Frozen, Then Shared: Post-Freeze Permission Changes Across 40 TRON Wallets

FreezeCheck research team · Version 1.1 · 2026-11-20 · Snapshot: TRON block 88,163,045

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Abstract

Tether can freeze USDT on TRON by adding an address to the token contract's blacklist. A frozen address keeps its own account permissions, and its owner can still change them. We asked what happened to the owner permissions of frozen wallets after the freeze. This paper describes one narrow pattern. One external key, which we call **K-1** (`TDDCoDCftE4S1j8iqFtuYrcQY8EGtw6bqp`), was added to the owner permission of **40** USDT-frozen wallets. In all 40 the addition came after the freeze, 46.3 to 901.5 days later (median 442.4 days). At the snapshot K-1 was still an owner key in 38 wallets.

We re-downloaded all 95 permission-update transactions of these 40 wallets. For each one we recomputed the transaction ID and recovered every signer from the secp256k1 signatures with two independent implementations. All 95 matched. K-1 was recovered as a signer in 10 of them, in 8 wallets. It never signed its own addition. The aggregate observed USDT balance of the 38 current wallets was 54,799,048.91 USDT at block 88,163,045. All 40 wallets were blacklisted at that block.

The data show a shared configured signer, added after the freeze, and verified signatures. They do not show who controls K-1 or the wallets, and they do not show common beneficial ownership.

1. Introduction

A TRON account has one **owner** permission and up to several **active** permissions. Each permission is a list of keys with weights and a threshold. A transaction is valid only if the weights of its signers reach the threshold of the permission it names. The owner permission can do everything, including `AccountPermissionUpdate`, the operation that rewrites the permissions themselves. An account created normally starts with owner 1-of-1: its own address key, weight 1, threshold 1. [R1][R2]

Freezing USDT works at a different layer. Tether's `addBlackList` call marks an address in the USDT contract. From then on the contract rejects every USDT transfer sent from that address: `transfer` requires that the sender is not blacklisted, and `transferFrom` requires the same of the `from` address. The recipient is not checked. A frozen address can therefore still receive USDT, and the tokens it receives are frozen together with the rest of its balance. The account itself is untouched: it can still change its permissions, receive and spend TRX, and sign transactions. [R3][R4][R12]

The combination matters. When a frozen wallet is changed so that an outside key must co-sign, the holder of that key has a say in anything the wallet does next. That includes what happens if the freeze is ever lifted. It also changes who can be asked to sign. Earlier work measured shared controller keys across TRON and their overlap with the blacklist, but it could not order the freeze against the permission change (Section 9). This paper does that ordering for one key.

2. Research question

For wallets whose USDT was frozen by Tether, when and how did one shared external key (K-1) enter their owner permissions, who signed those changes, and what can that key do now?

We do not ask who K-1 is, and we do not estimate how common the pattern is across TRON.

3. Dataset and selection

Source of addresses. FreezeCheck keeps the full list of USDT `AddedBlackList` events on TRON: 8,281 entries up to 2026-11-19, including the USDT contract address itself. For the addresses that still exist on chain, we read their current permissions and full permission histories. **K-1** came out of that history as the outside key present in the most frozen wallets: 38 at the snapshot, against 10 for the next most common key.

Inclusion. A wallet is included if K-1 appeared in its owner permission at any point in its verified permission history. That gives **40 wallets**: **38 current** (K-1 in owner at the snapshot) and **2 former** (K-1 later removed).

Period. Freezes from 2023-12-13 to 2026-05-14. K-1 additions from 2025-07-16 to 2026-11-16. Permission history up to 2026-11-19. Balance and blacklist snapshot at block 88,163,045 (2026-11-20 08:28 UTC).

What the sample is not. The 40 wallets are selected by one key. They are not a random or representative sample of frozen wallets, and no rate for the wider population can be derived from them. Other keys of the same kind are outside the scope of this paper. Our earlier work shows that co-keys of K-1 appear in 11 more frozen wallets. Those wallets are not analysed here and are not included in any number below.

Exclusions. Addresses checked by FreezeCheck bot users are never published. None of the 40 wallets, and no address in the public dataset, is on that internal list (0 matches against 113 addresses).

4. Methodology

All data come from public TRON infrastructure: the TronGrid HTTP API, plus full-node `gettransactionbyid` for raw transaction bytes. No private data source is used.

1. **Freeze events.** For each wallet we take the `AddedBlackList(address _user)` event of the USDT contract `TR7NHqjeKQxGTCi8q8ZY4pL8otSzgjLj6t` from `/v1/contracts/{contract}/events`. We match `_user` to the wallet, then record the transaction ID, block and block time. All 40 freeze events were found, and their block times equal the times in our blacklist list to the second.
2. **Permission history.** We list each wallet's transactions with `/v1/accounts/{address}/transactions` and keep every `AccountPermissionUpdateContract`. We then fetch the raw signed transaction with `/wallet/gettransactionbyid`. History is complete for all 40 wallets: 95 permission updates.
3. **Transaction integrity.** For each update we recompute `txID = SHA-256(raw_data)` and compare it with the network's ID (95/95 match). We also check that the contract's `owner_address` is the wallet (95/95) and that the network result is `SUCCESS` (95/95).
4. **Signer recovery.** Each 65-byte signature (r, s, v) is a secp256k1 recoverable signature over the txID. We recover the public key, hash it with Keccak-256, and take the last 20 bytes with prefix `0x41` as the TRON address. Recovery was done twice, with an independent pure-Python implementation and with the `coincurve` library (libsecp256k1). The two agreed on all 134 signatures in the 95 transactions.
5. **Threshold check.** We reconstruct the permission in force just before each update, from the previous update's signed bytes, or the account default for the first one. We then check that (a) every recovered signer is a key of the named permission, (b) no signer appears twice, and (c) the summed weight reaches the threshold. All 95 updates used the owner permission (`Permission_id 0`) and all passed. The network would reject a transaction that failed this check, so this step tests our reconstruction, not K-1.
6. **State after each update.** We decode the new owner and active permissions, including operation masks, from the signed `AccountPermissionUpdateContract` bytes.
7. **Current state.** We read `/wallet/getaccount` for all 40 wallets (2026-11-19, 16:22–16:23 UTC). It matched the state decoded from the last update in 40 of 40 cases.
8. **Ordering.** For each wallet, *delay* = time of the transaction that first put K-1 into owner minus time of the freeze event. Both are block timestamps in UTC.
9. **Balances.** We call USDT `balanceOf(address)` and `getBlackListStatus(address)` with `triggerconstantcontract` on the latest block. We record the block height before (88,163,045) and after (88,163,063) the 80 calls. Balances are in USDT (6 decimals). Each wallet is counted once. The same query on 2026-11-19 gave the same total to the cent.
10. **Fee funding.** We list incoming TRX in the 7 days before each K-1 addition from the same API. A permission update costs about 100 TRX, burned from the wallet's own balance.

