Introduction to Virtual Assets

High level overview

- **Natively digital** – Same as money transferred via traditional payment methods e.g. SWIFT.
- **Peer to peer** – Network sustained by participants, not a central third party.
- **Blockchain** – The statement/ledger of all transactions
- **Addresses** – Used to transact, similar to account numbers
- **Wallets** – User controlled software which generates and stores addresses
- **Transaction identifiers** – Each transaction gets a unique identifier
- **Inputs and outputs** - Input are assets being spent and outputs are those created from the inputs.
- **Mining** – The means of minting new coins and adding new transactions to the blockchain.
- **Transparent** – Many blockchains are easily auditable and so it is possible to attribute transaction activity to an address.
- **One or multiple** - Some cryptocurrencies use one address for all transactions activity, some use multiple.

Wallet	Install Bluewallet from Google Play or the Apple App Store
Mnemonic	Click on “Add Wallet” and select “Bitcoin”. The mnemonic representing the “private key” is now displayed. This needs to be written down. Once done click on “Ok I wrote it down”
Receiving	Click on the blue box titled “Wallet” which displays “0 BTC”. Now select “Receive” and click “Yes I have”.
Address	The QR code is a representation of the address (account number) and underneath the address is written out (alpha numeric starting “bc1q”)
HD wallet	Click back and then select the options/settings menu within the wallet. Click on Show addresses, review both “Receive” and “Change” headings. Explore the options within the app. Try turning on “Advanced mode” in settings (come out to the main screen and it’s under “General”). Create a new wallet and select “Segwit, what is different about the address?
Questions	Consider this process and confer in your breakout groups on what questions it raises. Choose the most poignant one for sharing with the rest of the participants

Practical 1 (See video)

Practical 2 (See video)

Using Bluewallet on a mobile device

- **Click “Add wallet”**
- **Select “Lightning” and click “Create”**
- **Copy (by clicking on) the text starting “lndhub://” and paste this into a notes application.**
- **Then click “Ok I’ve saved it”**
- **On the displayed screen select the Yellow background displaying “Wallet” and “0 Sats”.**
- **Select “Receive” and then click on “Scan”.**
- **Point your camera at the QR code on the right and once recognized you will see a page titled “Receive” and an amount displayed of 50 sats. Click on “Create Invoice”**
- **Choose “Ok” for notifications**
- **Congratulations you now have 0.0000005 Bitcoin! Let’s try out spending.**
- **Navigate in a browser to https://paywall.link/to/e4968**
- **Now in your Lightning wallet select “Send” and then click “Scan”.**
- **Confirm the payment and…Voilà! You have access to the resource.**

Intro

- Natively digital assets which have a value associated to them for two main reasons:
  - Application
  - Supply and demand
- Many different types of asset, in some ways the stock market can be seen as a parallel.
- There are an infinite number of business ideas which can lead to a company being formed. If appropriate a legitimate company involved in almost any type of business, can seek to be listed on a stock market.
- As a result, the stock market contains entities involved in well known corporate activities, those serving niche businesses cases and everything in between.
- Cryptocurrency markets are the same. Many different ideas and business models reflected by a digital asset. Some compete with each other for market share and some are unique in their offering.

Intro cont.

- The key metrics dictating use of cryptocurrency are liquidity and security.
- Security: To hold a significant value over the long term, an asset must be backed by sufficient security to prevent double spends or supply manipulation.
- Liquidity: An asset must be easy to buy and sell. This means many markets need to offer it as a trading pair.
- Bitcoin is currently the dominant cryptocurrency in respect of these features.

Networks

Two types of cryptocurrencies: Centralised (Recognised entity in control) and Decentralised (No entity in control).

Decentralised assets have two conceptual parts:

1) A Peer to Peer (P2P) network: P2P networks predominantly run over the internet. They use dedicated software to relay specific messages through a network of participants. Usually these are not regulated, anyone can join the network. This makes them difficult to censor.

2) Applications that run on this network. These are usually open source and free to run.

In summary applications generate data needed for transacting, while the network organizes and ensures the flow of information.

Networks cont.

Centralised cryptocurrencies have regulated network participants organising the flow of information. They can monitor and dictate what network traffic is deemed to be acceptable.

Often an exact mirror of the current financial system. Central bank digital currencies are an example of a centralised network.

There are obviously varying degrees of centralisation and this is something which is a constant discussion within the cryptocurrency environment.

