

Automated DX Cluster Spotting for Speech

This paper presents a method for automated spotting of voice modes. The AI Radio Transmitter Notification and Emission Reporter (ARTNER) enables the automation of DX clusters[1], reverse beacon networks[2], and skimmers[3] for voice transmissions. The proposed method was presented in the ARRL In-



Symbolic image showing the first recognized call signs

ternational DX SSB Contest Tested in March 2026 and has been operating on the 70cm Kahlenberg relay OE1XUU since May 2026 experimentally validated.

Introduction

DX clusters and Reverse Beacon Networks (RBNs) log heard amateur radio call signs on the internet. RBNs are designed as automated receiving networks, while DX clusters require manual entry of voice modes. Software can automatically receive digital transmission modes and CW and recognize call signs [3]. Analog voice transmissions have been a technological gap until now. RBNs are already automated, but do not work for voice . DX clusters already work for voice, but only manually. The system presented here closes this gap with an automated voice skimmer.

Automated DX clusters require several technologies to function. First, radio transmissions must be detected and classified. Classified call signs must be demodulated using the appropriate method. The call signs must then be identified in the demodulated signals. For DX clusters, it is also necessary to identify which station is making a general call on the frequency.

Discussion groups, chatting friends, experiments, and the like are not things one would want to disturb with the attention of the Clus- ters disturb.

Detection, classification, demodulation, and DX clustering are available and automated[4][5]. Therefore, I concentrate on the remaining problems to be solved: call sign recognition and whether the call signs are calling CQ.

Deterministic call sign recognition is based on standardized call sign structures (e.g. prefix, number, suffix)[6] or database queries such as QRZ.com or[7], but reaches its limits with analog voice transmission. To increase

use for comprehensibility Radio stations spelling alphabets, where, in addition to the ITU standard[8], alternative tables are often used (e.g. Able- Baker, DIN 5009, ÖNORM A 1081[9]) and also colloquial language e.g. Germany is used for G and kilowatt for K. Digimodes have fixed data structures.

The presented method employs a two-stage process combining speech recognition and a Large Language Model (LLM). Despite interference,

this approach is flexible and robust enough for call sign and CQ detection. LLMs are already used in amateur radio for shortwave listening [10], automated QSOS [11], and contests [12]. Other AI methods are used in amateur radio for speech synthesis [13][14] and as voice-controlled assistants [15].

and for noise suppression[16].

concept

The block diagram provides an overview of my method. The amateur radio station has an antenna and a receiver that performs demodulation and forwards an audio signal to a computer. The demodulated audio signal is fed into a speech recognition system, which converts the recognized speech into text and forwards it to a large language model (LLM). The LLM is then instructed to recognize call signs. The LLM is further instructed to only report call signs that are calling CQ. Recognized call signs are then forwarded to the DX cluster.



Concept of the AI Radio Transmitter Notification and Emission Reporter (ARTNER)

For my experiments, I use the station of the Vienna University of Technology, OE1XTU. On shortwave, the antenna is a Stepp-IR dB36 connected to an ICOM IC-7300. On 70cm, a Diamond antenna is connected to an IC-9700. For shortwave tests, I manually tune the receive frequency to a detected amateur radio signal. On 70cm, the downlink frequency of the Kahlenberg repeater OE1XUU is 438.950 MHz.

The settings are configured. I also manually select the demodulation method (lower sideband or upper sideband on shortwave, FM on the repeater). The ICOM receivers are connected to a laptop via USB cable. The driver installed on the laptop provides the audio signal as a USB audio codec. My Python script receives the audio signal as if it were coming from a microphone.

My Python script forwards the audio to the Google Cloud Speech-to-Text API, which provides the transcribed text. Austrian German is typically spoken on the 70cm repeater, but call signs are also spelled using the ITU phonetic alphabet, and this is recognized more accurately with the English setting. While simultaneous recognition of multiple languages would be possible in principle, it performs poorly in case of interference. Furthermore, the Google API allows for boosting the number of words in the ITU alphabet.