The scripts are published with the dataset (Section 11).

5. Findings

5.1 Summary

Measure	Value
Wallets with K-1 in owner, ever	40
Wallets with K-1 in owner at snapshot	38 (2 former)
K-1 added after the freeze	40 of 40
Delay from freeze to K-1 addition	46.3 – 901.5 days, median 442.4
Permission updates of the 40 wallets	95 (94 after freeze, 1 before)
txID recomputed / signers recovered / threshold met	95 / 95 / 95
Signatures recovered	134, two implementations in agreement
Updates with K-1 recovered as a signer	10, in 8 wallets
K-1 signed its own addition	0 of 40
Blacklisted at snapshot	40 of 40
Aggregate observed USDT balance, 38 current wallets	54,799,048.91 USDT (block 88,163,045)

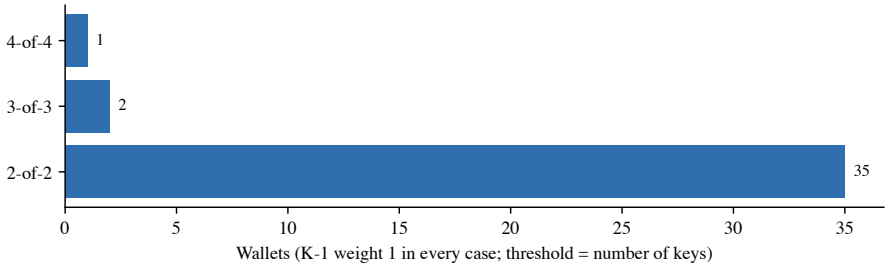
5.2 A shared configured signer

K-1 is a plain address: owner 1-of-1 and default active, and it has never changed its own permissions. At the snapshot it was an owner key with **weight 1** in 38 wallets. In every one of them the threshold equals the number of keys:

- **2-of-2** in 35 wallets (the wallet's own key and K-1);
- **3-of-3** in 2 wallets;
- **4-of-4** in 1 wallet.

K-1 was also in the active permission of 37 of the 38. There were no weighted schemes in any interval of the history.

Figure 3. Owner permission threshold schemes at snapshot

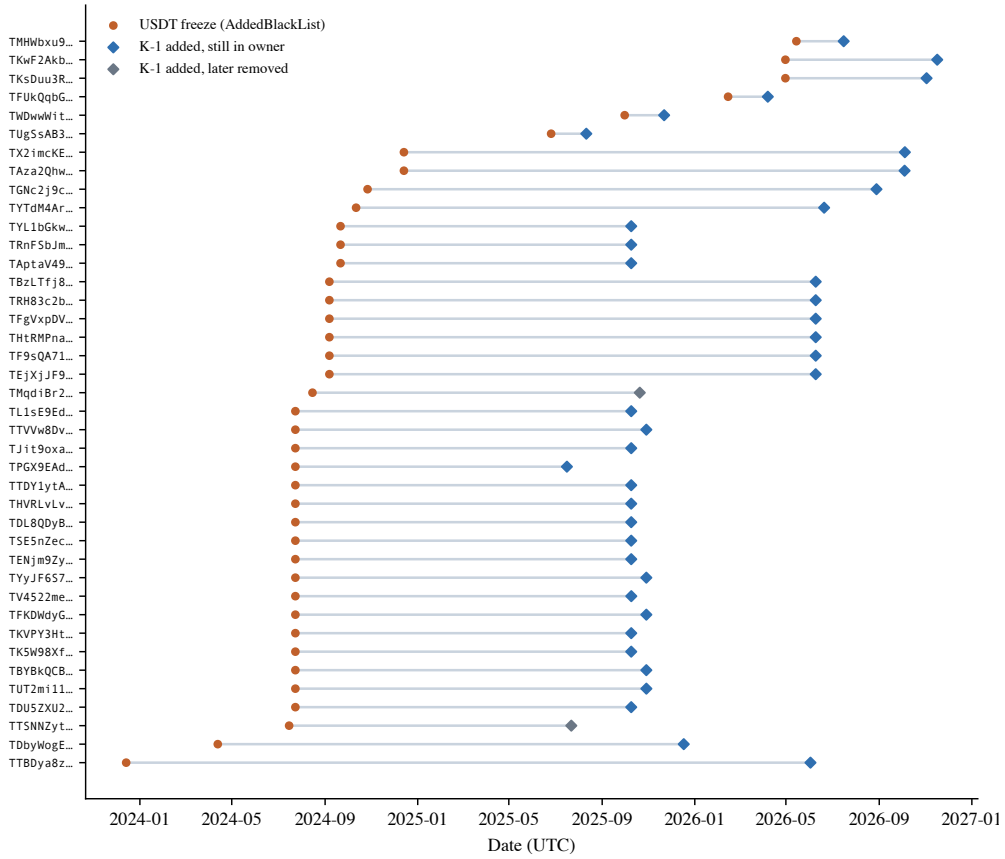


n = 38 wallets with K-1 in owner. Source: FreezeCheck K-1 dataset (TronGrid full-node data; snapshot block 88163045).

5.3 Post-freeze timing

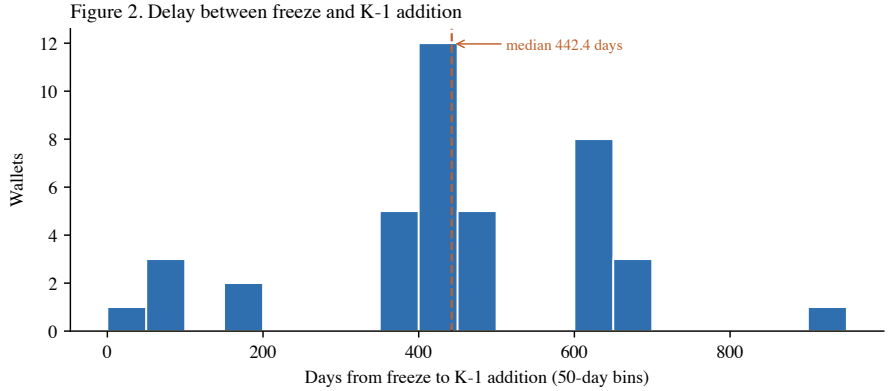
Every one of the 40 additions came after the freeze event: at least 46.3 days and at most 901.5 days later, median 442.4 days (Figures 1 and 2). The additions came in batches. 14 wallets got K-1 on 2025-10-09, 13 of them between 06:04 and 06:44 UTC, and the latest additions were on 2026-11-02 and 2026-11-16. One of the 95 updates predates its wallet's freeze (2024-12-08, freeze 2024-12-13); it does not involve K-1.

