nomadic labs

Making confidential transactions on Tezos

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Introduction

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The majority of public blockchains allow anyone with access to the Internet to have access to all operations on the chain.
Moreover, by knowing a user's address (from a payment, for example), anyone can:

- read the balance of their account
- see the transactions that they have issued and received since the account was created, as well as the amounts, recipients and issuers of the transactions.

These aspects may be incompatible[1] with the protection of users' privacy[2], as well as the right to be forgotten[3].

To remedy the situation, Tezos offers contracts based on the **Sapling** protocol. This protocol provides both **the protection of users' privacy and transparency with regard to the regulators**.

[1] https://www.eublockchainforum.eu/sites/default/files/reports/20181016_report_gdpr.pdf

[2] On this subject, in the European Union, the GDPR regulates the protection of natural persons with regard to the processing of personal data and the free circulation of such data.

[3] The right to be forgotten allows an individual to request the removal of information about them and that may harm them.

Definition of the main concepts

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- **Shielded transaction:** A transaction is said to be shielded when an external observer cannot find out any data from it (including the amount, the recipient and the sender[1]).
- **Transparent transaction:** A transaction is said to be transparent when it is not shielded.
- **Shielded pool:** A shielded pool is a set of tokens whose number we can find out but whose internal transactions are shielded.
- **Smart-contract:** In a cryptocurrency, a smart contract is a self-managed account whose interactions are configured by a code and data. On each transaction to the address of a smart contract, its code determines changes to its data and any transactions issued by it.

[1] In practice, an external observer can see the sender if they call the contract.

Key management

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Sapling is a cryptographic protocol that allows shielded transactions to be conducted, while ensuring that trusted third parties can view the transactions. Three elements need to be identified for this to happen:

- The **expense** key, which should be kept secret and which is used to sign transfers.
- The **viewing** key, which is derived from the expense key and allows transactions issued or received to be viewed (it is possible to create viewing keys that allow only transactions issued or transactions received to be viewed).
- Addresses that are used to receive transactions are all derived from the **expense** key. We can derive as many addresses as we wish, so two different users will not be able to know whether or not they are making a transfer to the same person.

Sapling is a cryptographic protocol that uses elliptic curves (Bls 12-381 and jubjub).

Demonstration

Example without monitoring of the transaction by a third party

In this example, Alice wants to send 8ℨ to Bob, without anyone else knowing.

Alice

Bob

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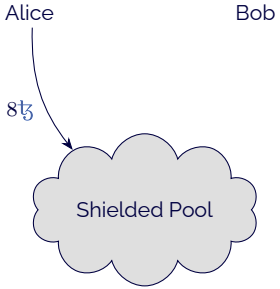

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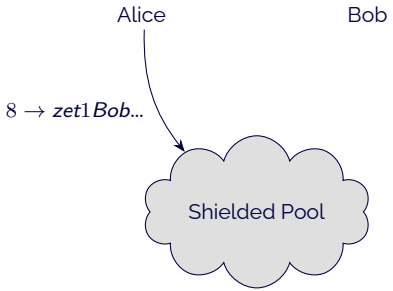

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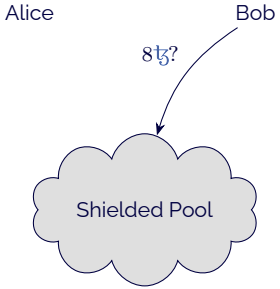

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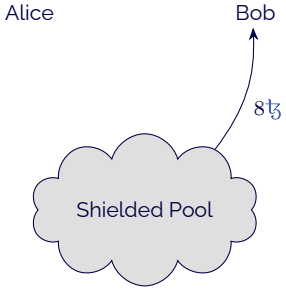

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This example is a simple case of the use of Sapling.

It is also possible to allow a third party, a regulator for example, to control all transactions of the Sapling contract.

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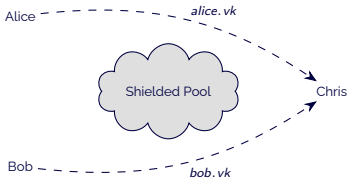

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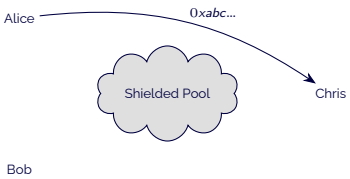

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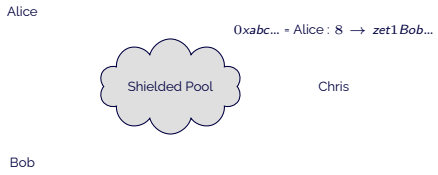

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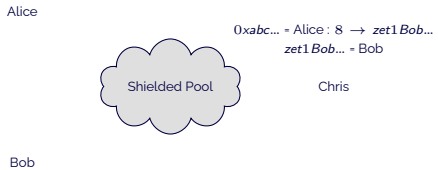

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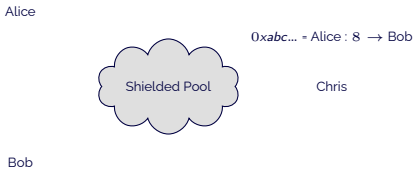

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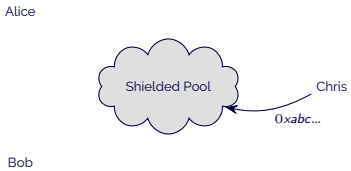

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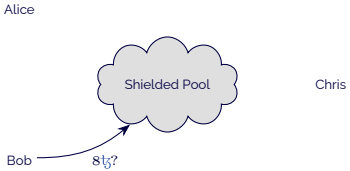

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Example with monitoring of the transaction by a third party (2/2)

This example shows the case where Chris deals with validating the compliance of operations, potentially because he is answerable for what happens in the contract, or even because he is responsible for protecting Alice (and the other members of the contract) against potential fraudulent transactions. Furthermore, if he decides that an operation is not valid, he may decide to contact Alice to tell her about it and ask her for more information concerning this transaction, or quite simply to verify that she has not had her wallet stolen and that she is indeed the originator of this transaction.

Chris is not necessarily a human; he may also be a simple secure oracle[1] that has view keys and automatically conducts transactions where the parties are known.

In both examples, we have assumed that the tokens represented tez. This is not mandatory and we might suppose that the tokens represented any other fungible asset (financial assets, raw materials, etc.). In this case, the regulator could also manage the deposits and withdrawals. There would no longer be any direct interaction between the actual asset and its representation on the contract (as we could do with the tez). The contract **might then have an evidential value** in the event of a dispute.

[1] An oracle is a program external to the blockchain, generally standalone, the role of which is to make calls to a smart contract to give it orders according to parameters that the smart contract cannot or does not need to control.

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Let's keep the conversation going

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