Jargon: There is a lot of this!

Crypto asset	**Cryptocurrency/ Cryptocurrencies**	**Token**	**Stablecoin**
Custodial/Non custodial	**VC: Virtual currency**	**NFT: Non fungible token**	**VA: Virtual asset**
VASP: Virtual Asset Service Provider	**CBDC: Central Bank Digital Currencies**	**DEX: Decentralised Exchange**	**DeFi: Decentralised Finance**
	DAO: Decentralised Autonomous Organisation	**Dapp: Decentralised application**	

Need to know terminology

Blockchain: Database containing unique identifiers linking a new entry to the previous one. In Bitcoin it acts as a financial ledger (think bookkeeping)

Transaction Identifier (TXID): Unique transaction reference in the blockchain.

Network time: The Bitcoin blockchain operates on UTC only.

Wallets: Software that can be thought of as a bank in which you assets reside.

Addresses: Account numbers generated by the wallet software.

Inputs and outputs: Input are assets being spent and outputs are those created from the inputs.

Mining

Computationally intensive process for validating transactions, including them in the ledger, minting new assets and securing the network.

Financial incentives to complete this task. Miners get rewarded with fees and new asset issuance. If they act honestly and safeguard the network, then the asset will potentially appreciate in price. This will provide miners with further profits and an ongoing investment in sustaining the network.

As the network is decentralised a central entity cannot dictate who mines or gets rewarded for doing so. To mitigate this the Bitcoin protocol makes mining a free market, competitive environment. Anyone can compete and those who are most efficient will gain the greatest rewards.

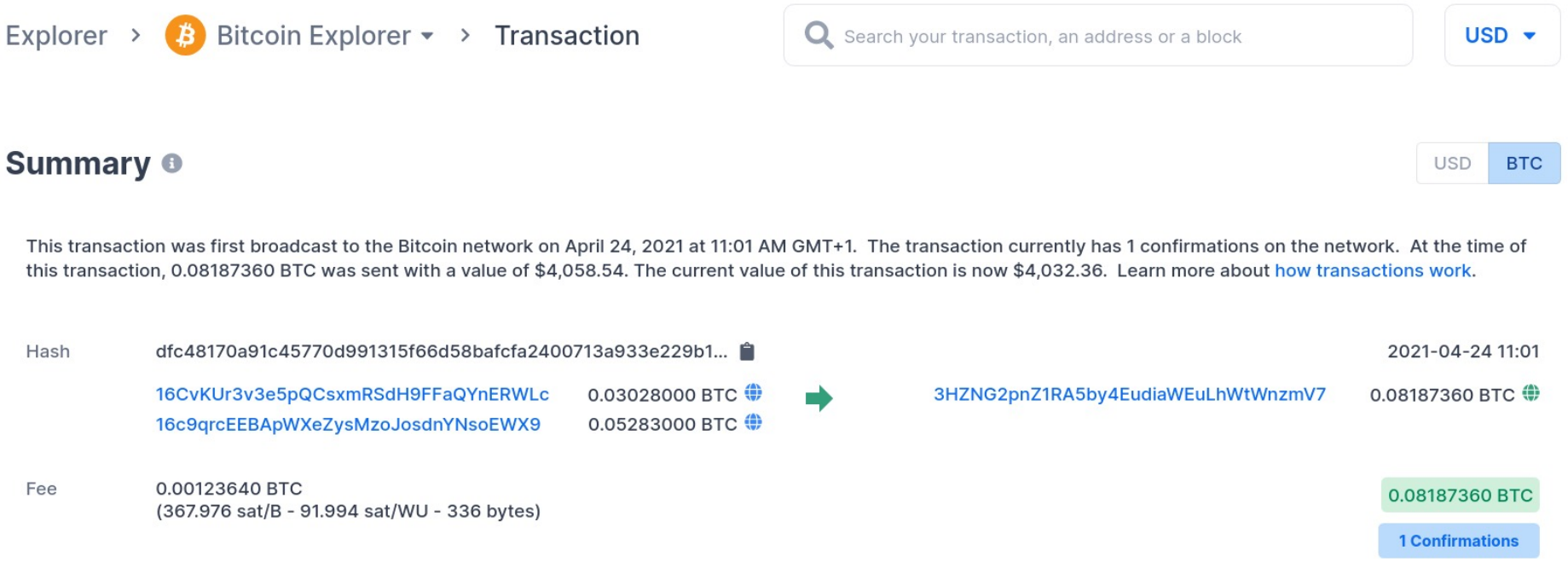
"A good way to describe mining is like a giant competitive game of sudoku that resets every time someone finds a solution and whose difficulty automatically adjusts so that it takes approximately 10 minutes to find a solution. Imagine a giant sudoku puzzle, several thousand rows and columns in size. If I show you a completed puzzle you can verify it quite quickly. However, if the puzzle has a few squares filled and the rest are empty, it takes a lot of work to solve!

