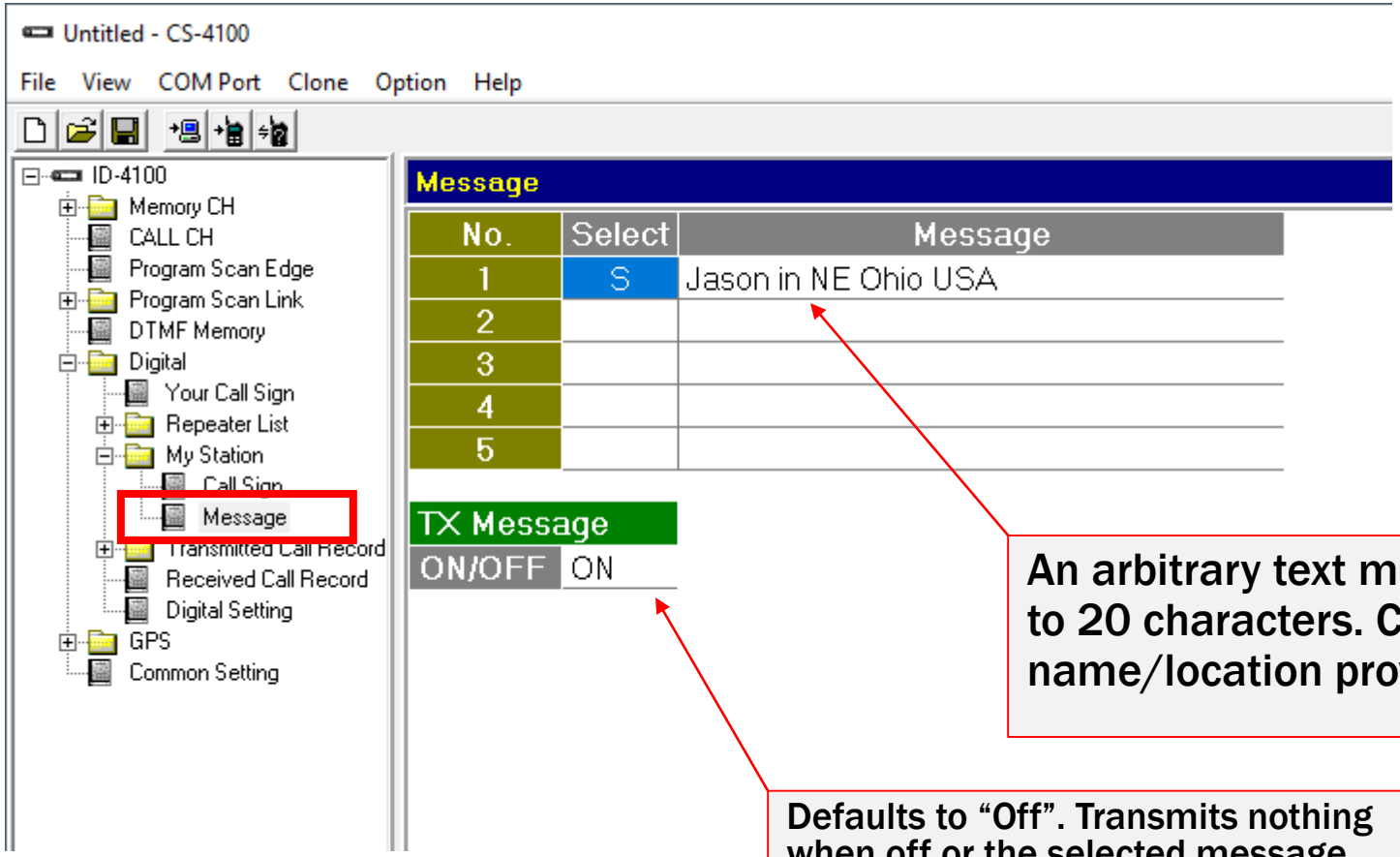


Four character suffix – M, P, QTH, etc. Some people put their name here – John. The slash is always assumed and transmitted properly – you don't have to list it.

This is always your callsign with no prefix or suffix. Eight characters maximum here.