Figure 1. Freeze (circle) and K-1 addition (diamond), per wallet



n = 40 wallets. Source: FreezeCheck K-1 dataset (TronGrid full-node data; snapshot block 88163045).

Figure 2. Delay between freeze and K-1 addition



n = 40; min 46.3, max 901.5 days. Source: FreezeCheck K-1 dataset (TronGrid full-node data; snapshot block 88163045).

5.4 Who signed the additions

All 40 additions were signed only by keys that were already in the wallet's owner permission:

- **37** by the wallet's own address key alone;
- **2** by the two keys of an existing 2-of-2;
- **1** by a different key that was then the sole owner key.

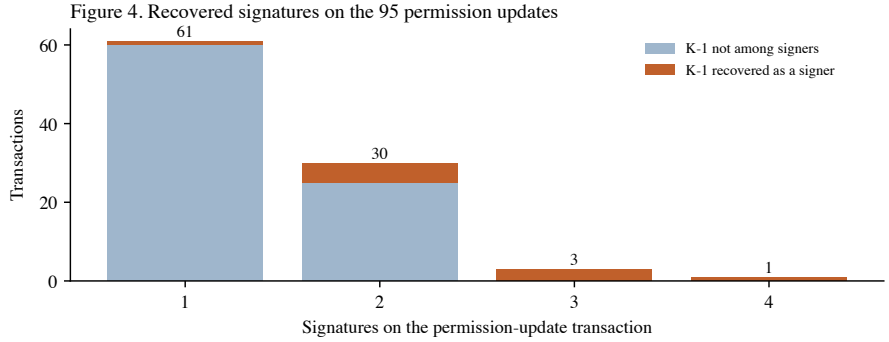
K-1 did not sign any of its own additions. In 11 wallets the K-1 addition was not the first change after the freeze.

5.5 Cryptographic evidence for K-1 as a signer

K-1 was recovered as a signer in **10** of the 95 updates, in **8** wallets, between 2025-07-18 and 2026-10-04 (Figure 4; full list in Table A2). Nine of these ten carry several signatures: the wallet's key and K-1 signed the same bytes. Their expiration was set about 24 hours after the timestamp. The tenth is the single-signature case described in Section 6.

A recovered signature shows that the holder of the K-1 private key signed that transaction. It does not show who that holder is.

Figure 4. Recovered signatures on the 95 permission updates



All 95: txID = SHA-256(raw_data) and signers recovered (secp256k1). Source: FreezeCheck K-1 dataset (TronGrid full-node data; snapshot block 88163045).

5.6 Balance observations

At block 88,163,045 all 40 wallets were blacklisted. The **aggregate observed USDT balance across the 38 current wallets was 54,799,048.91 USDT**, on 37 non-zero wallets. The two former wallets held a further 6,013,694.36 USDT and are not part of that figure. One current wallet (`TWDwwWitHBjcc9gy8eSTQZiDU9WmjajuY1`) shows 0. Its 900,259.71 USDT was destroyed by Tether on 2026-02-24, after K-1 was added (tx `92d81508971ee93144fc25978a6fd753e5d556ee55c153ef28393838cfa49633`).

This sum is an observed balance of frozen tokens. It is not stolen funds, not a loss, and not money under one party's control. **K-1 cannot move it.** No current configuration lets K-1 act alone. The USDT contract also rejects transfers from a blacklisted address, whoever signs.

5.7 Fee funding

The fee observations come from the 7 days before each addition:

- **17 wallets** received TRX from the same address, `TVud6AQ4nMQsVXUm4CvPQQ8Ygj9LUyhHyV`. Thirteen were funded on 2025-10-08 between 08:53 and 09:07 UTC, about 21 hours before their K-1 additions on 2025-10-09. Four were funded on 2025-10-28/29 and had K-1 added on 2025-10-29.

- **6 wallets** received TRX from `TBn1BwNUcXVBz9TEYmzW4z9jPNF3tXZ638`, 5–30 minutes before their additions on 2026-06-09.
- 9 wallets each had a different funder.
- 8 wallets received no TRX (1 TRX or more) in that window and paid from their existing balance.

Neither funding address has a label in our data. Who operates them is not established.

6. Case study: K-1

What K-1 is in this study. K-1 is an address, `TDDCoDCftE4S1j8iqFtuYrcQY8EGtw6bqp`, that appears as an owner key in 40 frozen wallets. It has 30 transactions of its own (TRX and TRC-10, no TRC-20), and it never changed its own permissions.

When it arrived. 2025-07-16 to 2026-11-16, in every case after the freeze.

What it can do. At the snapshot, in all 38 current wallets, K-1 has weight 1 under a threshold of 2, 3 or 4. **Alone it cannot change permissions, move TRX or call the USDT contract in any of them.** Its signature is required for any owner action, and in 37 wallets for any active action too. The exception is `TEjXjJF9Yr8mBcwXD2yGDFCyjBD7A8tZKa`. Its active permission is 1-of-1 with the wallet's own key, so that key can transfer TRX and call contracts without K-1. There K-1 only blocks permission changes.

When it could act alone. In one former wallet, `TTSNNZyt1bX8b5zHaV4LKVenqvUTZEhbmi`, owner and active were 1-of-2 [own key, K-1] from 2025-07-22 07:52 to 2025-07-24 02:44 UTC, about 43 hours. During that window K-1 alone, with a single signature, raised the threshold to 2-of-2. No funds moved. On 2026-05-29 the wallet's key and K-1 jointly removed K-1. A different co-key was added that day.

Where its signatures were recovered. 10 updates in 8 wallets (Table A2).

What can be concluded.

- One key was added, after the freeze, to the owner permission of 40 frozen wallets.
- In each case the addition was signed by keys the wallet already had.
- The same key later co-signed 10 updates.
- Several wallets in a batch were funded by the same address shortly before the change.

What cannot be concluded.

- Who holds K-1, or whether one person or several hold it.
- Whether the wallets have a common owner.
- Why the key was added.
- Whether anyone benefits economically.

A shared key is not proof of a shared owner. The keys were not shown to be held by different people either.

7. Interpretation

The data fit several explanations. We do not choose between them.