The difficulty of the sudoku can be adjusted by changing its size (more or fewer rows and columns), but it can still be verified quite easily even if it is very large. The "puzzle" used in bitcoin is based on a cryptographic hash and exhibits similar characteristics: it is asymmetrically hard to solve but easy to verify, and its difficulty can be adjusted."

- *(Mastering Bitcoin: https://github.com/bitcoinbook/bitcoinbook/blob/develop/ch02.asciidoc)*

Mining overview

- Hash: Any change to input changes the hash result
- Block: Contains transactions and hash of preceding block
- Mining: Involves hashing the block data and a nonce
- Chain of blocks: Linked via hashes proving “work” expended.



Anatomy of a Bitcoin transaction

Inputs

HEX | ASM

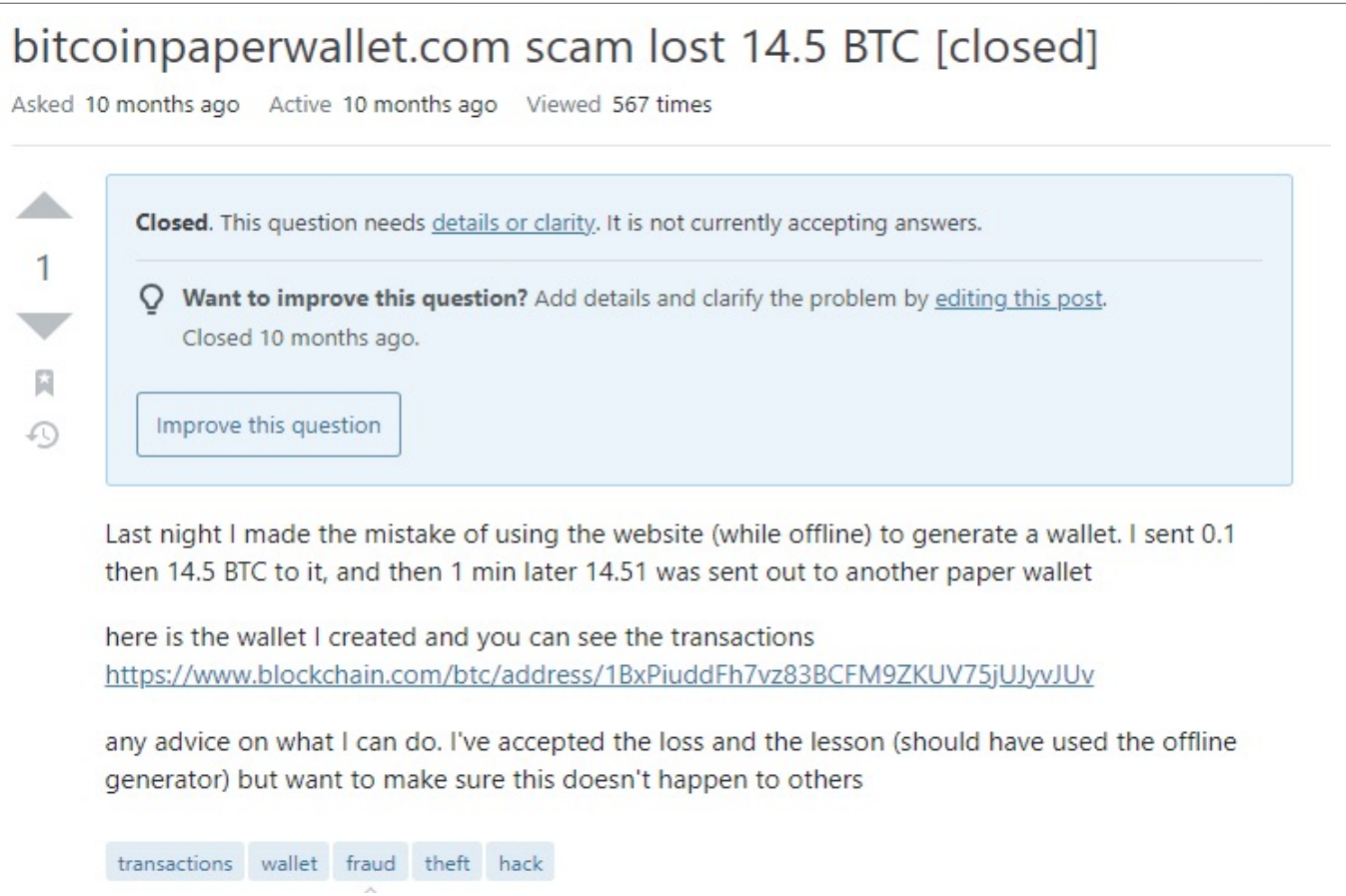
Index	0	Details	Output
Address	16CvKUr3v3e5pQCsxmRSdH9FFaQYnERWLc	Value	0.03028000 BTC
Pkscript	OP_DUP OP_HASH160 3919b66fc78f9e0a739fb630ad79c9d3bf097bbc OP_EQUALVERIFY OP_CHECKSIG		
Sigscript	3044022067c429d37093682c5990e4588a0680ab0c5907ee790e51e2951b649a8b7ebf3402202ef2320480bb03e6e53b9f40fc48bcaa092d544e72c2081745194032f26c210b01 02f63d2d95ec336499a6bbc1b8109fcd6086a6f8d7e78fb1862e976b12ae5e487b		
Witness			

