

TECHNOLOGY & INNOVATION - NFT-QSL

NFT-QSL on the Ethereum Blockchain

Radio contacts evaporate quickly. As soon as a QSO is successful, the waves have disappeared again. For this reason, a system was developed early on in amateur radio to confirm and permanently document radio connections: the QSL card. The sending of traditional QSL cards in paper form "directly" or "via office" is still very popular, but the majority of confirmations is now done online via electronic data banks with web portals such as Logbook of the World, eQSL.cc or clublog.org and many more.^{1,2,3} Instead of using one's own signature, online QSLs are confirmed by password-protected user accounts and digitally signed logbooks.

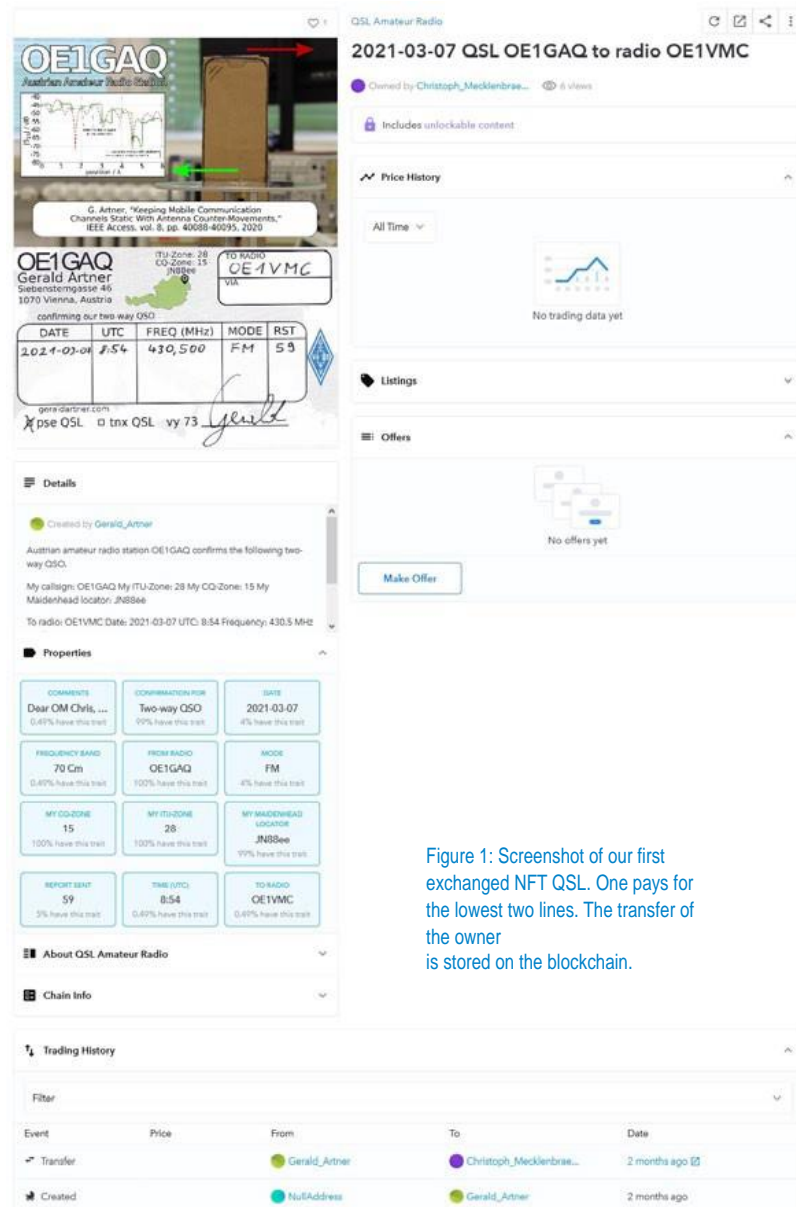
The currently popular online databases have a centralized architecture. Apart from the unlikely (but real) possibility that the central entity could shut down the QSL system or that a hacker attack could lead to data loss, the online databases differ in important details - for example, what constitutes an entity in the sense of radio traffic be. The nations of the world continue to disagree about which other nations they recognize. If one also wants to recognize islands, mountain peaks, castles, ships, space stations or events (such as Marconi's birthday or 100 years of the Republic of Austria), then this question becomes even more complex. Also, the mode of operation of a QSO is usually only possible from a predefined selection, in order to be able to specify an innovative experimental mode of operation, one would have to update the ADIF file format first. In practice, one must either live with the currently valid settings of the centralized QSL systems, or one must found a new one, which has led to a multitude of smaller QSL and diploma programs.