- **Custody or co-signing service.** Holders of frozen wallets hand a co-signing role to a service, for example in the hope of an unfreeze or as part of a dispute or recovery process. The batches and the shared fee payer fit a service that pays fees for its clients.
- **Shared operational infrastructure.** One operator controls many frozen wallets and manages them with one tool. The shared fee payer fits this too.
- **Third-party signing arrangement.** A key holder collects co-signing rights over frozen balances in case they are ever released. The holder's motive cannot be seen on chain.
- **Coordinated permission management after compromise.** The owner keys were copied or stolen, and the copier added K-1. A signature by the wallet's own key does not tell us whether the owner or someone with a copy signed it. We cannot rule this out.
- **Other.** A recovery or "unfreeze" service, legitimate or not, acting on many clients' behalf. Unfreeze scams aimed at holders of frozen USDT have been reported [R10].

What the data do rule out is narrower. K-1 was not added before the freeze. It did not add itself. It cannot move USDT out of a blacklisted wallet.

8. Limitations

- **Selection.** The 40 wallets are defined by one key. They are not a representative sample of frozen wallets, and no prevalence claim follows from them.
- **Attribution.** On-chain data identify keys, not people. Nothing here establishes the identity of K-1, its holder's role, or beneficial ownership of any wallet.
- **Control.** "K-1 must co-sign" describes the permission rules, not who in practice decides. A key can be shared, sold, copied or lost.

- **Time slices.** Permissions are as of 2026-11-19 16:23 UTC, and balances and blacklist status as of block 88,163,045. Both can change.
- **Search scope.** TRON offers no public reverse index from key to accounts. Whether K-1 sits in accounts we did not check is unknown. It was not found in 4,049 unfrozen neighbouring accounts we checked, but that search is not exhaustive.
- **Fee funding.** Only a 7-day window before each addition was examined, and the funders are unidentified.
- **Review.** The analysis was re-run by a second, separate internal reviewer with its own code. No independent external review has been carried out.

9. Related work

- **Bitquery, "TRON · Permission Layer"** (data to 2026-08-10, updated 2026-10-20) [R5].
- It reports that "3,481 controller keys hold signing power over more than one account each", and that "271 of them, holding $343.5M, are on Tether's blacklist".
- It notes that "the label set carries no timestamps, so we cannot order the freeze against the permission change".
- Shared signers on TRON, and their overlap with frozen wallets, are therefore not new.
- **AMLBot via Cointelegraph** (2025-01-21) [R6]. It reported over 14,500 TRON addresses at risk of silent takeover through permission updates. It counted 2,130 wallets compromised this way in Q4 2024. Permission changes as an attack and control vector on TRON are documented.
- **BlockSec.**
- "Following the Frozen" (2025-07-11) [R7] and "$1.26 Billion Frozen" (2026-01-30) [R8] analyse the blacklisting itself: who is frozen, when, and what balances were left.
- "Tether destroyBlackFunds: Burn & Reissue Explained" (2026-07-26) [R9] describes the burn mechanism behind the zero balance in Section 5.6.
- "How to Unfreeze USDT" (2026-07-26) [R10] warns of scams aimed at frozen-wallet holders.
- These works do not examine owner-permission changes after the freeze.
- **AMLBot, "Tether Freeze Gap..."** (2025-05-15) [R11]. It concerns the window between freeze proposal and execution, before the freeze. The present paper looks at the period after it.

What this paper adds.

- A narrow, fully ordered case: freeze event versus permission change, per wallet, with transaction IDs.
- Signer recovery for every update, done independently twice.
- An exact statement of what the shared key can and cannot do at the snapshot.

This is a new sample and a new ordering, built from known methods. We do not claim to be the first to observe shared signers, permission changes or frozen-wallet infrastructure on TRON.

10. Conclusion

One external key, K-1, was added to the owner permission of 40 USDT-frozen TRON wallets, in every case after the freeze. The additions were signed by the wallets' existing keys, often in batches and with a shared fee payer. K-1 later co-signed 10 updates. At the snapshot K-1 is a required co-signer in 38 wallets that together hold 54,799,048.91 USDT in frozen tokens. It cannot act alone in any of them, and it cannot move blacklisted USDT at all.

Freezing a token balance leaves the account's permissions open to change. Exchanges, investigators and issuers looking at a frozen wallet should look at its permission history as well as its balance. Who holds K-1, why it was added and whether the wallets share an owner remain unknown. Two directions for further work follow from this: the other shared keys over frozen wallets, and the funding addresses.

11. Reproducibility and data availability

Public files (`publication/final/`):

- this paper (EN, RU, PDF);
- `K1_PUBLIC_DATASET.csv` — 40 wallets with freeze and addition transaction IDs, timings, permissions and balances at the snapshot;
- `K1_PUBLIC_DATASET.json` — the same, plus all 95 permission updates with recovered signers;
- `K1_METHODOLOGY.md`, `K1_DATA_DICTIONARY.md`, `K1_SOURCE_REGISTER.md`, `K1_REPRODUCIBILITY.md`;
- the figure files and `data/` (freeze events, snapshot readings, summary numbers);
- `scripts/`;
- `MANIFEST.sha256`.

Public scripts.

- `k1_verify_signatures.py` with `crypto_a.py` — re-downloads the 95 updates, recomputes the txIDs and recovers the signers;
- `k1_check_chain.py` — freeze events, order, blacklist status, and the blacklist rule by simulation;
- `k1_render.py` — appendix tables, HTML, PDF and the automatic EN/RU number check.

What stays internal. Three things are not part of the public package:

- the raw API responses;
- the reviewer tables and scripts that decoded the full permission histories and built the dataset;
- the list of addresses checked by FreezeCheck users, which is private by policy.

`K1_REPRODUCIBILITY.md` lists exactly which checks run from the package and which need these tables. All inputs are public TRON data, and no secret or API key is needed.