I use LLM ChatGPT as an online version via an API. ChatGPT receives the speech recognition history and a set of instructions (prompts). The prompts tell LLM how it should behave, or rather, what it should do with the received text. My prompt set is:

- You are an amateur radio shortwave listener.
- Your goal is to find out the call sign of stations that call CQ (seek you) and generate the output with their callsign as [callsign].
- Operators will spell their callsign, so try to find amateur radio callsigns in the spelled words.
- For example, if you receive Oscar Echo One Golf Alpha Quebec then return [OE1GAQ].
- If the conversation contains no callsign then reply with [empty].

The frequency is queried using Computer Aided Transceiver (CAT) commands. Call sign and frequency are entered into the cluster using Telnet .

optimization

The method can still be optimized. I started with signal detection to save time and money on speech recognition and LLM:

- A hard threshold for the audio signal strength acts as a squelch. If the signal strength is not above (below for FM) a threshold value in the first few moments, the audio is not recorded and nothing is sent to the speech recognition system.
- Simple signal detection: If the audio signal strength is above the threshold, recording continues until the signal strength falls below (above for FM) the threshold for a period of time.
- Faint reception signals, interference, and foreign languages result in blank output. If the speech recognition output is blank, it is not sent to the LLM.

Safety precautions

The combination of speech recognition and LLM sometimes fails and generates incorrect output.

Sometimes search-and-ponce stations are also called

Call signs are recognized even though they are not calling CQ. As a workaround, I use a running list of the ten most recently recognized call signs. The same error rarely occurs twice. Only if a call sign is already in the list and is recognized a second time is it flagged. DX clusters have their own rules for handling duplicate call signs.

Off-Air Tests

I started off-air with a microphone in my living room. Speech recognition worked with clear audio. While there were some inaccuracies in speech recognition with CQ calls, the LLM responded with the call sign. There were no false negatives; all call signs were recognized.

Rapid speech can cause problems with speech recognition, but the LLM still recognized the call signs . The LLM only output the call sign or [empty]; there were no incorrect outputs.

```
Google Cloud API: or cake or 1 Gulf Alpha Quebec contest
ChatGPT: [empty]
Google Cloud API: Oscar Echo 1 golf alpha Quebec contest
ChatGPT: [OE1GAQ]
Google Cloud API: Oscar Echo 1 Gulf Alpha Quebec contest
ChatGPT: [OE1GAQ, S&P]
Google Cloud API: osk 1 golf alpha Quebec contest
ChatGPT: [empty]
Google Cloud API: 1 Gulf Alpha Quebec contest
ChatGPT: [empty]
Google Cloud API: CQ contest CQ contest Oscar echo1 golf alpha Quebec
ChatGPT: [OE1GAQ]
No speech captured.
Google Cloud API: okay 1 golf alpha Quebec
ChatGPT: [empty]
```

First test in the living room; result: good voice quality without interference.

After that, I tested poems for false positives. I read aloud "schtzngrmm und als dieses" by Ernst Jandl. The speech recognition was set to English; it incorrectly recognized the word "truly," and the ChatGPT output was [empty]. In English, I read aloud the short story "Robot Dreams" by Isaac Asimov. The speech recognition worked well except for the characters' names.

All ChatGPT outputs were [empty], except for the first line "Last night I dreamed," said LVX-1, calmly [Callsign, S&P].

Tests im ARRL International DX Contest SSB

My experiments with automatic AI stations showed [11][12] that shortwave is a difficult environment for speech recognition. DX contacts are, of course, exactly what one wants to spot in DX clusters. A usable method for speech skimming must work for intercontinental contacts. For on-air tests on shortwave, I used the ARRL International DX Contest in SSB on March 7, 2026. The tests went very well; many call signs with CQ signals were correctly identified in the contest. However, I consider the contest a stress test and am focusing here on problems.

The number of false negatives (unrecognized call signs) and false positive outputs (no call sign at all) was noticeably higher than in

Clean audio quality. Videos of the tests are available on social media (TikTok, Instagram, YouTube and Facebook).