Index	1	Details	Output
Address	16c9qrcEEBApWXeZysMzoJosdnYNsoEWX9	Value	0.05283000 BTC
Pkscript	OP_DUP OP_HASH160 3d7e919c2aec4ae3a1bb3fde39c7e03457ff14b0 OP_EQUALVERIFY OP_CHECKSIG		
Sigscript	304402203d02ceec5ccb1d3d89c4cd73bff286def94a109cffbd0a3c26b301089104e33c02207ee257d4e4cf4e80791853d57bd4bda6c469bf14ebf9dd8e320d4f31f26ce6ba01 0293590a3fb3d03afebe1d5cdffc4f0f07cc9c83dabc934ee025cc0b7a9beb22c8		
Witness			

Outputs

Index	0	Details	Unspent
Address	3HZNG2pnZ1RA5by4EudiaWEuLhWtWnzmV7	Value	0.08187360 BTC
Pkscript	OP_HASH160 ae0fa915f65c6fe4ebaa19d29237368fb43a66af OP_EQUAL		

Example (Video)



bitcoinpaperwallet.com scam lost 14.5 BTC [closed]

Asked 10 months ago Active 10 months ago Viewed 567 times

1

Closed. This question needs details or clarity. It is not currently accepting answers.

Want to improve this question? Add details and clarify the problem by editing this post.
Closed 10 months ago.

Improve this question

Last night I made the mistake of using the website (while offline) to generate a wallet. I sent 0.1 then 14.5 BTC to it, and then 1 min later 14.51 was sent out to another paper wallet

here is the wallet I created and you can see the transactions
https://www.blockchain.com/btc/address/1BxPiuddFh7vz83BCFM9ZKUV75jUJyvJUv

any advice on what I can do. I've accepted the loss and the lesson (should have used the offline generator) but want to make sure this doesn't happen to others

transactions wallet fraud theft hack

https://www.blockchain.com/btc/address/1BxPiuddFh7vz83BCFM9ZKUV75jUJyvJUv

What is Blockchain Analysis?

- The days of believing that Bitcoin is completely anonymous are long gone. Over the last few years significant research has been done on tracing Bitcoin transactions and attributing addresses to entities. The over arching term for this process is called blockchain analysis.
- Essentially this is the process of **analysing transaction data on the blockchain using a block explorer**. On transparent crypto asset protocols such as Bitcoin, **block explorers facilitate searching and examining every transaction recorded on the blockchain**. For Bitcoin this extends back all the way to the genesis block in 2009.
- The **transaction data can be used to identify insights into criminal activity such as patterns of behaviour, clustering of addresses and points of friction with the traditional financial world**. There is a caveat though, **blockchain analysis makes assumptions based on common heuristics which do not always hold up to be true**. It is important to have a good grasp of the basics in order to make good judgements when utilising the results of deploying the tactic.