In contrast to centralized databases, data records are stored decentrally on a blockchain. Blockchain technology is on everyone's lips because of *non-fungible tokens* (NFT), i.e. non-exchangeable data records. These are currently mainly used to sell digital artworks, and record prices are paid for some of them. The technology is interesting for amateur radio, because the confirmations of radio contacts are *non-fungible* data. For example, my confirmation is only valid for OE1GAQ and not as a contact with any other Austrian station. Each radio contact is unique and NFTs map this technically on the blockchain.

We took a look at how decentralized QSL works on the Ethereum Blockchain. Several websites allow for easy creation, exchange, and sale of NFTs. We chose OpenSea⁴, which creates NFTs on the Ethereum Blockchain.

Writing data on the blockchain requires computing power, which has to be paid for. On the Ethereum blockchain, services are paid for with the cryptocurrency of the Ethereum network, called Ether. To store cryptocurrencies, you first need a digital *wallet*. For the Firefox browser, for example, there is the extension MetaMask. Once you have created a wallet (write down the password and keep it safe!), you can buy Ether on an online exchange - e.g. with euros.

This brings us straight to our main criticism of QSL via blockchain NFT - the cost. Cryptocurrencies have risen dramatically in value over the past few years and so have the fees ("*gas*" fee) for a transaction on the blockchain. To be able to create NFTs on OpenSea,



The screenshot displays an NFT marketplace interface for a QSL card. The main content is a QSL card image with the following details:

- Call Sign:** OE1GAQ (Gerald Artner, Seibersdorfstrasse 416, 1070 Vienna, Austria)
- Call Sign:** OE1VMC (via)
- Date:** 2021-03-07
- UTC:** 8:54
- FREQ (MHz):** 430,500
- MODE:** FM
- RST:** 59

The interface also shows a table of properties for the NFT:

Property	Value	Percentage of Owners
COMMENT	Dear OM Chris, ...	0.0% have this trait
CONFIRMATION	Two-way QSO	99% have this trait
DATE	2021-03-07	4% have this trait
FREQUENCY BAND	70 Cm	0.0% have this trait
FROM RADIO	OE1GAQ	100% have this trait
MODE	FM	4% have this trait
MY CO-ZONE	15	100% have this trait
MY IT-ZONE	28	100% have this trait
MY Maidenhead LOCATOR	JNB8e	99% have this trait
REPORT TEST	59	3% have this trait
TIME UTC	8:54	0.0% have this trait
TO RADIO	OE1VMC	0.0% have this trait

The trading history at the bottom shows:

Event	Price	From	To	Date
Transfer		Gerald_Artner	Christoph_Mecklenbrae...	2 months ago
Created		NullAddress	Gerald_Artner	2 months ago

Figure 1: Screenshot of our first exchanged NFT QSL. One pays for the lowest two lines. The transfer of the owner is stored on the blockchain.

registration is required, which cost a little over €100 at the time. After that you can upload media files for free. For the time being, these remain only images and text on a website and transaction fees (*gas*) only become due when they are sent/sold. Sending or selling an NFT on the Ethereum Blockchain currently costs around €30. Compared to this, central online QSL systems are practically free; you only pay for premium accounts and diplomas.

We tested it anyway and exchanged NFT QSLs between OE1GAQ, OE1VMC and OE1XTU in March. To create an NFT, you upload a media file and add text. For our first NFT, these were simply scans of our QSL cards, which also makes things quite visual. Additionally we entered the QSO data (callsign, frequency band, locator, rig, etc.) as *description* and *properties*. A NFT QSL then looks something like the one in Figure 1.

Since the creation of NFTs is free for the time being and only the transfer costs, we have made further considerations and tested as NFT; but without paying for a transfer. First of all, you don't need a scan of a paper card, because the NFT already contains the QSO data as text. One is also not bound to photos, as with the back of a QSL card. The NFT can be an animated version of the paper card, for example as a video. For experimental transmission methods, the

The videos illustrate the special features of QSOs. Here we have created two NFTs for QSOs with channel modulation. In this transmission method, the information is transmitted by selecting the radio channels instead of modulating it on a carrier signal.