References

- [R1] TRON Developers, "Account Permission Management". https://developers.tron.network/docs/multi-signature
- [R2] java-tron, `AccountPermissionUpdateActuator.java` (commit 4e8389f). https://github.com/tronprotocol/java-tron/blob/4e8389f159d0782f1ebcd9dab2fd88388c0e6fe9/actuator/src/main/java/org/tron/core/actuator/AccountPermissionUpdat
- [R3] Tether, "Tether Introduces New Policy to Strengthen Ecosystem Security". https://tether.io/news/tether-introduces-new-policy-to-strengthen-ecosystem-security/
- [R4] USDT TRC-20 contract on Tronscan. https://tronscan.org/#/token20/TR7NHqjeKQxGTCi8q8ZY4pL8otSzgjLj6t
- [R5] Bitquery, "TRON · Permission Layer". https://bitquery.io/investigations/tron-permission-changes
- [R6] Cointelegraph Magazine, "Over 14,500 TRON addresses at risk of silent hijacking" (AMLBot data), 2025-01-21. https://cointelegraph.com/magazine/tron-addresses-risk-silent-hijacking
- [R7] BlockSec, "Following the Frozen: An On-Chain Analysis of USDT Blacklisting and Its Links to Terrorist Financing", 2025-07-11. https://blocksec.com/blog/following-the-frozen-an-on-chain-analysis-of-usdt-blacklisting-and-its-links-to-terrorist-financing
- [R8] BlockSec, "$1.26 Billion Frozen: USDT Blacklisting on Ethereum and Tron in 2025", 2026-01-30. https://blocksec.com/blog/1-26-billion-frozen-usdt-blacklisting-on-ethereum-and-tron-in-2025
- [R9] BlockSec, "Tether destroyBlackFunds: Burn & Reissue Explained", 2026-07-26. https://blocksec.com/blog/destroyblackfunds-tether-mechanic-explained
- [R10] BlockSec, "How to Unfreeze USDT", 2026-07-26. https://blocksec.com/blog/how-to-unfreeze-usdt-address
- [R11] AMLBot, "Tether Freeze Gap Becomes Laundering Loophole for Criminals", 2025-05-15. https://blog.amlbot.com/tether-freeze-gap-becomes-laundering-loophole-for-criminals-an-analytical-report/
- [R12] TetherToken.sol, verified source code of the USDT TRC-20 contract (Tronscan: "Source Code Verified (Perfect match)", solidity 0.4.25), read 2026-11-20: `transfer` contains `require(!isBlackListed[msg.sender])`, `transferFrom` contains `require(!isBlackListed[_from])`; `deprecated()` returned false. https://tronscan.org/#/contract/TR7NHqjeKQxGTCi8q8ZY4pL8otSzgjLj6t/code

Appendix A. Evidence tables

Table A1. The 40 wallets: freeze, K-1 addition and state at the snapshot (block 88,163,045). Source: `K1_PUBLIC_DATASET.csv`.

#	Wallet	Freeze (UTC)	K-1 added (UTC)	Delay, days	Owner after addition	At snapshot	USDT at snapshot
1	TTBDya8zvk6WQmHRwgByt6wvSWS3tcBSvw	2023-12-13 22:21:48	2026-06-02 09:28:48	901.5	2-of-2	K-1 in owner, 2-of-2	468,010.93
2	TDbyWogEUCvfkqHcK5YYA6KQoXGRMCLv9C	2024-04-12 14:32:09	2025-12-17 11:11:12	613.9	2-of-2	K-1 in owner, 2-of-2	1,500,043.21
3	TTSNNZyt1bX8b5zHaV4LKVenqvUTZEhbmi	2024-07-15 14:11:42	2025-07-22 07:52:18	371.7	1-of-2	former (2-of-2)	1,013,644.35
4	TDU5ZXU2okL3AKeYBuhpFTP1oC9xMuXeYq	2024-07-23 19:50:36	2025-10-09 06:23:09	442.4	2-of-2	K-1 in owner, 2-of-2	2,322,602.00
5	TUT2mi11zNewe4VUDNDwyWmcj7CtYHcySx	2024-07-23 19:50:39	2025-10-29 05:23:45	462.4	2-of-2	K-1 in owner, 2-of-2	2,334,973.41
6	TBYBkQCBNWaAQkbhZG69Ee8xnZ8Cmk7o8K	2024-07-23 19:50:51	2025-10-29 04:08:39	462.4	2-of-2	K-1 in owner, 2-of-2	2,200,098.00
7	TK5W98XfxE1yuaH5iEbpPio7qgGrCqBfoy	2024-07-23 19:50:54	2025-10-09 06:25:18	442.4	2-of-2	K-1 in owner, 2-of-2	2,100,104.00
8	TKVPY3Ht9hDrQc9iaFD895cDBj7hrjUB7C	2024-07-23 19:50:57	2025-10-09 06:41:03	442.4	2-of-2	K-1 in owner, 2-of-2	2,200,089.00
9	TFKDWdyGKLukoKytCryfhJetVvedNNtAT2	2024-07-23 19:51:00	2025-10-29 04:18:42	462.4	2-of-2	K-1 in owner, 2-of-2	2,400,102.00
10	TV4522meaQDMmkiVJ2v1gBzcoBMqM9UxdV	2024-07-23 19:51:09	2025-10-09 08:33:54	442.5	3-of-3	K-1 in owner, 3-of-3	2,200,101.00
11	TYyJF6S7Q9znNUrzb8Bpp5CvjdGALyYSZo	2024-07-23 19:51:09	2025-10-29 04:12:21	462.4	2-of-2	K-1 in owner, 2-of-2	2,230,088.00
12	TENjm9Zyn4McrqQmLzhMvNNX6oFj85tAoW	2024-07-23 19:51:12	2025-10-09 06:28:00	442.4	2-of-2	K-1 in owner, 2-of-2	2,149,097.00
13	TSE5nZecBdxjXovBdGueY9DYetueSVQahE	2024-07-23 19:51:15	2025-10-09 06:04:48	442.4	2-of-2	K-1 in owner, 2-of-2	2,346,400.00
14	TDL8QDyBkgwYeaz1yf263qULPopiX6K9yq	2024-07-23 19:51:18	2025-10-09 06:28:00	442.4	2-of-2	K-1 in owner, 2-of-2	2,278,502.00
15	THVRLvLvXAZKDts9LxC1XynEzSdFPoTKue	2024-07-23 19:51:21	2025-10-09 06:04:45	442.4	2-of-2	K-1 in owner, 2-of-2	2,020,538.00
16	TTDY1ytAJ88GKiJNR1qCTGug85VqYXAjZR	2024-07-23 19:51:21	2025-10-09 06:17:42	442.4	2-of-2	K-1 in owner, 2-of-2	2,100,101.00

