Atomic Swaps on ⚡

Atomic Swaps on ⚡

... just hit a snag

What we are building

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What we are building

A decentralized exchange protocol.

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What we are building

A decentralized exchange protocol.

For centralized exchanges.

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What we are building

A decentralized exchange protocol.

For centralized exchanges.

On ⚡lightning⚡.

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What we are building

A decentralized exchange protocol.

For centralized exchanges (& individuals).

On ⚡lightning⚡.

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What we are building

A decentralized exchange protocol.

For centralized exchanges (**Why? Liquidity.**)

On ⚡lightning⚡.

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Endgame

Every individual who runs **XUD**, the node software, is part of the network and **can trade with everyone** else

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Atomic Swaps - The Concept

- Trustless exchange of two different assets
  - Trustless = no middleman/escrow service
- How: guarantee atomicity
  - Both sides of the trade happen or none at all
  - Technology: Hash Time Lock Contracts (HTLCs)

Atomic Swaps - The Concept

Atomic Swaps - The Concept

preimage

Atomic Swaps - The Concept

H(preimage)

Atomic Swaps - The Concept

Atomic Swaps - The Concept

Lockbox only opens with ‘**preimage**’ + **B**’s signature

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Atomic Swaps - The Concept

Lockbox only opens with '**preimage**' + **B**'s signature

Hashlock
(H in HTLC)

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Atomic Swaps - The Concept

Lockbox only opens with '**preimage**' + **B**'s signature

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Atomic Swaps - The Concept

Lockbox only opens with ‘**preimage**’ + **B**’s signature

Lockbox only opens with ‘**preimage**’ + **A**’s signature

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Atomic Swaps - The Concept

Lockbox only opens with ‘**preimage**’ + B’s signature

Lockbox only opens with **‘preimage’ +** A’s signature

Both lockboxes need the same ‘preimage’ to be opened!

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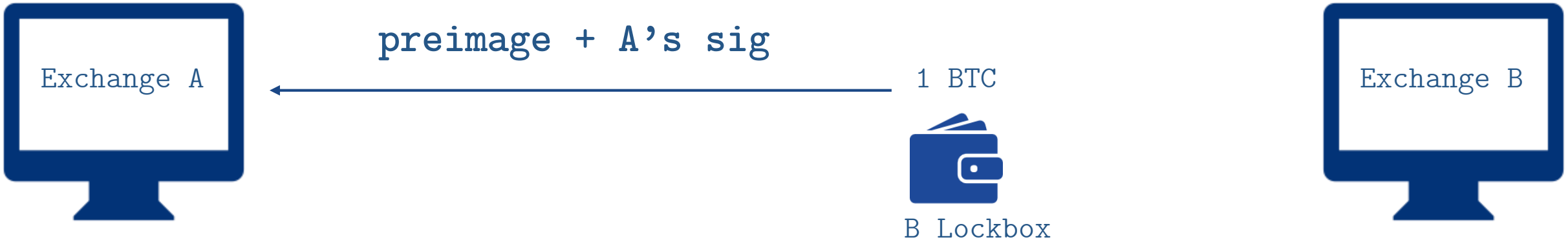
Atomic Swaps - The Concept



If A wants to open B's lockbox it has to reveal the **preimage** on the blockchain / payment channel

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Atomic Swaps - The Concept

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Atomic Swaps - The Concept

TimeLock (T & L in HTLC):
If something goes wrong, 100 LTC go back to A and 1 BTC back to B after certain time interval (# of blocks)

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Atomic Swaps - The Concept

Hash Time Lock Contracts (HTLCs):
On-chain and off-chain. Via BIP199 on Bitcoin and *native* in Lightning payment channels.

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Atomic Swaps - The Concept

Hash Time Lock Contracts (HTLCs):
On-chain and off-chain. Via BIP199 on Bitcoin and *native* in Lightning payment channels.

- Scripts on Bitcoin
- Smart Contract on Ethereum

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Atomic Swaps - The Concept

```
OP_IF
     OP_SHA256 H(preimage)
     OP_EQUALVERIFY OP_DUP OP_HASH160
     a_pubkey
OP_ELSE
     timeout OP_CHECKSEQUENCEVERIFY OP_DROP
     OP_DUP
     OP_HASH160 b_pubkey
OP_ENDIF
OP_EQUALVERIFY
OP_CHECKSIG
```

Source: https://github.com/bitcoin/bips/blob/master/bip-0199.mediawiki

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Atomic Swaps - The Concept

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Source: https://github.com/bitcoin/bips/blob/master/bip-0199.mediawiki

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Atomic Swaps on ⚡

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Goal: minimal changes to
lightning implementation (LND)

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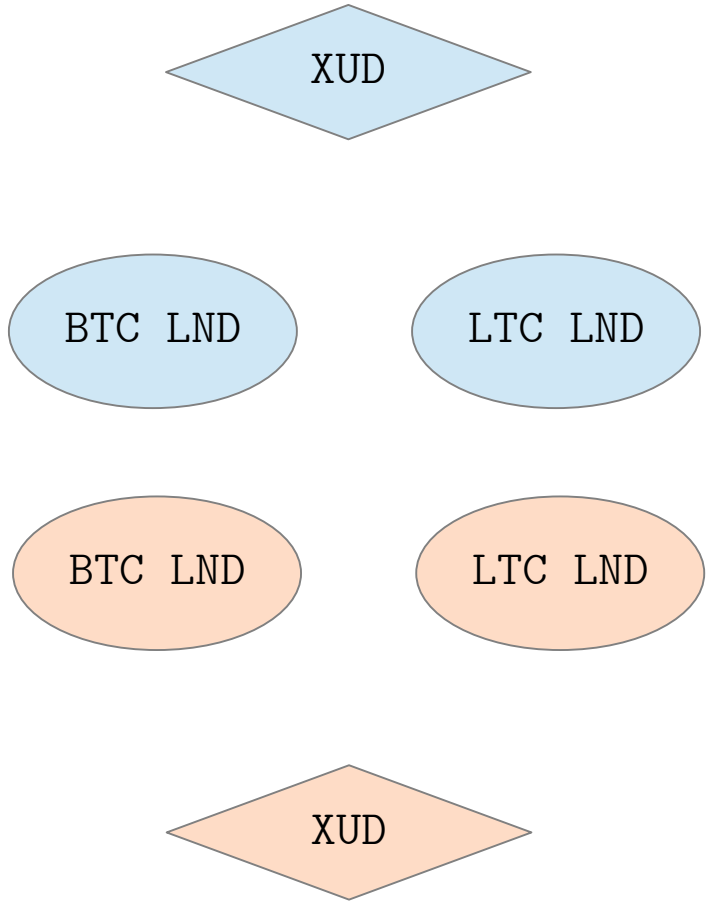
Atomic Swaps on ⚡



The Setup

- Two **XUD** that each manage **two LND clients, one on BTC and one on LTC**.