What is Blockchain Analysis?

- **"Clustering addresses"** refers to the process of attributing numerous addresses to the same wallet/controlling entity through the use of transaction behaviour heuristics.
- There are a number of factors which go into these heuristics. We will cover some of the well known ones in the following slide. It is important to note however that none of the heuristics are definite. They can be wrong and as investigators it is necessary to corroborate the results.
- Cryptocurrencies focused on principles of self sovereignty recognise blockchain analysis as an attack on the network. **Small minorities within these communities are working to break the heuristics used and minimise the ability to undermine privacy within the protocol**.
- The key point here is that the methods being used to provide Blockchain Forensic Tools is likely to evolve in line with efforts to break the heuristics. It could become more difficult to identify how results are being provided and this makes it important to keep informed on the subject.

Heuristic 1 – Common Input Ownership

Assumption: All inputs in a transaction belong to the same entity as they reside in the same wallet.

- Vast majority of bitcoin transactions are simple in nature. Very few collaborative transactions.
- As a result one wallet controlled by one entity will have provided all of the transaction inputs to send funds.

Heuristic 2 – Change address detection:

- Change amounts are linked to addresses never previously seen in the blockchain.
- If an output address is the same as an input address it is the change.
- Wallet fingerprinting can be used to detect change outputs because a change output is the one spent with the same wallet fingerprint.
- Round numbers as an output are payments not change.
- If the values of the inputs are more than one of the outputs but less than another, the lower figure output is change (Unnecessary input heuristic) e.g.

Inputs	Outputs	Assumption
1BTC	3.5BTC →	Payment
2BTC	0.5BTC →	Change
1BTC		

Assumptions:

- **If an output address has been reused it is very likely to be a payment output**, not a change output. This is because change addresses are created automatically by wallet software but payment addresses are manually sent between humans.

- Entities utilise wallet defaults for coin selection and fee payments.

- **Many payment amounts are round numbers**, for example 1 BTC or 0.1 BTC. The leftover change amount would then be a non-round number (e.g. 1.78213974 BTC). This potentially useful for finding the change address. The amount may be a round number in another currency. The amount 2.24159873 BTC isn't round in bitcoin but when converted to USD it may be close to an exact dollar value.

Private intelligence

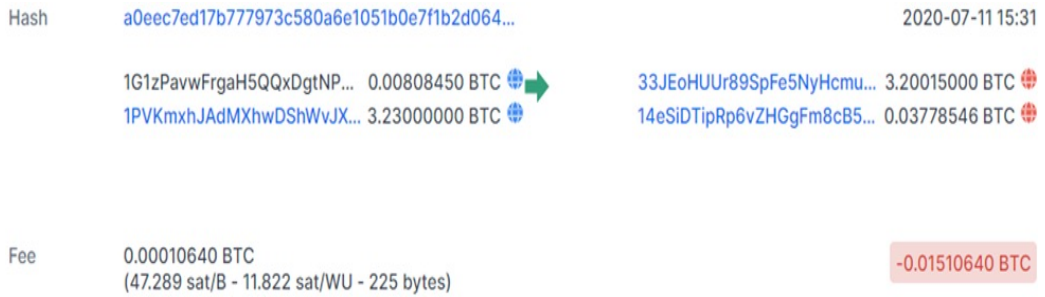
Further to these heuristics Blockchain Forensic Tools will **utilise industry intelligence and covert surveillance tactics to attribute entities to addresses and build clusters**. This will mean it is often **opaque as to how an identification or cluster has been developed**.

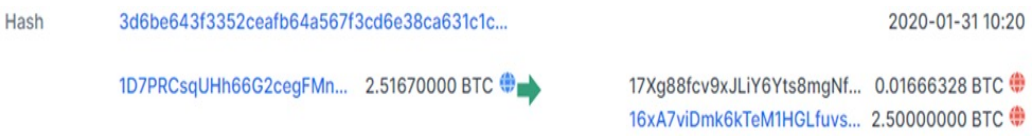
It is possible to try and find connections. You can manually check for the heuristics and carry out open source research. This may however become unpractical (if significant amounts of data) or turn out to be inconclusive. In these instances it would be worth noting down the efforts made and the negative result. Such process will at least show efforts have been made to understand the intelligence and quantify it's origins.

Examples

Common input heuristic

Change heuristic: Outputs are different script types.