#	Wallet	Freeze (UTC)	K-1 added (UTC)	Delay, days	Owner after addition	At snapshot	USDT at snapshot
17	TPGX9EAdsuEfrxhaXiFNi6XYCsZTHALz98	2024-07-23 19:51:24	2025-07-16 13:00:06	357.7	3-of-3	K-1 in owner, 3-of-3	2,118,490.00
18	TJit9oxaNWYNCxfw5Psf1Q9NmSCsv9ASRo	2024-07-23 19:51:27	2025-10-09 06:33:42	442.4	2-of-2	K-1 in owner, 2-of-2	2,290,800.00
19	TTVVw8DvQ8HFYqqVd399AyGyDp8U36VATV	2024-07-23 19:51:33	2025-10-29 04:15:42	462.4	2-of-2	K-1 in owner, 2-of-2	2,302,980.00
20	TL1sE9EdfVZ57LPftXmzJSGDQ7KC6o9Zkj	2024-07-23 19:51:36	2025-10-09 06:38:57	442.4	2-of-2	K-1 in owner, 2-of-2	2,309,108.00
21	TMqdiBr2ExrKQpCysR9gGYBhzdVfCPHGYM	2024-08-15 08:21:48	2025-10-20 12:43:21	431.2	3-of-3	former (3-of-3)	5,000,050.01
22	TEjXjJF9Yr8mBcwXD2yGDFCyjBD7A8tZKa	2024-09-06 15:01:09	2026-06-09 07:15:33	640.7	2-of-2	K-1 in owner, 2-of-2	111,837.52
23	TF9sQA71jifU2U2Qcs6n9wNVfodDS8HXYM	2024-09-06 15:01:18	2026-06-09 07:37:54	640.7	2-of-2	K-1 in owner, 2-of-2	112,301.41
24	THtRMPna3S5EaKWdGxLp1mZf1fTPb3suQk	2024-09-06 15:01:36	2026-06-09 07:40:30	640.7	2-of-2	K-1 in owner, 2-of-2	113,531.26
25	TFgVxpDVPRhgaNdKcCES1o6WHsXczCb3it	2024-09-06 15:01:54	2026-06-09 07:38:51	640.7	2-of-2	K-1 in owner, 2-of-2	113,321.98
26	TRH83c2byegtwshxpkKRHXtFiqxMB5Einj	2024-09-06 15:02:21	2026-06-09 07:39:36	640.7	2-of-2	K-1 in owner, 2-of-2	113,606.58
27	TBzLTfj8k8Jdr7rVsWzkNooKPSUiq7Z4hF	2024-09-06 15:02:39	2026-06-09 07:36:51	640.7	2-of-2	K-1 in owner, 2-of-2	112,851.96
28	TAptaV49xGV3eTE4epFwuqZjMmp6xZfaiE	2024-09-21 07:28:42	2025-10-09 06:10:54	382.9	2-of-2	K-1 in owner, 2-of-2	1,750,000.00
29	TRnFSbJmAnLBo43fkCwnyKJdHgAYeUJSNQ	2024-09-21 07:29:27	2025-10-09 06:44:15	383.0	2-of-2	K-1 in owner, 2-of-2	1,910,000.00
30	TYL1bGkw4vgj6WUynZ2JKccuQogSBo9tZU	2024-09-21 07:30:06	2025-10-09 06:10:30	382.9	2-of-2	K-1 in owner, 2-of-2	1,880,000.00
31	TYTdM4ArE4ykEAm7qHMEFD2xMbojoGUyjE	2024-10-11 19:18:36	2026-06-20 09:48:06	616.6	4-of-4	K-1 in owner, 4-of-4	253,511.59
32	TGNc2j9cGcXQtpNRJ6fbjXQAsJsSbmjYRq	2024-10-26 22:11:24	2026-08-28 08:32:00	670.4	2-of-2	K-1 in owner, 2-of-2	511,822.39
33	TAza2QhwZnk2affATf9bxNXw7xJdnP1Rj1	2024-12-13 19:25:36	2026-10-04 09:12:36	659.6	2-of-2	K-1 in owner, 2-of-2	5,752,041.15
34	TX2imcKEoPXPV1XUF2t8cYZ8kzixy8K1AX	2024-12-13 19:26:12	2026-10-04 17:58:06	659.9	1-of-1	K-1 in owner, 2-of-2	531,606.20
35	TUgSsAB3pDjofFgEQnthJnfao1KvZQUSq5	2025-06-25 17:58:42	2025-08-11 01:59:24	46.3	2-of-2	K-1 in owner, 2-of-2	360,896.20
36	TWDwwWitHBjcc9gy8eSTQZiDU9WmjajuY1	2025-09-30 15:15:45	2025-11-21 15:04:51	52.0	2-of-2	K-1 in owner, 2-of-2	0.00
37	TFUkQqbG5a6R6wCYVapm11wwTW4Vy8f6ph	2026-02-13 20:52:54	2026-04-07 04:56:33	52.3	2-of-2	K-1 in owner, 2-of-2	145,337.23
38	TKsDuu3RRLy1JD2S44x5ezRLD8NUrVeejr	2026-04-30 09:05:18	2026-11-02 08:13:09	186.0	2-of-2	K-1 in owner, 2-of-2	608,987.01
39	TKwF2Akbj6aJY2NdsSHuXptkJ3AnpP7ooF	2026-04-30 09:05:21	2026-11-16 08:55:27	200.0	2-of-2	K-1 in owner, 2-of-2	184,211.84
40	TMHWbxu9taKn8JFFRarg4LUtjNhQXkqZdz	2026-05-14 19:58:30	2026-07-16 03:39:00	62.3	2-of-2	K-1 in owner, 2-of-2	360,957.04

Table A2. The 10 permission updates in which K-1 was recovered as a signer. Source: `K1_PUBLIC_DATASET.json` → `permission_changes`.

#	Wallet	Time (UTC)	Signatures	Owner before → after	Transaction ID
1	TPGX9EAdsuEfrxhaXiFNi6XYCsZTHALz98	2025-07-18 06:24:57	3	3-of-3 → 3-of-3	8381201afd4351be09dbb1f782b0e44e5b60aee21df133a60bc2b847c76ede4d
2	TPGX9EAdsuEfrxhaXiFNi6XYCsZTHALz98	2025-07-18 06:32:51	3	3-of-3 → 2-of-2	a606ade7d3531d05dc42a836f585c6b35924022b163521b91768f13ac8e61ed5
3	TTSNNZyt1bX8b5zHaV4LKVenqvUTZEhbmi	2025-07-24 02:44:33	1	1-of-2 → 2-of-2	4ff52c9e7dc7e8ae1beb48851a21c7c6b61497647550e57209b651cb23dfa25b
4	TDbyWogEUCvfkqHcK5YYA6KQoXGRMCLv9C	2025-12-18 01:55:57	2	2-of-2 → 2-of-2	96bf33da816495e0ab26229b74cd5be351e61de6076f321b01daa39468bbf394
5	TMqdiBr2ExrKQpCysR9gGYBhzdVfCPHGYM	2026-01-23 08:00:27	3	3-of-3 → 2-of-2	be88de81211db4b4099128da7dd875c9fa5d7ecd4da99a53e60833ea7852c5fe
6	TTSNNZyt1bX8b5zHaV4LKVenqvUTZEhbmi	2026-05-29 09:19:54	2	2-of-2 → 1-of-1	1c3b6a435431356923aa3f9e81568eeaa4f914a78a2ab67b5683f1ced11a87cf
7	TYTdM4ArE4ykEAm7qHMEFD2xMbojoGUyjE	2026-06-22 12:32:30	4	4-of-4 → 4-of-4	315b81b4cf0e70e0f682f8571124376a0182da398c3afad8ad7cfc2d0c184c12
8	TMHWbxu9taKn8JFFRarg4LUtjNhQXkqZdz	2026-07-16 03:40:42	2	2-of-2 → 2-of-2	984b9e665c575966d6f72735de9d48bd0e4115ca22fdda767dfcedc898432073
9	TGNc2j9cGcXQtpNRJ6fbjXQAsJsSbmjYRq	2026-08-28 08:50:48	2	2-of-2 → 2-of-2	4baaa0c6da4a734a75a5d77c329eba5e29cf496d7a1f5a837d824447ec6e5e90
10	TAza2QhwZnk2affATf9bxNXw7xJdnP1Rj1	2026-10-04 14:36:09	2	2-of-2 → 2-of-2	01d117e066d48e83518c2c470d2eb53051b475988548677ee27fe8bf418f2026