Speech recognition (input into LLM) foxtro	LLM edition
for Alpha Delta 59 New Mexico Charlie [empty]	
December 2 in the HR [empty]	
Denver 2 in the HR Lake	[empty]
test November 2 in the HR late	[empty]
November 2 India CQ contest CQ contest	[N2IC]
November 2 India Charlie uh yeah the frequency is in use very much to contest CQ contest November 2 India Charlie	
if you contact CQ contest November 2 India hr8 uh Bravo	[empty]
Franklin 2ic CQ contest CQ contest November 2 India Charlie	[N2IC]

Call sign recognition of N2IC (New Mexico) in the ARRL Int. DX Contest by OE1GAQ in Vienna on the 15 m band. There are correct positives (CQ calling sign reported), correct negatives (non-CQ calling sign not reported) and false negatives (CQ calling sign not recognized) but no false positives (incorrect call sign or non-CQ calling sign reported).

Splatter and stations on slightly offset frequencies are a much smaller problem than I had anticipated. They make speech recognition of the desired signal more difficult, but are not themselves recognized as speech because they are too distorted. Like most interference, they result in blank speech recognition outputs, but not in false positives .

The speech recognition boost has been extended to include numbers.



The desired signal (K8AZ, shown in green) and the other station (shown in red) overlap significantly. As a result, the speech recognition (Google Cloud API) and the LLM output (ChatGPT) remain empty, but false positives are rare.

Two/to and four/for are homophones in English. This led, for example, to the following speech recognition output: CQ contest golf for India India Yankee golf for India India Yankee golf for India India Yankee Yankee golf for India India Yankee for Sierra golf 59 kilo thank you for India India Yankee. The call sign G4IYY was not recognized . The boost increases the number of recognized "four"s and reduces the number of "for"s. We accept false positives of "for" as "four" if this reduces the number of false negatives of "four" as "for". We don't care that many "for"s are recognized as "four" in everyday conversations because we are only interested in call sign recognition.

The LLM sometimes outputs call signs that are far from the actual call sign in difficult conditions. The simplest solution is to spot a call sign only after it has been recognized twice.

LLM errors rarely repeat themselves. Here are some examples of false positive outputs:

Speech recognition (input into LLM) radio	LLM edition
juliett 59k	[RJ59K]
November 3 Hotel lady Oscar 59k USL Char-lie	[N3HLO59K]
Norway 3 America	
India Charlie golf Mike 4 foxtro bravo x-ray	[J4FBX4F-
4 Fox Bravo x-ray golf Mike 4 foxtro bravo x-ray	BXGM4FBX]
Bravo x-ray Germany Mexico 4 foxtro bravo x-ray	
Bravo x-ray 59 New Mexico Roger thank you you're	
59100 speak November 2	
Indianapolis	
Delta Lima 7 Alpha Romeo Juliet 59 New Mexico	[DL7ARJ59NM]
Mike 5 juliett Fox truck Sierra 59 New Mexico [M5JFT59NM]	
Alpha 5 for our hotel 59 New Mexico 2 India Charlie	[A5OH59NM]
okay got it pop out for sale Alpha 59 Victor	[59VA]
Alpha thank you November 3 uniform alpha if you contact Norway 3 uniform alpha if you contact Norway 3 uniform alpha alpha	
November 3 Alpha July is my Charlie November 59 Victoria Alpha	

Tests am 70ÿcm Repeater

FM transmissions at the repeater differ in details from shortwave. One source of error was that I used a hard limit for audio level in speech recognition . On shortwave, there is noise.

Weak signal, speech signals are strong. The IC-9700 delivers the noise on 70cm.

But loud and decoded FM signals are weak. The sign at

The threshold comparison needs to be reversed.

Different communication methods are common on repeaters . Stations do not call out immediately.

mer CQ, German is spoken, Call signs are spelled without a spelling-

The call sign was spelled out or spoken in a mix of German and English, like "Oscar Echo eins...". Simultaneous speech recognition for German and English is possible, but this worked poorly in practice. English worked best for call sign recognition, as it allowed the ITU alphabet to be recognized. The rest was not understood, but we are only interested in the call signs.

The repeater regularly repeats its own call sign.