Change heuristic: The address 16xA7 was active prior to this transaction. The address 17Xg88 was first active as part of this transaction. Round payment made to 16xA7 address

Blockchain analysis example

- The following example will demonstrate the interface of Chainalysis (a paid for blockchain analysis tool).
- An example graph will be drawn out using the tool to highlight the flow of funds linked to a theft.
- This will help visualise some of the opportunities available to investigators when using blockchain analysis.

Cryptocurrency Prices by Market Cap

USD | Filter | Portfolio | Explore All Coins | Recently Added | Categories

#	Coin		Price	1h	24h	7d	24h Volume	Mkt Cap	Last 7 Days
1	Bitcoin	BTC	$49,643.86	-0.0%	-2.3%	-17.6%	$40,994,473,986	$928,031,806,988	
2	Ethereum	ETH	$2,294.40	-0.2%	0.6%	-2.0%	$33,245,743,168	$265,699,125,886	
3	Binance Coin	BNB	$501.91	-0.5%	-1.3%	-2.9%	$3,206,163,902	$77,593,462,608	
5	Tether	USDT	$0.997877	0.1%	-0.1%	-0.2%	$87,435,549,732	$50,000,878,543	
4	XRP	XRP	$1.09	-0.2%	-0.5%	-29.7%	$6,603,376,362	$50,029,479,116	
6	Cardano	ADA	$1.11	-0.4%	-1.8%	-18.9%	$2,065,409,903	$35,744,184,429	
7	Dogecoin	DOGE	$0.253554	0.9%	-8.6%	-11.1%	$6,254,492,048	$33,146,619,777	

What about the rest?

Ethereum: Key points

1. Ethereum utilise “accounts” as opposed to a UTXO model. This means one address can be used to complete all transactions. There is no separate change address or need to create a new address for every receipt.

2. Tokens created on the Ethereum protocol are not stored by holders in separate address types. They are credited to an Ethereum address.

3. Transaction fees are calculated using an element called “Gas”. The native Ethereum asset (ETH) is used to pay for fees.

4. It is possible to utilise the transparent nature of many smart contracts to follow the route an asset has taken.

5. The more complex the execution of the transaction, the more Gas it consumes. This equates to higher fees being paid.

6. ETH on it’s own is not seen as a significant asset utilised by criminals.

7. It is however the main platform for stablecoins which have seen extensive use in money laundering. In particular the asset Tether (USDT) has been prominent.

8. The ability to utilise cryptocurrency as a money laundering tool is strengthened by USDT’s stable value (pegged to a dollar). This allows for deals to be struck and payments made via other channels (bank transfers etc.) without volatility affecting the terms of the agreement.