- LNDs configured to query XUD when they are recipients of a payment with an unknown preimage

Assumptions:

- Routes with sufficient capacity exist between the BTC LND nodes and the LTC LND nodes.
- XUDs can communicate with each other via P2P layer e.g. negotiate a trade, exchange LND pubkeys

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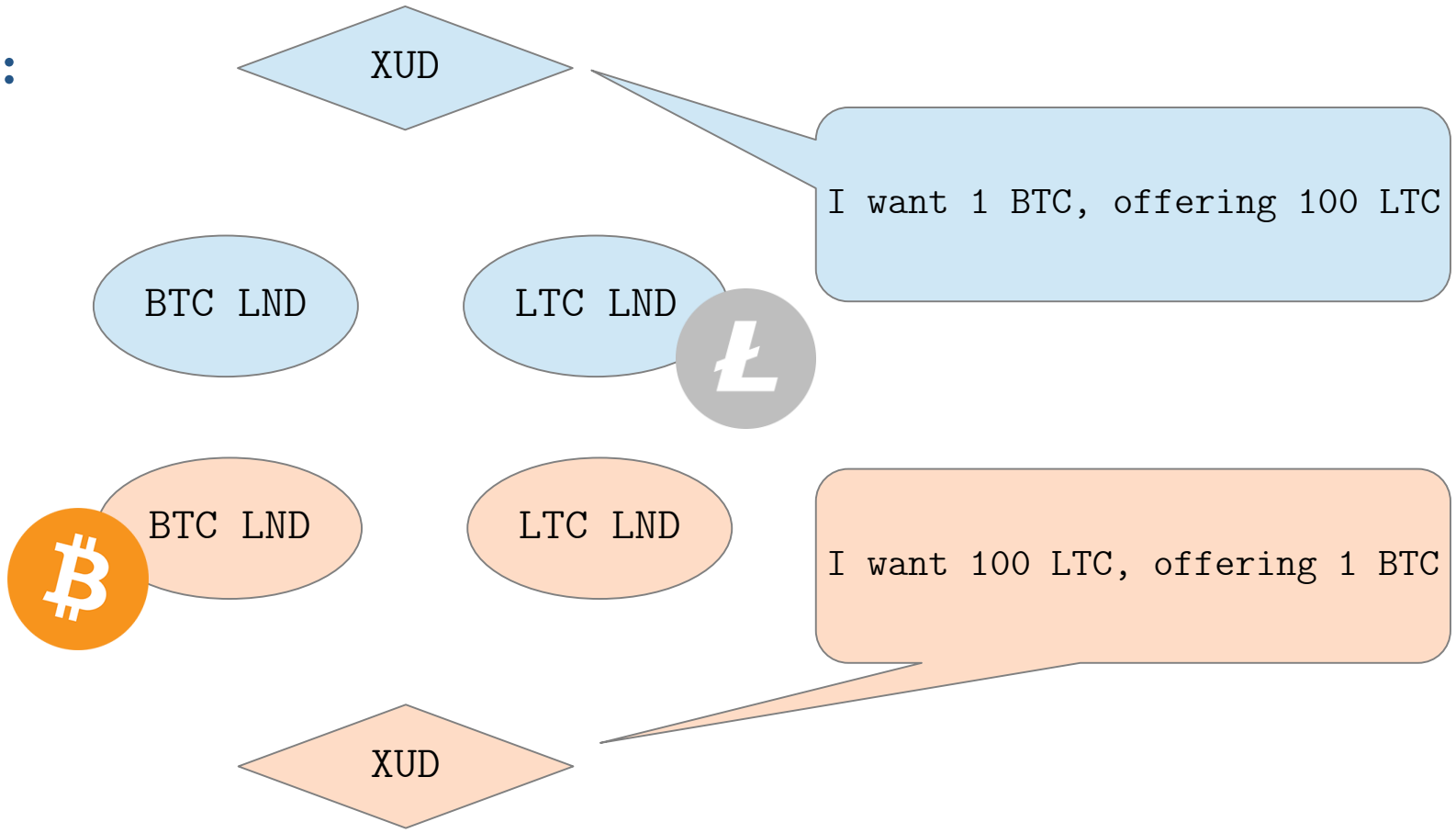
Atomic Swaps on ⚡

Step 0:



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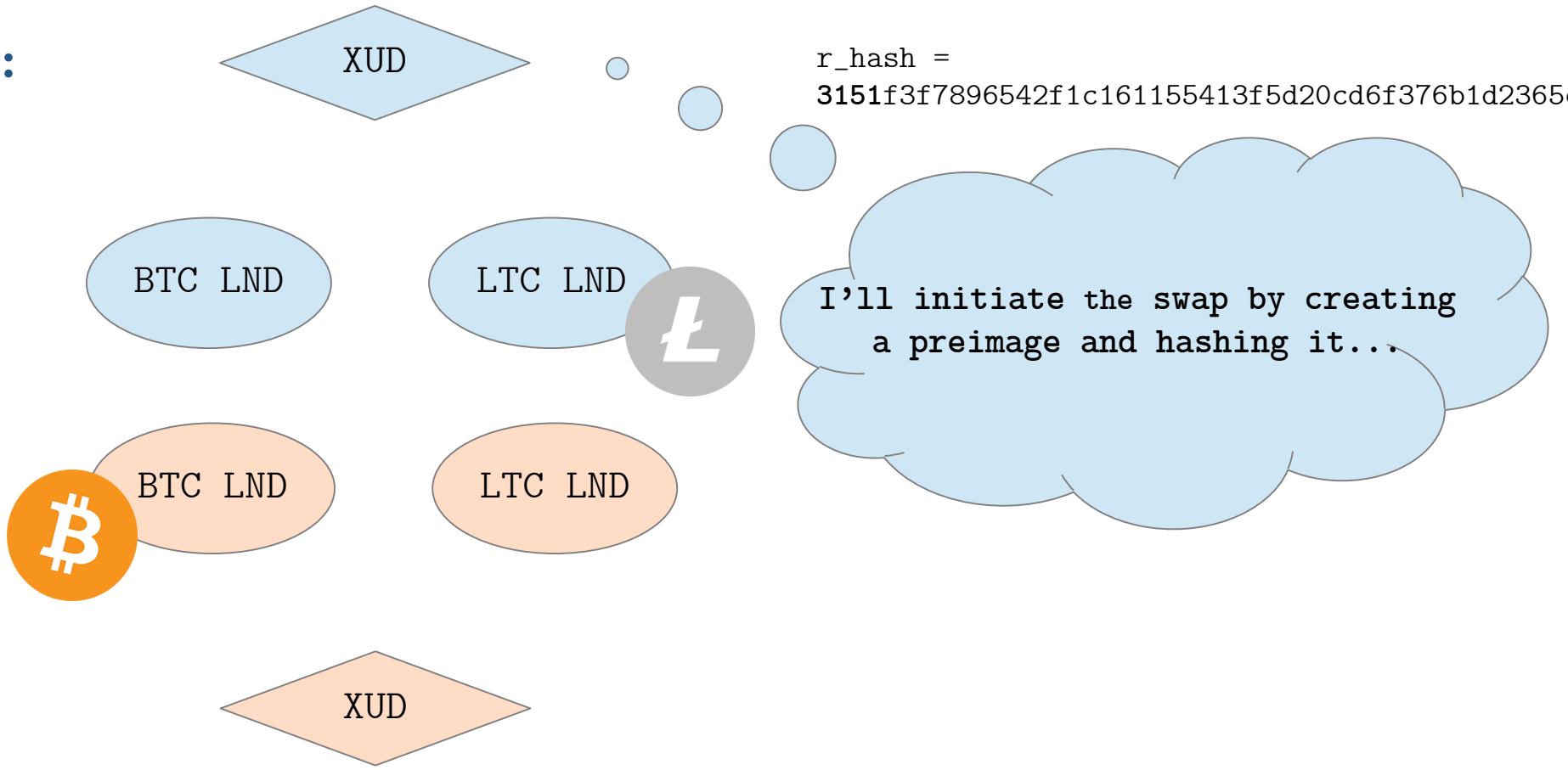
Atomic Swaps on ⚡