The speech recognition system recognizes these with varying degrees of success depending on the reception quality , but the LLM usually correctly recognized that this call sign does not call CQ and delivers an empty output (OE1XUU repeater OE1XRS link).

Google Cloud API: o e 1 x u u repeater oh 1 XRS link
ChatGPT: [empty]

During a self-test with my own handheld radio, OE1XTU was detected; the first test was then on May 2nd, 2026 with Arnold OE1IAH:

Speech recognition (input into LLM): thank	LLM edition
you this is Oscar Echo 1 India I for hotel [OE1IH]	
thank you this is Oscar 1 India I for hotel [empty]	
Oscar Echo 1 India Alpha Hotel [empty]	
okay uh you have thought of this Oscar Echo 1 India Alpha Hotel, Hotel One, Okay	[OE1IAH]
CQ CQ this is Oscar Echo 1 India Alpha Hotel	[OE1IAH]

Long-term test on the 70 cm repeater OE1XUU

Since the beginning of May 2026, I've been testing a live version of my AI voice skimmer on the 70cm repeater OE1XUU on Vienna's Kahlenberg. The program runs autonomously and spots detected callsigns calling CQ to the DX cluster. The repeater supports Echolink; you can call CQ yourself and be spotted within the cluster. Overall, I'm quite satisfied with the tests. The method has survived countless conversations , rounds of chat, and even broadcasts without erroneously spotting callsigns that weren't calling CQ.



Photo of the long-term test – all you need is a receiver and an old computer

Latest Spots submitted by OE1GAQ					
DX de	Freq	DX	Comments	UTC	Date
OE1GAQ	438 950,0	IKW	OE1XUU AI spot	08:28	03/09/26
OE1GAQ	438 950,0	DB0EIC	OE1XUU AI spot	07:17	03/09/26
OE1GAQ	438 950,0	OE1AES	OE1XUU AI spot	17:44	02/09/26
OE1GAQ	438 950,0	OE3PKB	OE1XUU AI spot	18:24	01/09/26
OE1GAQ	438 950,0	DK8DB	OE1XUU AI spot	12:05	01/09/26
OE1GAQ	438 950,0	OE1HGA	OE1XUU AI spot	19:09	29/08/26
OE1GAQ	438 950,0	SV4GDM	OE1XUU AI spot	17:00	29/08/26
OE1GAQ	438 950,0	OE9SSZ	OE1XUU AI spot	19:12	28/08/26
OE1GAQ	438 950,0	OE3GMW	OE1XUU AI spot	13:02	28/08/26
OE1GAQ	438 950,0	OE1KPM	OE1XUU AI spot	12:47	28/08/26
OE1GAQ	438 950,0	DF3SM	OE1XUU AI spot	09:44	28/08/26
OE1GAQ	438 950,0	K9DK	OE1XUU AI spot	08:49	28/08/26
OE1GAQ	438 950,0	DD2DF	OE1XUU AI spot	07:28	28/08/26
OE1GAQ	438 950,0	OE3W0N	OE1XUU AI spot	20:02	27/08/26
OE1GAQ	438 950,0	DB0TUD	OE1XUU AI spot	14:03	27/08/26
OE1GAQ	438 950,0	OE10GH	OE1XUU AI spot	10:14	27/08/26
OE1GAQ	438 950,0	SV4GDM	OE1XUU AI spot	12:20	26/08/26
OE1GAQ	438 950,0	OE1BMA	OE1XUU AI spot	08:25	26/08/26
OE1GAQ	438 950,0	DK1DD	OE1XUU AI spot	08:24	26/08/26
OE1GAQ	438 950,0	E7ABH	OE1XUU AI spot	17:08	25/08/26
OE1GAQ	438 950,0	OE8JHK	OE1XUU AI spot	11:34	25/08/26
OE1GAQ	438 950,0	DJ0JB	OE1XUU AI spot	07:31	25/08/26

When someone connects via Echolink, a message like "connected OE 1 WCA" is spoken. The spelling without a phonetic alphabet is recognized surprisingly well , and the LLM is now instructed to also broadcast these call signs.