You can keep multiple entries here and swap between them on the radio if you want. For programming, pick your default and mark is "Select" in the *Select* column

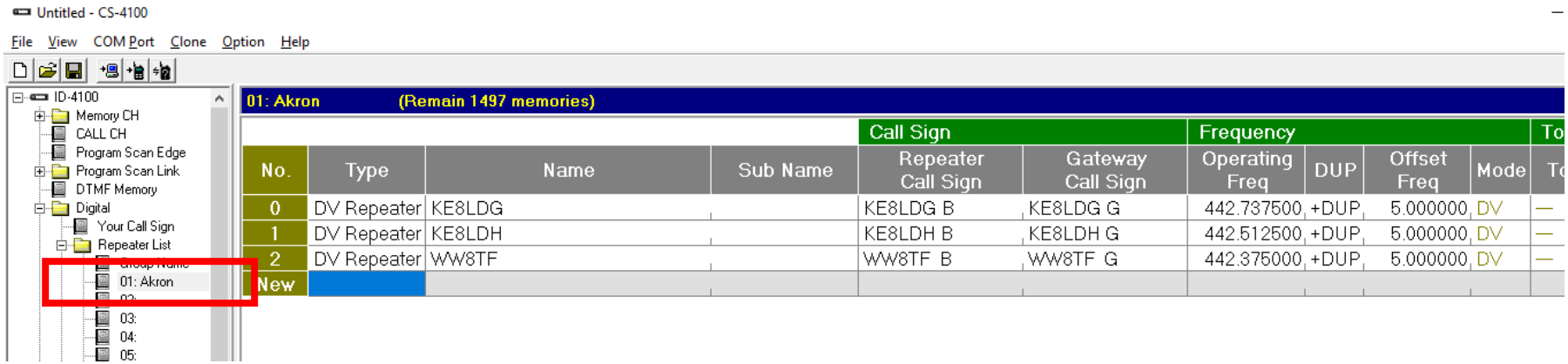
Transmission Message



An arbitrary text message of up to 20 characters. Commonly a name/location provided.

Defaults to “Off”. Transmits nothing when off or the selected message when “On”. Can be easily toggled on the device for on/off and selection.

Digital Repeater Setup



This is identical to setting up a normal memory channel. You can list FM and DV (D-STAR) repeaters here. It's very helpful to reduce typing in Memory Channels. It's not very useful for FM analog repeaters.