Step 0:



preimage = **MVHz**94llQvHBYRVUE/XSDNbzdrHSNl4f3pANIhin6ZA=

r_hash = **3151**f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

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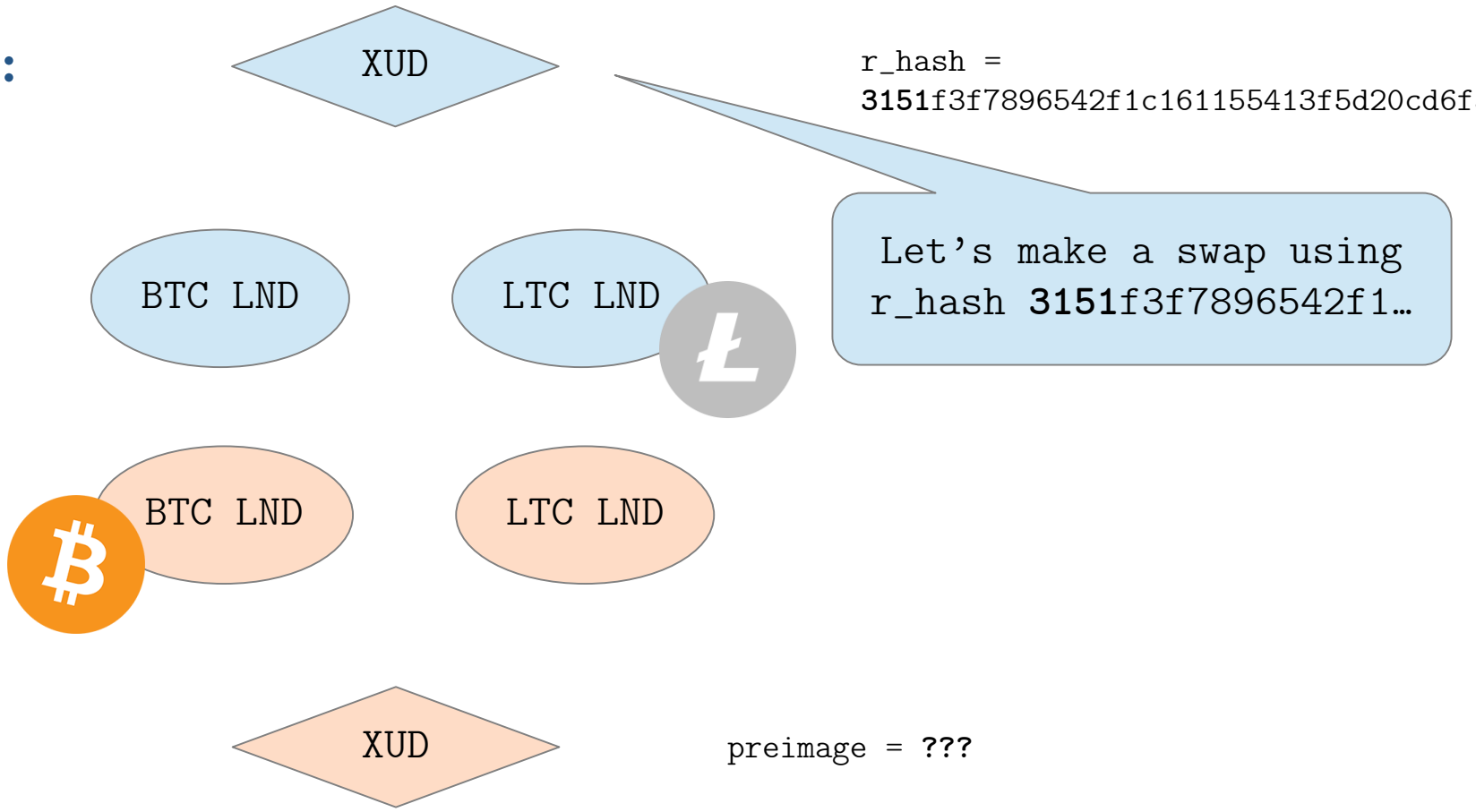
Atomic Swaps on ⚡

Step 1:



preimage = **MVHz**94llQvHBYRVUE/XSDNbzdrHSNl4f3pANIhin6ZA=

r_hash = **3151**f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

preimage = **???**

r_hash = **3151**f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

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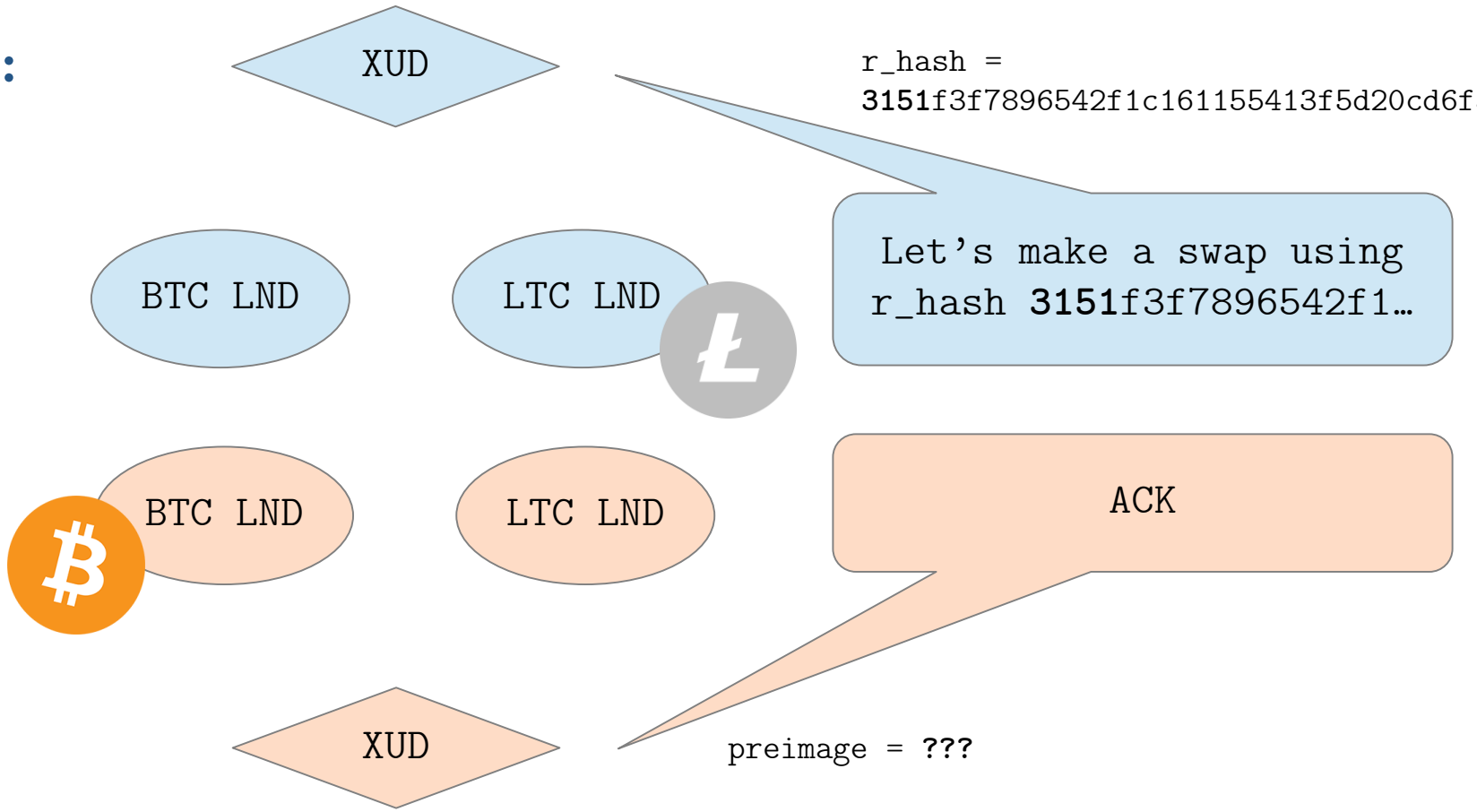
Atomic Swaps on ⚡