Long-term tests showed that rare errors can become problematic and need to be fixed. The test

This also led to some incorrect spots on the cluster: The repeater regularly repeats OE1XUU repeater OE1XRS link. Even though it's usually not detected, the large number of identical outputs rarely leads to OE1XRS being recognized. OE1XRS was spotted, and a night later, the entire list of the last 10 recognized callsigns was OE1XRS. I then implemented an IF statement to prevent OE1XUU and OE1XRS, but even that wasn't enough. The next rarest false detections were incorrectly identified callsigns containing OE1XUU or OE1XRS ; two of these even made it into the cluster. I 'm now checking whether the LLM output contains these strings.

In rare cases, ChatGPT also returns spaces. Returning to the square brackets would have resulted in [empty] being mocked, but this prevented a check on the cluster side.

outlook

For use in RBN and skimmers, the method still needs to be refined. Scaling will include: reception of entire frequency bands, automated signal detection and classification to find voice signals, and parallel evaluation.

Scaling (e.g., within the framework of RBN) requires broadband, parallel processing. Operating costs are a critical hurdle in this regard. While theoretical

Estimates for contest-wide broadband operation (150 channels) range up to USD 17,000 per 48-hour weekend [14], but the long-term test shows significantly more moderate values. Due to local squelch pre-filtering, the costs for the Google STT API at repeater OE1XUU amount to approximately EUR 60/month. The API costs for the LLM (GPT-3.5-

The costs for turbo versions are approximately €10 per month, resulting in total annual costs of around €840 (approximately €1000 including buffer) for continuous single-channel operation. AI-based voice skimmers are technically feasible, but broadband scaling requires more cost-effective processing models.

The repeater on Vienna's Kahlenberg (OE1XUU) supports Echolink. The AI voice skimmer test runs for an extended period.

Time, you can try it out. Call CQ several times in a row slowly and spell out your call sign using the ITU alphabet (in English).

vy 73 Gerald Artner OE1GAQ

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Dates for the ÖVSV VHF Championship 2026

Contest Band Datum	IARU Region 1 UHF Contest ab 70 cm 3.–4.	Time of submission deadline
Oct.		2:00 PM–2:00 PM Oct. 11
Marconi Memorial Contest (CW)	nur 2m 7.–8. Nov.	14.00–14.00 15. Nov.

The IARU-Region 1 UHF-Contest

The penultimate competition in the ÖVSV VHF Championship of the 2026 contest season begins on Saturday, October 3rd, at 2:00 PM UTC and ends on Sunday at 2:00 PM UTC.

The correct end time should actually be 13:59, but this notation has been used for years. Occasionally, the last quick QSO in a log is deleted by the analysis software because the time already entered is 14:00. It's worth checking this after exporting the log as an edi file.

It also doesn't hurt to check all other entries ; errors or missing information can cause problems with the evaluation! I'd like to mention the ADL (Average Daily Dispatch) in single-operator logs, as sometimes the wrong time is used. Checking the ODX (Outstanding Dispatch Point) is also recommended; a small typo can lead to an OK station being over 1000 km away and located somewhere in southern Italy or the Mediterranean.

Please upload the logs to the evaluation server <https://ukwauswertung.oevsv.at> . Please note the upload deadline (formerly the submission deadline)! During the upload process, the log will be checked, any errors will be detected, and the report will also be sent to you by email.

In case of "unsolvable problems", please contact me at ukw-contest@oevsv.at ! Have fun and good luck with the contest!

Such things are noticed by attentive observers, who also report them to me, but this has no consequences, as the evaluation server works very well and only rarely requires subsequent correction. Of course, if you notice any unjustified deletions, you can send me an email. Then I can check it and correct it if necessary!

During the last contest, the IARU-VHF, I worked a large number of OE stations that unfortunately didn't upload their logs to the results server. I've noticed this phenomenon repeatedly in the past. My request is this: even if it's only a few dozen QSOs, the results lists demonstrate the activity of amateur radio, so uploading your log is worthwhile!

If you have any questions or problems with the contesting, please contact me by email, I'm happy to help!

Have fun and good luck in all the contests!
Your contest coordinator Franz OE3FKS