Transaction Details

Buy Exchange Earn Gaming

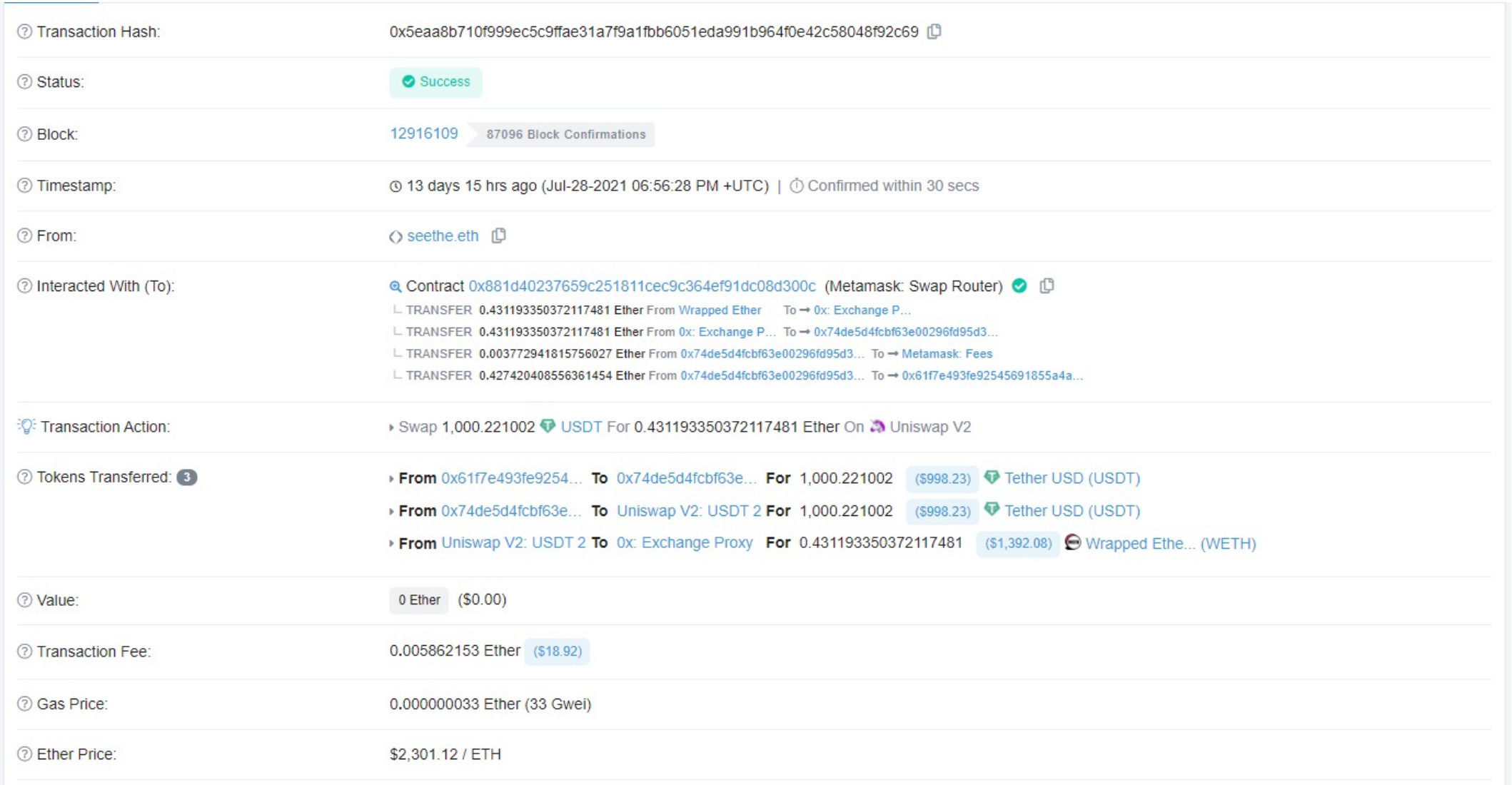
Overview | Internal Txns | Logs (5) | State | Comments

Transaction Hash:	0x042b7053bab1e80e5761adab3b223c3c576ff4e2a93c392d46cc5715308acefd
Status:	Success
Block:	12290049 4 Block Confirmations
Timestamp:	53 secs ago (Apr-22-2021 12:38:28 PM +UTC) | Confirmed within 12 secs
From:	0xd7f8157fc629584c2b3c6f7291de1a373b045676
To:	Contract 0x7a250d5630b4cf539739df2c5dacb4c659f2488d (Uniswap V2: Router 2) TRANSFER 0.11 Ether From Uniswap V2: Rout... To Wrapped Et...
Transaction Action:	Swap 0.11 Ether For 189,675,405.387924102848950964 SHIB On Uniswap
Tokens Transferred: 2	From Uniswap V2: Rout... To Uniswap V2: SHIB 4 For 0.11 ($284.71) Wrapped Ethe... (WETH) From Uniswap V2: SHIB 4 To 0xd7f8157fc62958... For 189,675,405.387924102848950964 ($286.41) SHIBA INU (SHIB)
Value:	0.11 Ether ($284.20)
Transaction Fee:	0.0099856944 Ether ($25.80)
Gas Price:	0.0000001089 Ether (108.9 Gwei)

Click to see More

Private Note: To access the Private Note feature, you must be Logged In

- DeFi does confuse things a bit!