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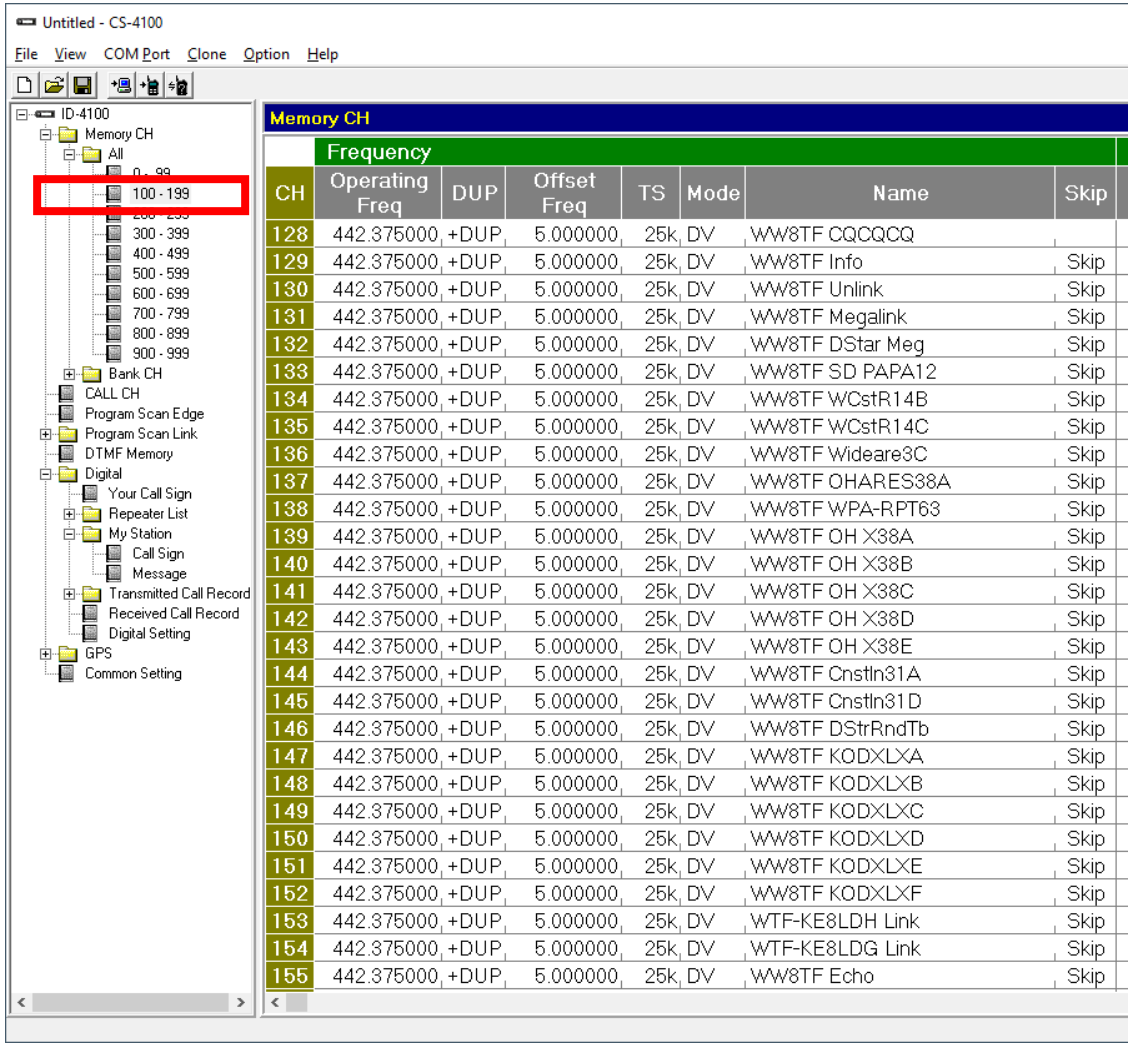
Memory Channel Setup



- Memory programming is largely the same as analog FM except the mode is “DV”
- Memory label is 16 characters long
- Mark all your “command” memories with Skip