Table A3. Transaction IDs of the freeze event (`AddedBlackList`) and of the K-1 addition, per wallet.

#	Wallet	Freeze transaction	K-1 addition transaction
1	TTBDya8zvk6WQmHRwgByt6wvSWS3tcBSvw	ccf0a704c81984e33625dc6f2d6e69d5235da420e1c2cf6b80cac354757de3ac	cc1de093afd3e352de68d22f12cb1d742477bee154ed6a22682c598602ade72c
2	TDbyWogEUCvfkqHcK5YYA6KQoXGRMCLv9C	3917b9040221aeebb7509d1359b7f1a4e445dffaff962585960de2bb4c7eca7c	d5a6480f57b952baa1c0f4db0eed3ba5c3983a22e5416325e072ee701f908b8e
3	TTSNNZyt1bX8b5zHaV4LKVenqvUTZEhbmi	5a4f4794dcc548d58b90e3e61400aec0de7b36e6d5e540a0e6cad84ee1072444	355758e7917e99e3a0422c2ef8a74f019827141b2a4375d2eab20f3e2877f40e
4	TDU5ZXU2okL3AKeYBuhpFTP1oC9xMuXeYq	79afd82d3c24d3226c092bbf0851cd3f3a37d0cffd554bdaa12fcd9b82d4ad2c	27d852cc64c2bd8453fa7b57ee8ca28315538e1ba65d543a0a9f44f7c7ab1e11
5	TUT2mi11zNewe4VUDNDwyWmcj7CtYHcySx	f8ca8d94b9a21c796f3f7f21980fa894c194186342cd0e5c081dccd4507ce77e	644812c29732503aa0e8f8369c69789e7da521feae5b3ff036bd98e6f780a0a2
6	TBYBkQCBNWaAQkbhZG69Ee8xnZ8Cmk7o8K	ddf6b3240a31340a4bbd3ba26c8b7ff8d156586c1b3d6925f6395bb03d36c1e4	27a9eb4327e1823a5aaaa0ae0499054ddee92f5238e9f90badf94f995a14d510
7	TK5W98XfxE1yuaH5iEbpPio7qgGrCqBfoy	5df910e8a3186ecf503abf4fb806371ca99bc956b97d04e00822aa36fe3517c2	5a8e39ac5703de2960392803bdc405499c39b91b68a3b7b0cd26bfc51410c6b7
8	TKVPY3Ht9hDrQc9iaFD895cDBj7hrjUB7C	2c507270fd432e624e949b06f6e6fd9404a34c8442eb7d454ef0f4bff3b1945e	eb517bc99653bebb192d75092678ad028f757e88a59404709da37a4250140c8e
9	TFKDWdyGKLukoKytCryfhJetVvedNNtAT2	63944722acda7bc412f407d813dc78a44b979161b2d36ac6e7ccd38d02f4e0e9	cfa3e79a539f26d966a7dac184df27034ed01b709a8e3b99f8482e0c42b9451d
10	TV4522meaQDMmkiVJ2v1gBzcoBMqM9UxdV	3664dafbe4bf3f06214847a7eb2297641597b847ce9ac7ce371259a0cfd86dce	39e26f4cf7cb40a9ed7bf1f46dd13e4179b6d30d699c9e533790a1d56b1c4769
11	TYyJF6S7Q9znNUrzb8Bpp5CvjdGALyYSZo	a68e053339cc1561f36f187a5f21ed5fde799e7008c4a3725e6432e3ff8a371a	739953ae75272106068ade7d0448cbb3f9c15ae184baa96948ac2a534ba12d4e
12	TENjm9Zyn4McrqQmLzhMvNNX6oFj85tAoW	945ba0dc44a3e2bb81145a006fa5e078eac5343ab558fd85f45edd5fda745762	477856aa4dc4fe62c1f957c831560d089ad32f4678f046524236586dca7908a7
13	TSE5nZecBdxjXovBdGueY9DYetueSVQahE	d136d58799d7c90f7213485ec1f8f894e0cc7d713a6a2e5b17d64c1cb8cb61fb	4848fab1862163d586465683cc27b30836881faee8217c4453ac34a0f803b82f
14	TDL8QDyBkgwYeaz1yf263qULPopiX6K9yq	ebb41e55c388f54f51dadfc2d7eaae8c372efddb0cebe66da6657b52be61aee7	c09a8f51fcae0ae939d3bcf138e32c8195ff6334b253cec24e22b8fe0a06645a
15	THVRLvLvXAZKDts9LxC1XynEzSdFPoTKue	2c741788eccb83d0edb79a03c3ad478388f4327049f67632617db66e4fdd9b5c	f5cc37f1de5db9889072882293c3c73f3f70b47c4e280ce74d5a275f7e1e28dd
16	TTDY1ytAJ88GKiJNR1qCTGug85VqYXAjZR	7d31c98f50d11d68c925f5048f8f6d19c05f622de7d3484a2020190645a44ae0	96e074ebd2a847f2ddfa65c32d04bf530c5cc0c2074aa6a6cf7f697bb88cce46
17	TPGX9EAdsuEfrxhaXiFNi6XYCsZTHALz98	557cc4b5872a49b4614e2c43a98bb190e09d6bbf42f3629258b67ac1030e64e2	a553224ddf0c08f3e3e85882ceb8108f897d72f3fa6c855ad55be90f73f9d7b7
18	TJit9oxaNWYNCxfw5Psf1Q9NmSCsv9ASRo	22a4d0494a3ad223360417347b96147ef6f3269de03104681b555e83faeda90d	f160e50903f1cb5fdf894952567988eea3a17a1c22eb7407cfac6eaa8d02c63d
19	TTVVw8DvQ8HFYqqVd399AyGyDp8U36VATV	84d0699d6f95a1daa10567e0aea5f329226d8d051b2194b7761b342df2c8d897	a5a51fef766206bf07e30d6501e8b2279819ed25b156d2e82be787094b09f6a2
20	TL1sE9EdfVZ57LPftXmzJSGDQ7KC6o9Zkj	cba5d926e662e14851717d21d7d170e920290e90389d6b902907db16c6b1c12b	74a0e54d3c9ca3fce74bcf38b206062ebb1bc0c6326eab319f3891ed724dedc2