Step 2:



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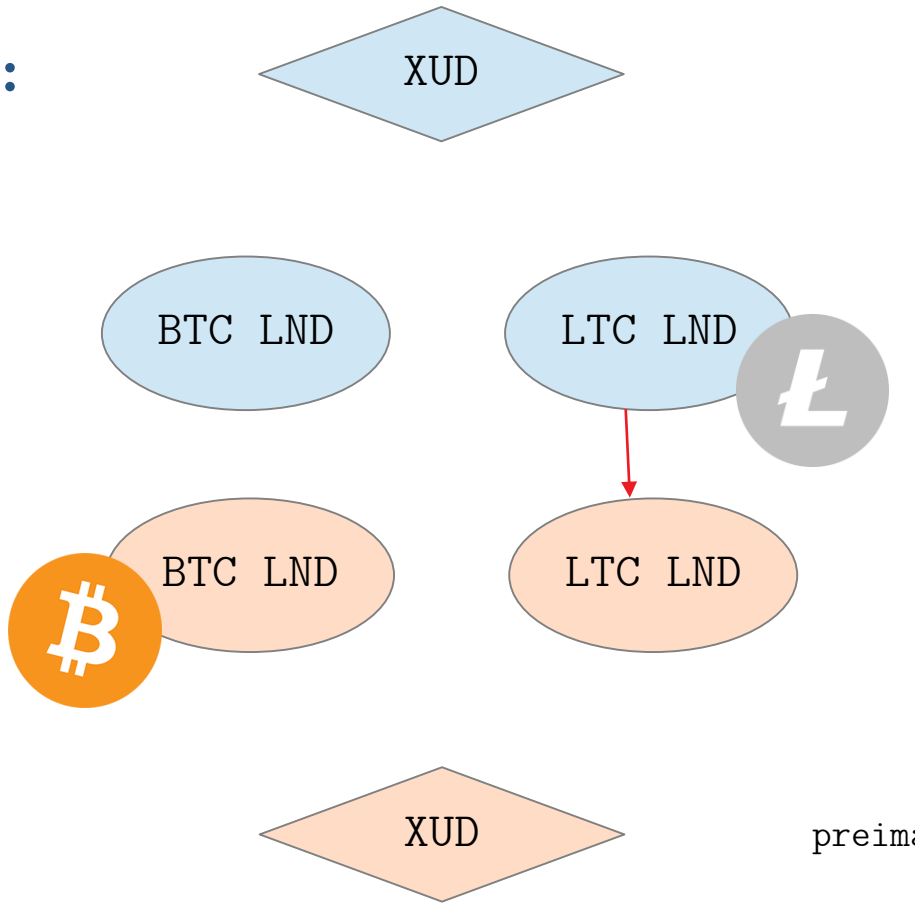
Atomic Swaps on ⚡

Step 2:



preimage = **MVHz**94llQvHBYRVUE/XSDNbzdrHSNl4f3pANIhin6ZA=

r_hash =
3151f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

Pending HTLC

amount = **100 LTC**
r_hash = **3151**f3f7896542f1…

Note: This payment can route through any number of intermediary nodes on the LTC lightning network

preimage = **???**

r_hash =
3151f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

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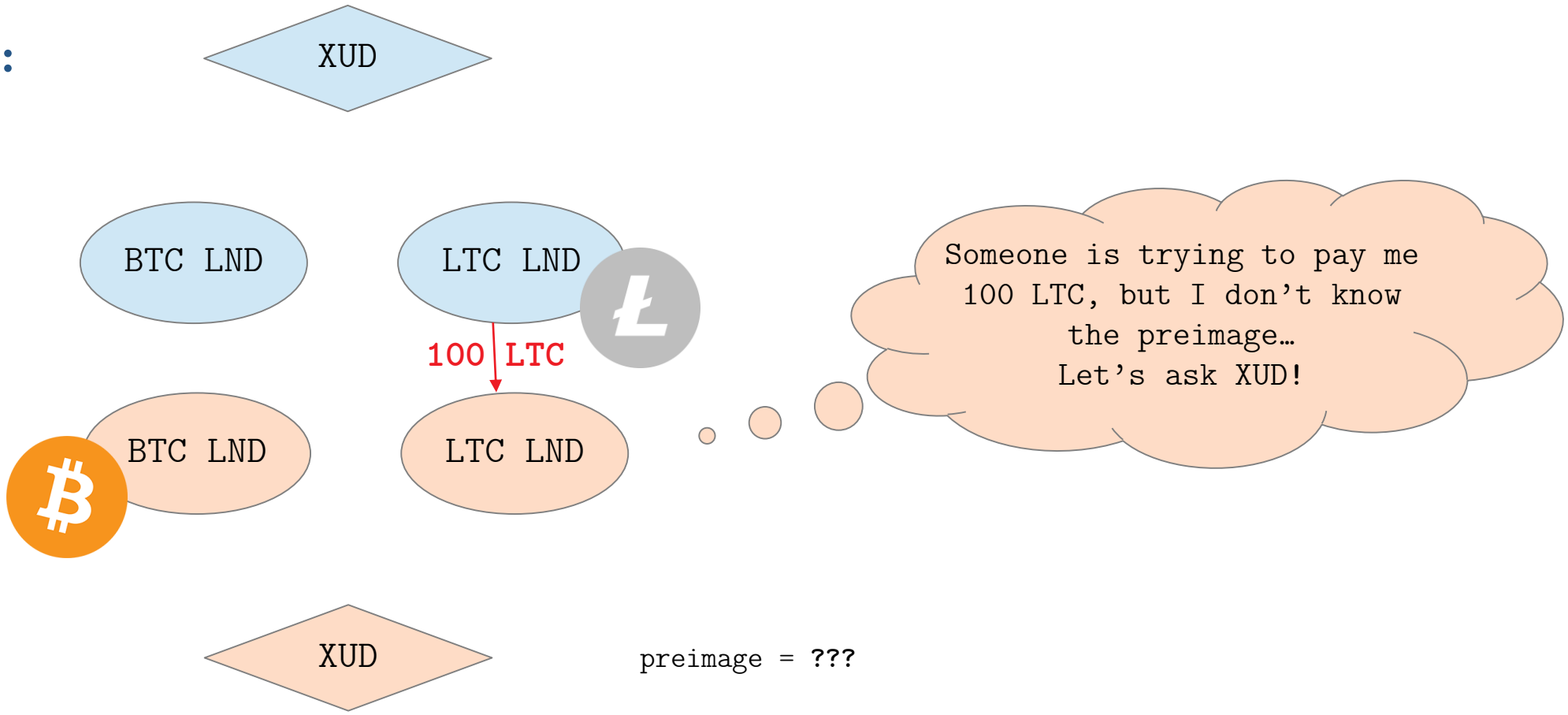
Atomic Swaps on ⚡