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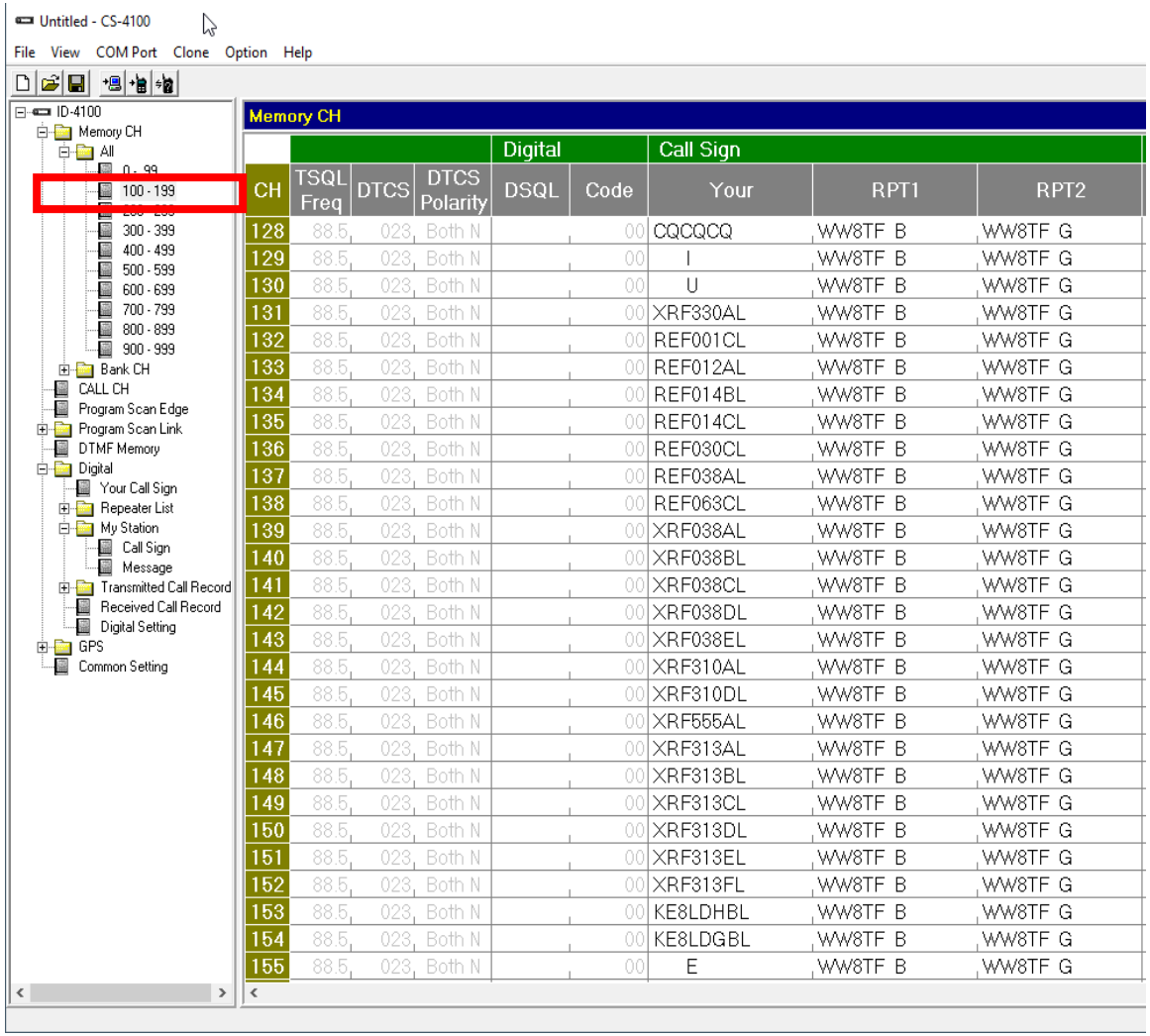
Memory Channel Setup



- However, instead of Tone, etc. you program D-STAR information
- One unskipped channel for “CQCQCQ” the remaining for your linking commands

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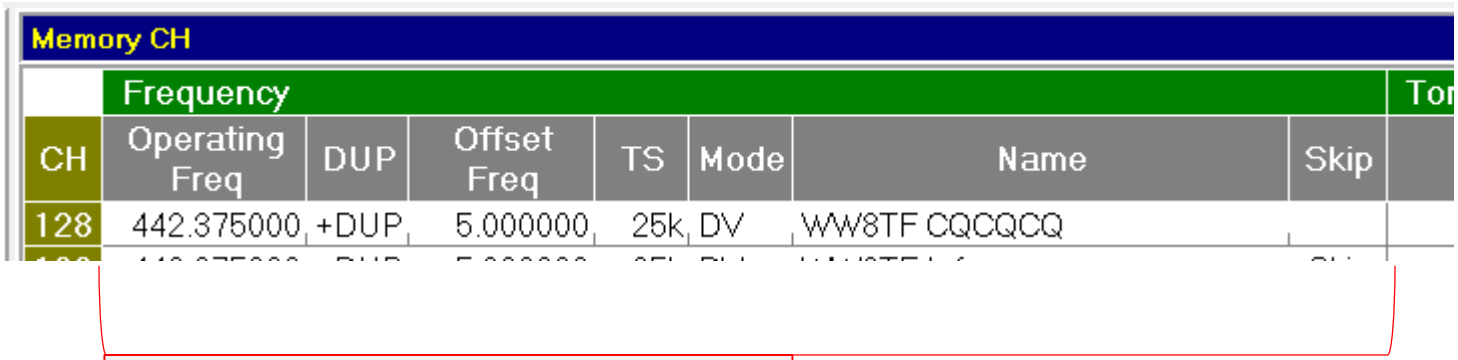
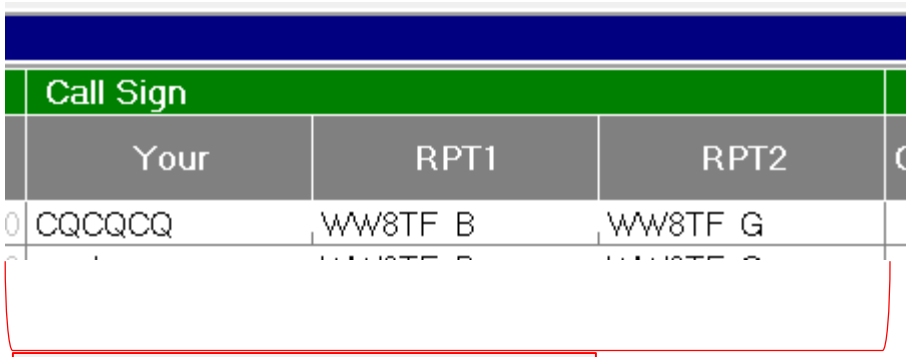
D-STAR Memory Channel Close-Up