21	TMqdiBr2ExrKQpCysR9gGYBhzdVfCPHGYM	e8718b2b53879253f10e284c1c3a7c9b91ae5a52eeecd614dda2d716a663aed0	8f19c4fcf4231a80f059fc88163b3de18aa05db91904640aae6298545ad343d1
22	TEjXjJF9Yr8mBcwXD2yGDFCyjBD7A8tZKa	9e292c11abdec82fbd92ea7923b6acc20c60e0fec481fc7abcc8deae82a3b257	53d58b351a8a128a6009e5a01037b44ce88fc8d6e56d6be8c4a620f8494d5197
23	TF9sQA71jifU2U2Qcs6n9wNVfodDS8HXYM	e142bee932e2f314c2f4611eee40ce487028c8bb7a13517dddfd11ab1bd54206	45c67a14a1f5b97b6d382406bb8cff8451e4472456e6c00c7c583b836b7b198a
24	THtRMPna3S5EaKWdGxLp1mZf1fTPb3suQk	07b70041bf911f9f03284cbba01a69486e5b94767ca5938edaa219bd2d252155	43ec3153b262d8cac744f2455d4b3b5b078c640619b751f63fedfc22bb3e73ec
25	TFgVxpDVPRhgaNdKcCES1o6WHsXczCb3it	e495d2d7d89829d311824ba4741f485000ebbce22c4ec2a78f6e104aadb0ee08	ef51812f6c2329f2636444c4af2a6969e8f51722039a73560095b221a30782fb
26	TRH83c2byegtwshxpkKRHXtFiqxMB5Einj	fdac97b6946fb7426be4db7c3cc3c38a6c69a58d31e6d18b62efe572924cf81c	441ae091599855d7531016a28f579943687223223d0f77ad39995f386bcf94b3
27	TBzLTfj8k8Jdr7rVsWzkNooKPSUiq7Z4hF	d9366c8202e091f5989d2b15db71291162f6ad68db9dbe2d832c7e408e1b6c29	d4461bad9ce6d19a3567668faf23f086c68fd5f855d726ec8b26e9d1814c0034
28	TAptaV49xGV3eTE4epFwuqZjMmp6xZfaiE	efedc70ff2dda7c383ec1956a45ce839ae26dbe668691aaab26e75ed403dd937	f832d00f7a3d9b8a944e8ecdecaaee10282b38a051dbe7489a37c9b26e5f3b6b
29	TRnFSbJmAnLBo43fkCwnyKJdHgAYeUJSNQ	010f9a2c43e09d0a9d8080f7814d84faf8bfe1f0ecc7381128f21c6c2036534d	bb1a8d0209bf2e2c266c5565aba74b8a96f0dcbf8b2f91cd1c209841ff016cc5
30	TYL1bGkw4vgj6WUynZ2JKccuQogSBo9tZU	b53a4fab68013be36d06f862e384d0f4ea3fa19ba98eac1c8bc25e39baedfd46	67744d0dc9372a97ebd823b7d4687cd59b9ff8336eaf8ff621204cba09fb6c79
31	TYTdM4ArE4ykEAm7qHMEFD2xMbojoGUyjE	634502297a0d138050253f9f6536d94c174fd2b97b44d023e42765afcfb5b094	6d987e174bf103c5efe4439c0117f8536aa9d11ec8f63d57ef8a058034bb6119
32	TGNc2j9cGcXQtpNRJ6fbjXQAsJssbmjYRq	9160e456323b84b4b3ebe3e7b63b0578da0aa269de82839b55d958821a05af0e	145546dd86ca86886e5aa4099844b4d3e2efb42b86aa9835b11524a45b3ad554
33	TAza2QhwZnk2affATf9bxNXw7xJdnP1Rj1	b482335eea9238fa6c542970b6332f95d754de72f46f3dd3683517dfbc7f4d7b	ac95732d444adb1321ac3182e7e4d20e98fdec3f10bb96c75d3c37b60a186ac7
34	TX2imcKEoPXPV1XUF2t8cYZ8kzixy8K1AX	4a5f28f9db96320b9a314af9a3d36acff412b42b391d1d59a07a0c73396d1103	87475f0ca274bf2213901f2c92600480fa0a2af2a0ffe54364d2f5c60fe707b3
35	TUgSsAB3pDjofFgEQnthJnfao1KvZQUSq5	0dd6da797722401092a90511a7e48a4400a255bc34d9f0a9b2afa4f3615b43df	a457e851e9f7bacd426b20d848e5bdba65bf53ae4bdff4d51237a24395e68cd4
36	TWDwwWitHBjcc9gy8eSTQZiDU9WmjajuY1	dd6dcffc19843b7d88b647cd71e6b7563eeff96caf6205076757c161a69ed3f9	ff08e7ee2ed88748fecb86dbc9dd2a6e040b8e34910ac534053c23a584c37143
37	TFUkQqbG5a6R6wCYVapm11wwTW4Vy8f6ph	ed87fb7b2c4c19eb2d2dc047953e93e211bf147866278ed2c777d334c54b5144	2d5f9ec3e39b3c92ef0ddbe1f057cb2ce61b55655fb95ce66afa0afa43c8154c
38	TKsDuu3RRLy1JD2S44x5ezRLD8NUrVeejr	9d1683cc678050bf01577cbe09b3d72c58281e052a61da4c67fd09312d04f77e	18e6f2bf767b902fdc639a821ebf0f16c94fcf4486a53fc9da58e67cb1c4aaaf

#	Wallet	Freeze transaction	K-1 addition transaction
39	TKwF2Akbj6aJY2NdsSHuXptkJ3AnpP7ooF	c44b6efaab188dfb4b42abde84e378409a1ec0d48e7141ad0d25bf9c779aa0a1	6a3dd4f33596ce4bf893565ad6ba2e9b8861be4f24dcc4450022b35966c18e40
40	TMHWbxu9taKn8JFFRarg4LUtjNhQXkqZdz	a7ab6013f7cbd6c2d1a287154e777c839451845709eaf0cd04c200dd396a0ff5	05192558332ce0800bbd413d42806562a43e396664a304d4ff8a28b6679f12cc