Further considerations brought us to a topic that has not been dealt with in QSL systems until now: Evidence. In current QSL systems, a station confirms the correctness of the QSO data by a signature, digital nature, user account, or similar, associated with the callsign. The media file can additionally provide evidence that a QSO has actually taken place. For voice connections have

we added audio recordings of the QSOs to the NFTs and

for digital QSOs video recordings of the screen (see figure 2). For the audio recordings, we have obtained the consent of the remote station beforehand.

SWL stations can help in collecting evidence and we have also created a SWL report as an NFT.

Media files can not only provide evidence of QSOs, but also document interference for the band watch. However, we feel that the final decision as to whether a successful QSO has taken place should always rest with the station itself and have also created a few "Not in Log" NFTs.

If QSL on the blockchain should prove to be practicable after the experimental phase, diploma programs could be implemented as smart contracts, which evaluate the QSL on the blockchain, and the diplomas are then in turn placed on the blockchain as NFTs. Location data can be centrally stored first as Maidenhead Locator or GNSS coordinates. Deciding how geographic locations match nations, islands, or mountain peaks can be done later in the smart contracts of the diploma programs.

The costs are certainly the biggest obstacle at the moment. 1.80 EUR for a stamp is already a lot to send QSL cards by mail, 0.01 ETH for the gas fee is definitely too much to transmit NFT QSL on the blockchain. Above all, it is questionable whether the concept of ownership in NFTs is useful for a QSL system. Most confirmations will be valuable mainly for the stations involved.

73 de Gerald OE1GAQ,
es Chris OE1VMC

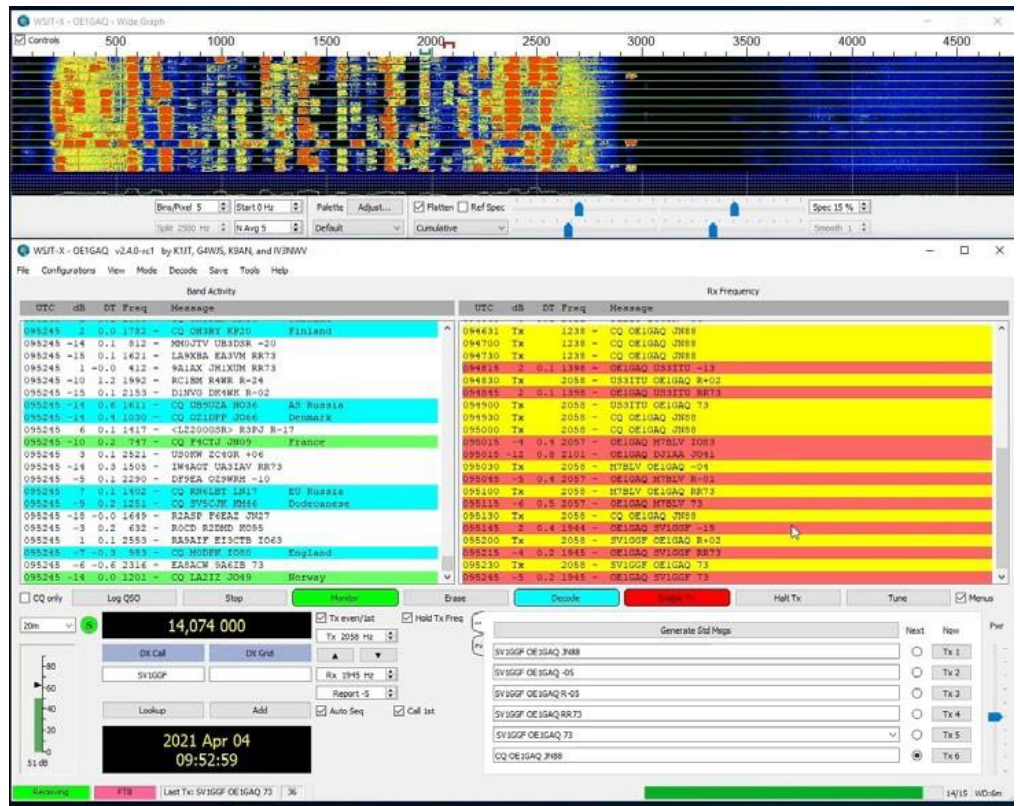


Figure 2: Video recording of the screen as evidence for a FT8 QSO.

Links

- [1] lotw.arrl.org
- [2] eQSL.cc
- [3] clublog.org
- [4] opensea.io