Step 3:



preimage = **???**

r_hash =
3151f3f7896542f1c161155413f5d20cd6f376b1d2365e1fde900d2218a7e990

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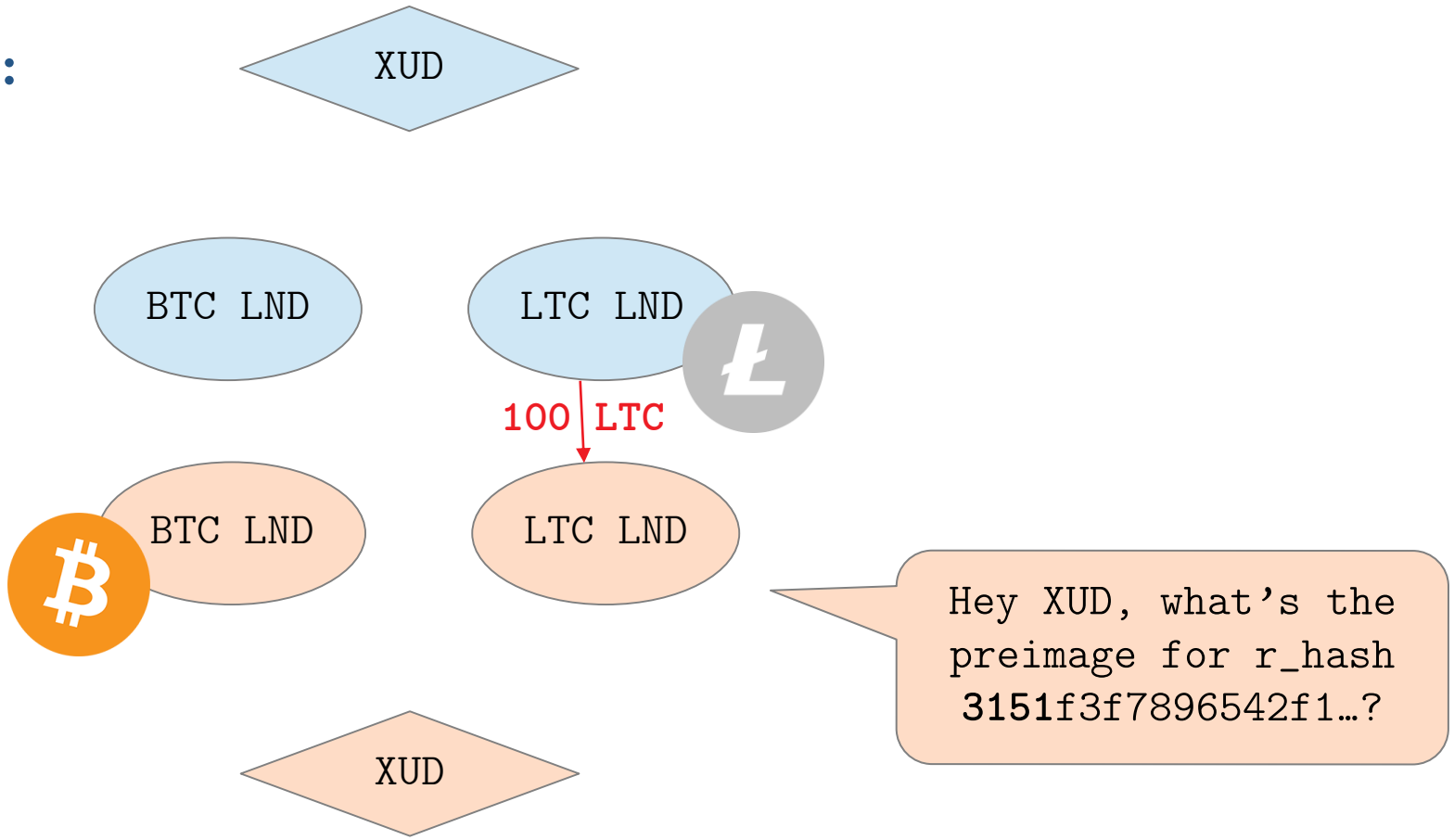
Atomic Swaps on ⚡

Step 3:



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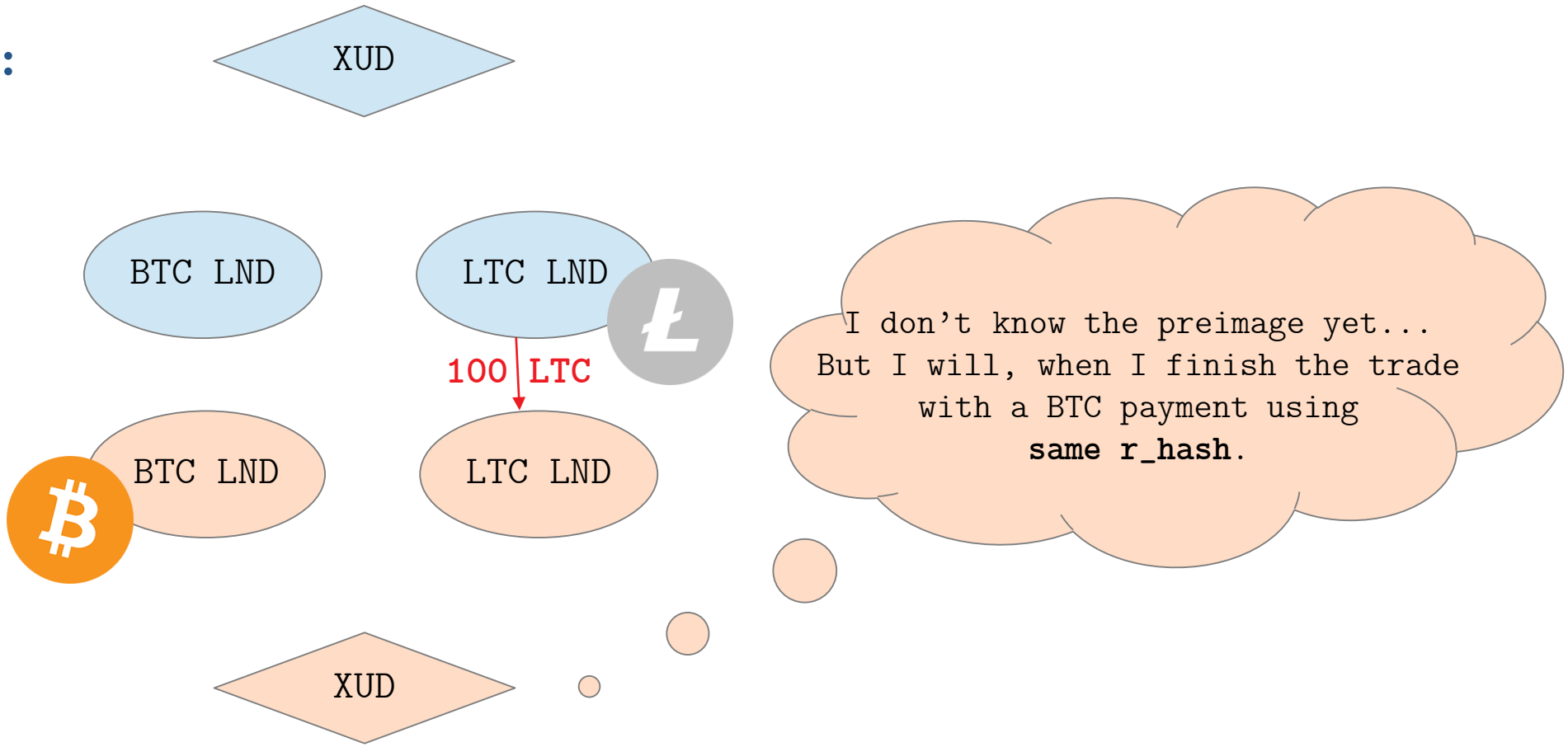
Atomic Swaps on ⚡