Memory CH							
	Frequency						To
CH	Operating Freq	DUP	Offset Freq	TS	Mode	Name	Skip
128	442.375000	+DUP	5.000000	25k	DV	WW8TF CQCQCQ	

Standard radio info: RX frequency, offset direction and size, tune step, mode, alphanumeric label and skip



	Call Sign		
	Your	RPT1	RPT2
0	CQCQCQ	WW8TF B	WW8TF G

D-STAR URCALL, RPT1 field, and (optional) RPT2 field

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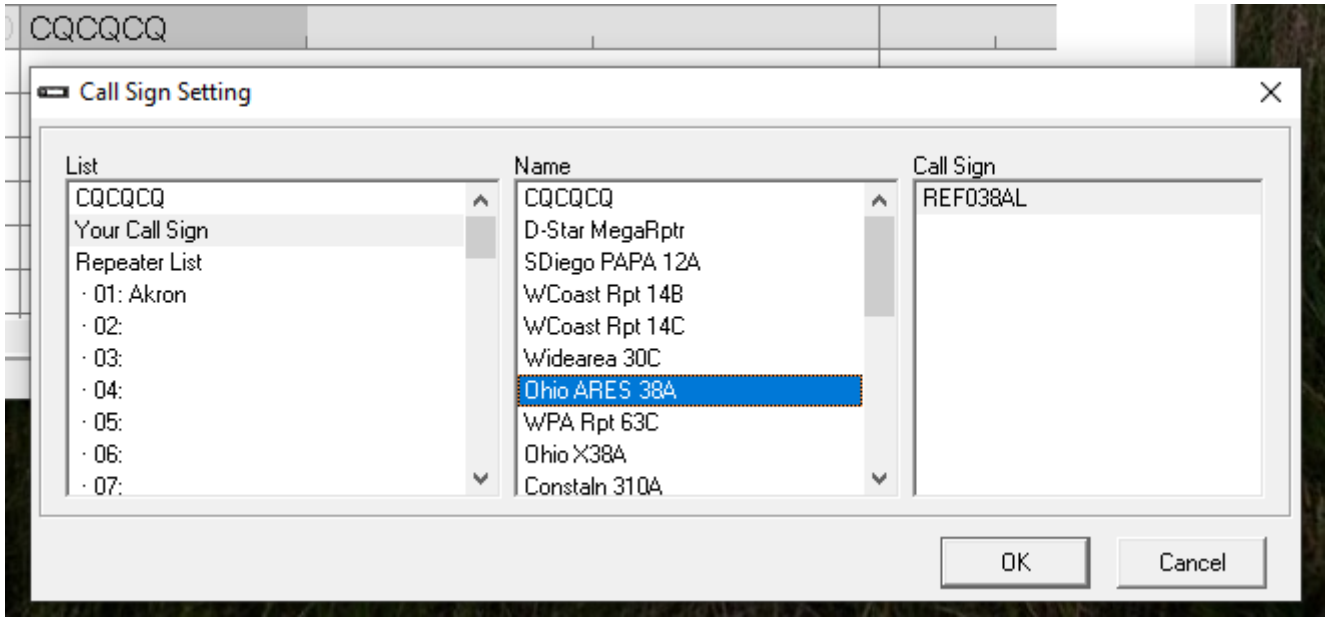
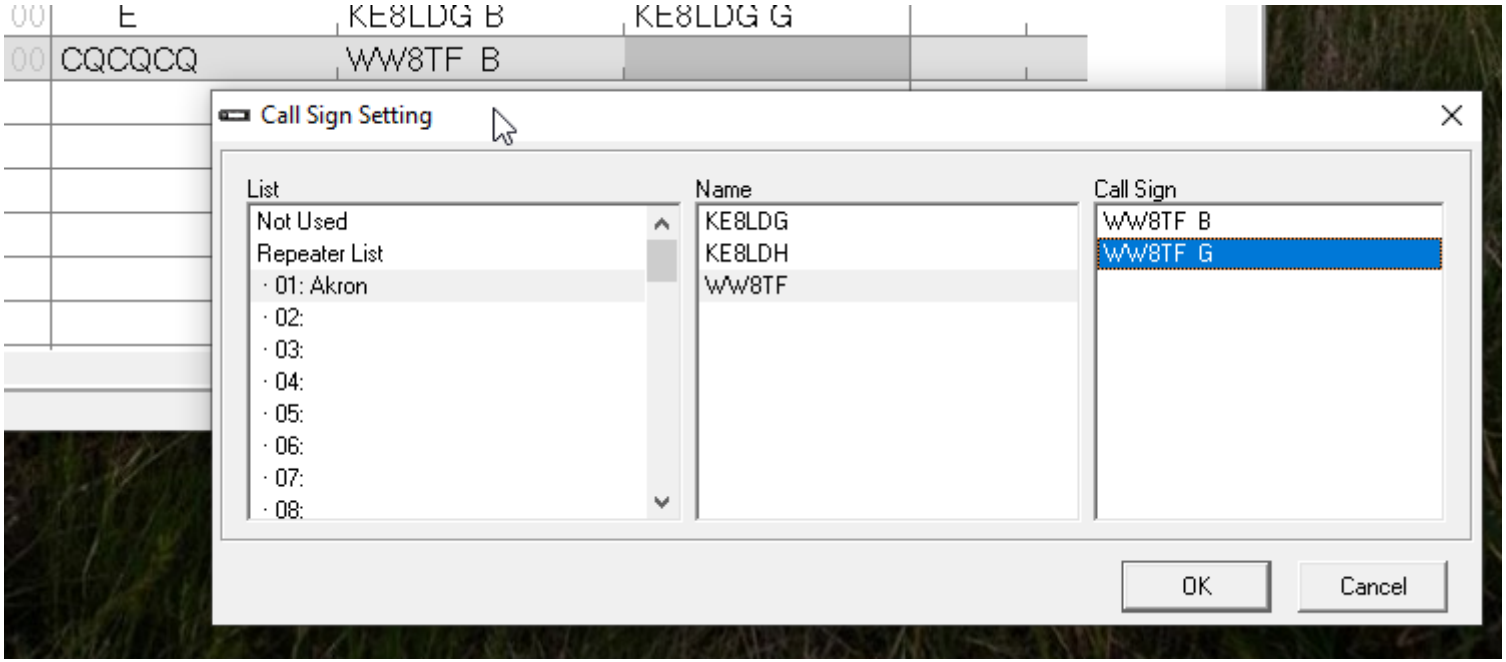
Entry Shortcuts

Right-click on the *Your* field, choose ***Select***, and you can pick from the various items you set (i.e. allows you to reuse!). Select one and it fills in the URCALL field.



Entry Shortcuts

The same applies to filling in the repeater settings.



Caller Information, BER, etc.

- D-STAR radios sent information about your contact, including callsign, GPS location, and more depending on the radio types at both ends
- Icom D-STAR radios record your Rx history so you can recall who you were talking to and their information if you need it
- D-STAR provides some signal quality telemetry in the form of a Bit Error Rate (BER)

Helpful D-STAR Links

- http://dstarinfo.com
- http://www.dstarusers.org
- http://dstargateway.org
- http://ww8tf.club/repeaters/multi-mode-repeater-how-to/
- http://hub.megalink.network/xlx
- https://ww8tf.ww8tf.club

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