Transaction Hash:	0x5eaa8b710f999ec5c9ffae31a7f9a1fbb6051eda991b964f0e42c58048f92c69
Status:	Success
Block:	12916109 87096 Block Confirmations
Timestamp:	13 days 15 hrs ago (Jul-28-2021 06:56:28 PM +UTC) | Confirmed within 30 secs
From:	seethe.eth
Interacted With (To):	Contract 0x881d40237659c251811cec9c364ef91dc08d300c (Metamask: Swap Router) TRANSFER 0.431193350372117481 Ether From Wrapped Ether To 0x: Exchange P... TRANSFER 0.431193350372117481 Ether From 0x: Exchange P... To 0x74de5d4fcbf63e00296fd95d3... TRANSFER 0.003772941815756027 Ether From 0x74de5d4fcbf63e00296fd95d3... To Metamask: Fees TRANSFER 0.427420408556361454 Ether From 0x74de5d4fcbf63e00296fd95d3... To 0x61f7e493fe92545691855a4a...
Transaction Action:	Swap 1,000.221002 USDT For 0.431193350372117481 Ether On Uniswap V2
Tokens Transferred: 3	From 0x61f7e493fe9254... To 0x74de5d4fcbf63e... For 1,000.221002 ($998.23) Tether USD (USDT) From 0x74de5d4fcbf63e... To Uniswap V2: USDT 2 For 1,000.221002 ($998.23) Tether USD (USDT) From Uniswap V2: USDT 2 To 0x: Exchange Proxy For 0.431193350372117481 ($1,392.08) Wrapped Ethe... (WETH)
Value:	0 Ether ($0.00)
Transaction Fee:	0.005862153 Ether ($18.92)
Gas Price:	0.000000033 Ether (33 Gwei)
Ether Price:	$2,301.12 / ETH

Interpretation: Sender uses smart contract to move from USDT to WETH, this is potentially held on a DeFi platform providing liquidity. The sender would potentially be earning yield on this.

Monero: Key features

Ring CT:

Conceals the transaction amount

Ring Signatures:

Protect the sender by obfuscating which output was spent.

Dandalion++:

Obfuscates the transaction broadcast origin.

Stealth addresses:

Ensure that the recipient's address is not recorded on the blockchain.

These features make tracing Monero very difficult. There are some options still available. These involve weakening the anonymity set, engagement with cryptocurrency services and timing analysis.

Monero is becoming a significant asset in ransomware attacks. Outside of this however it is still a long way behind Bitcoin. This is down to a smaller liquidity pool being available for the money laundering process

It is possible to swap from Monero into Bitcoin and this is likely the MO many would take to launder criminal proceeds.

This is not an easy process however as timing analysis can reveal the points at which the conversion takes place. It is then much easier to trace the Bitcoin assets as they move through the financial system.

Difficulty	Height	Hashrate	Emission
287773042775	2344885	2398.1 Mh/s	17892727

Transaction 3a7359d3e589ce71888b5152b6392261c94a7ef4f3d22f07b188020c508d2625

Confirmations	1
From Block	2344884
Output total	confidential
Fee	0.018856790000 XMR
Size	1456 bytes
Mixin	10
Unlock	0

Confidential Transaction — amounts are not disclosed.

Inputs (1)

Amount	Key Image
0.000000000000	26511d04d1fea4f6b132ff13047a5d6f53bd0f9de6e9c483f9ac07d433940eab

From Block	Public Key
2314316	bc171b412410732963e6623a8bd4de3491b6ec53ddfe3912cf0c7d9653d32bcb
2335113	45d1e748be84b5efefb101f1a40aaef59ef4e2a3cae58884323ae4bcc96c5ac3
2342631	613df1c762e3f9536bf8b4904bc4bad97710fc5ab0ca992eaca4c31f3617a480
2343112	4ef5172d333c1ec9a66abf7ff702566b49c9d6aee98ca737b8cf22862139b007
2343768	4055765e2d47eb886d92234e1c16090ba359d996c9e99a17030326b60037d388
2343950	807e60cee001db3a8b161e797e2a79daefec8d02ae6a33d3cbacc3ad62c03278
2344013	e2f2eca59917bc1e1986dbea736bb32d55abc0b5666e60b2b02448279f2b4736
2344241	0f49ecf93702ab680e84343c7cca380bd3787e975dc50e97bbf4f83f4f9d5437
2344447	2b851f462b71ec7bf0c4100a1d07e4936693b42a9e76fa72706125499c339bda
2344779	4487223ba0353b60794df84b5cbf6ed6bc8dd7b3031f86542a735b4b62a73ee7
2344809	6810ed6d3ccb06e68e7aed34bfe3c325dd51bab4cd39947b68fc1b96ad40448f

Outputs (2)

Amount	Public Key
0.000000000000	8932b6720f4b202b435982cec94e55d07f0df4315ad02a633e7d8647bb14f305
0.000000000000	171cfb05313556873a73424bcf4636ba2f62f9c4994a229192fd26f3ee33824e

Quiz time!

https://forms.gle/9fmdtMVe3aHBBgm88

The End!
Any questions?