Step 4:



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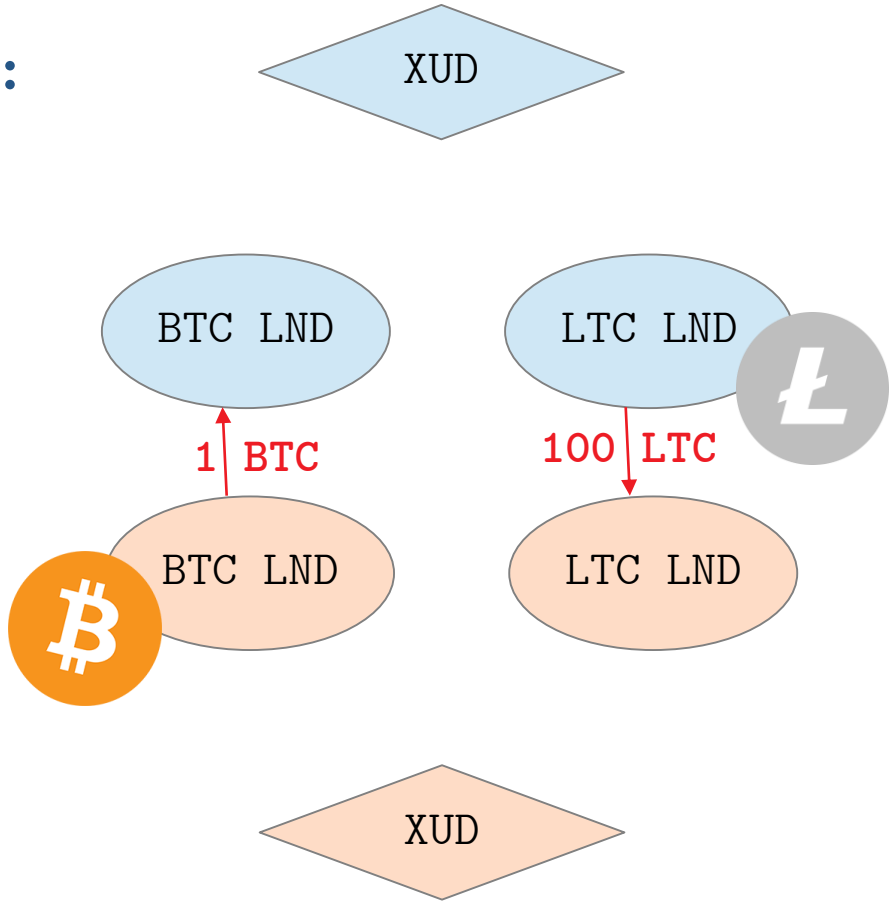
Atomic Swaps on ⚡

Step 4:



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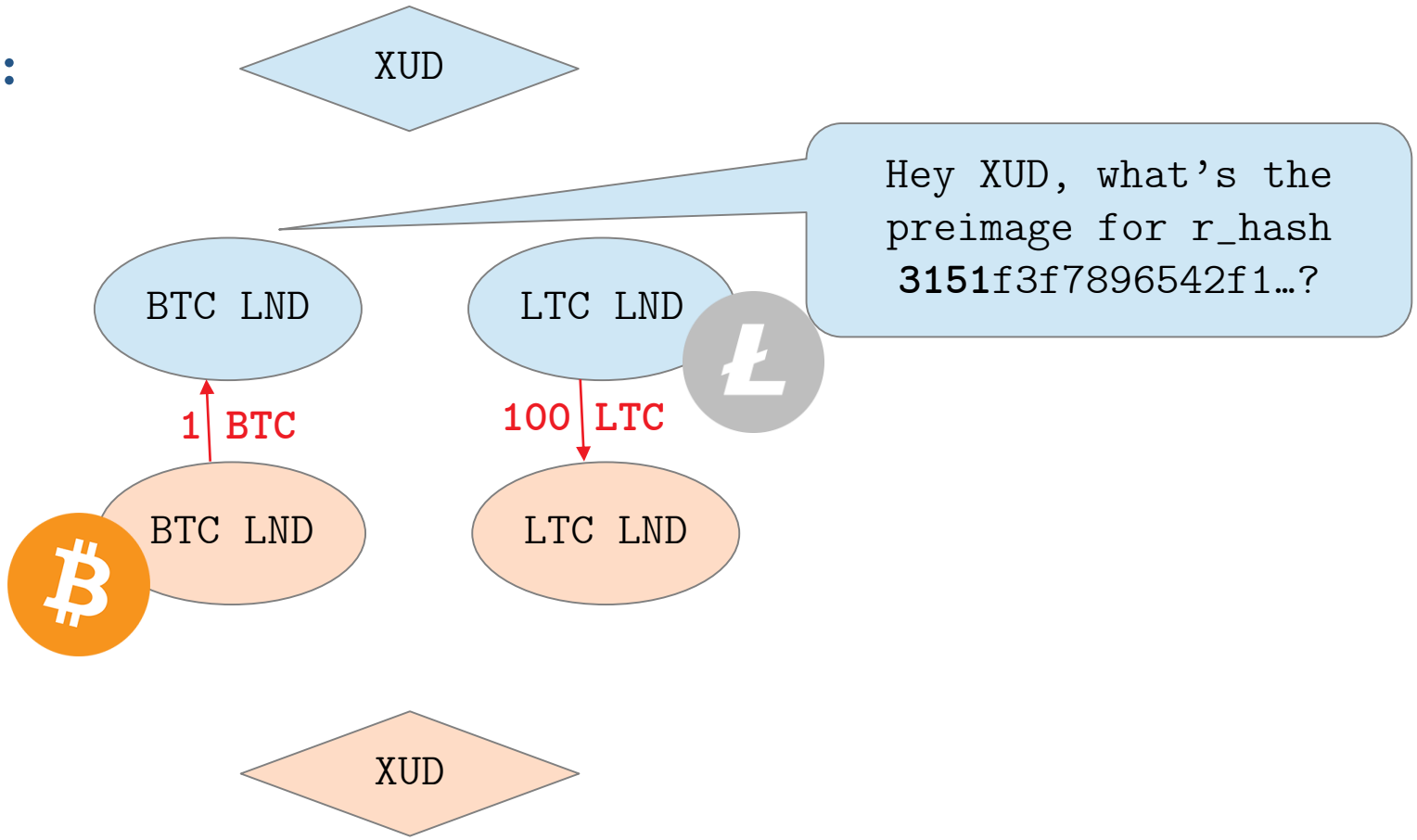
Atomic Swaps on ⚡

Step 5:



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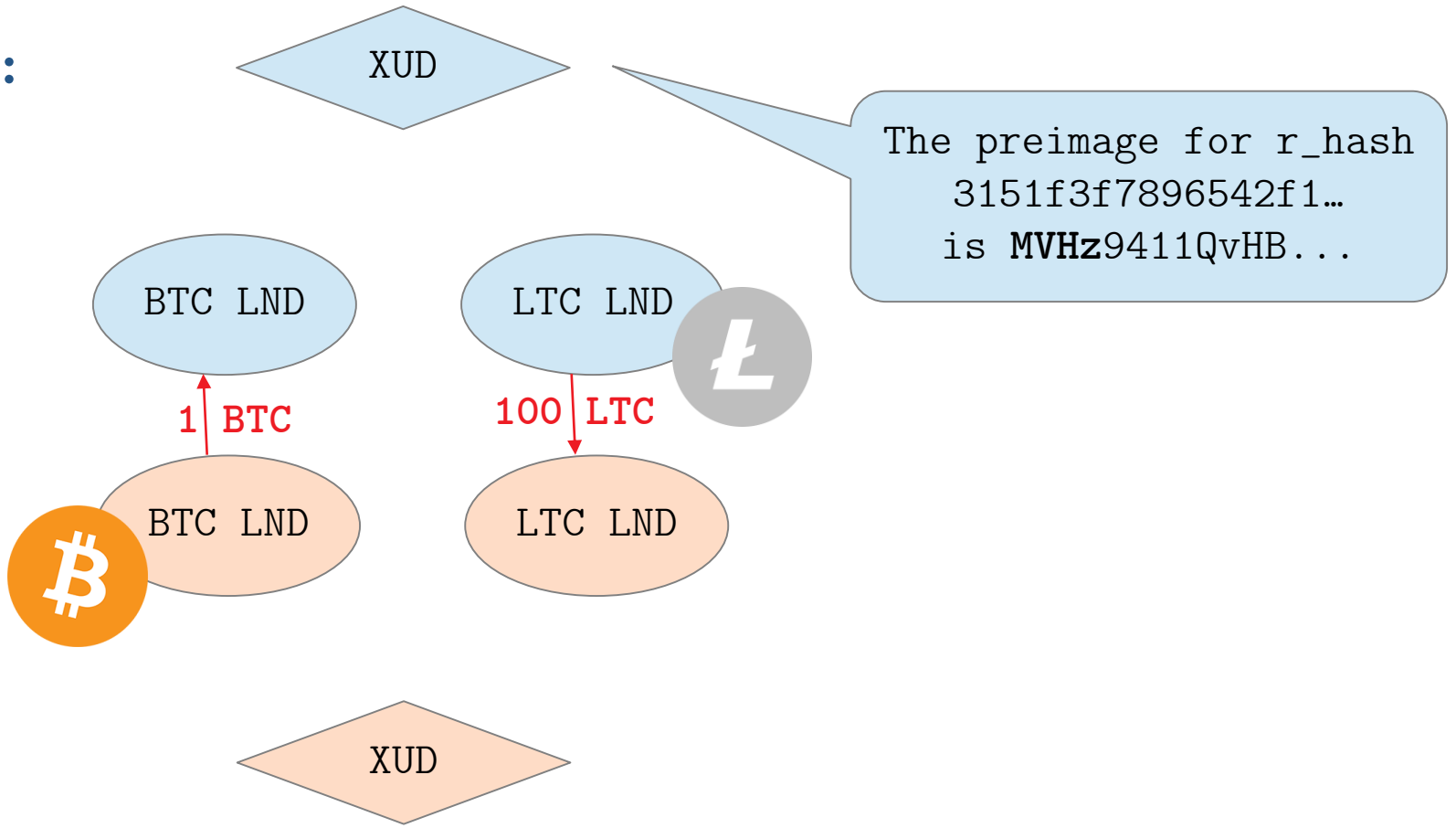
Atomic Swaps on ⚡

Step 6:



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Atomic Swaps on ⚡

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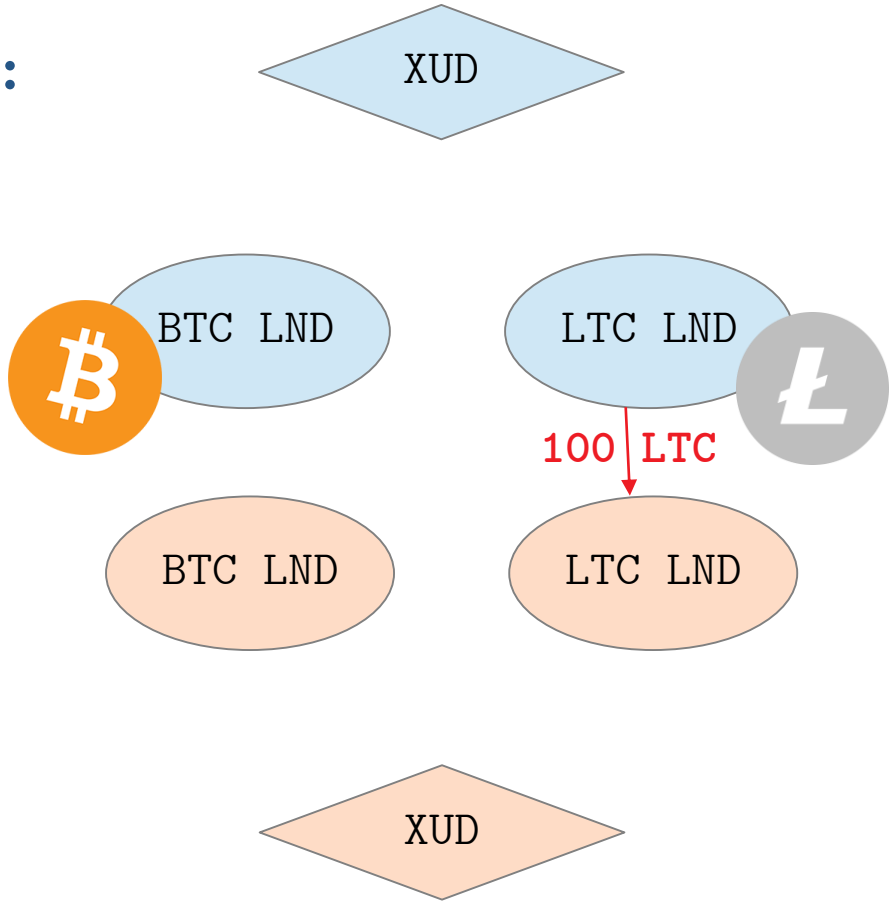

Preimage revealed

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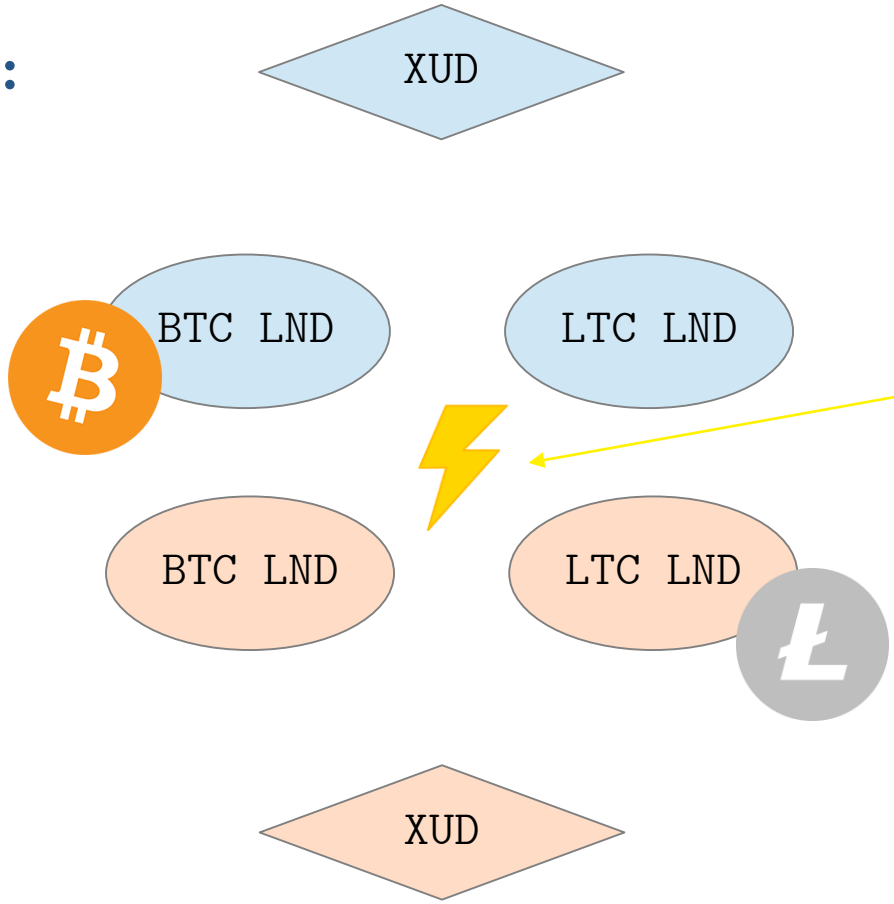
Atomic Swaps on ⚡

Step 6:



Preimage revealed

BTC & LTC Lightning payment settled!

Note: This payment can route through any number of intermediary nodes on the BTC & LTC lightning network

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DIY: github.com/ExchangeUnion/xud/wiki/SimNet-Guide

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But there is a BUT

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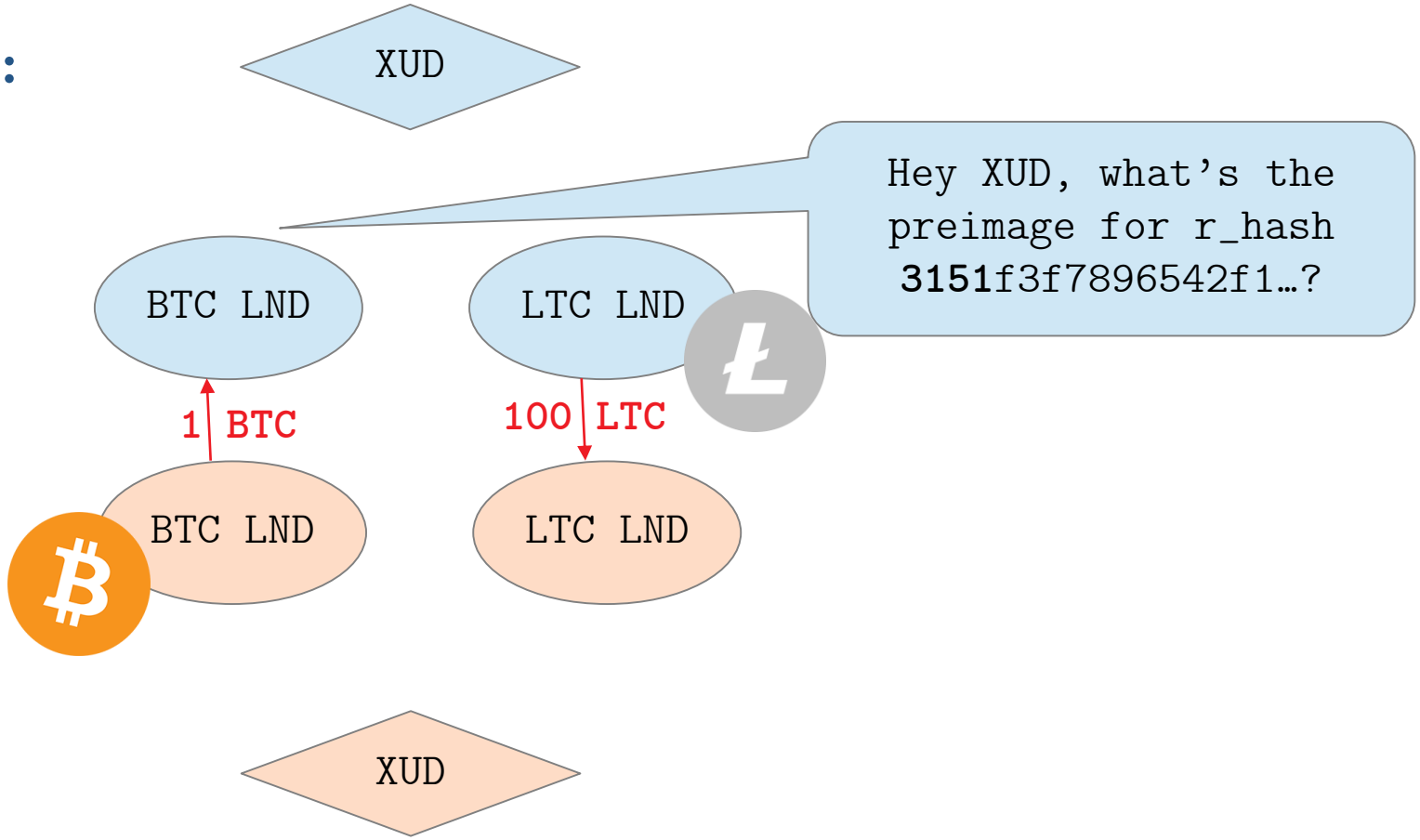
But there is a BUT

Step 5:



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But there is a BUT

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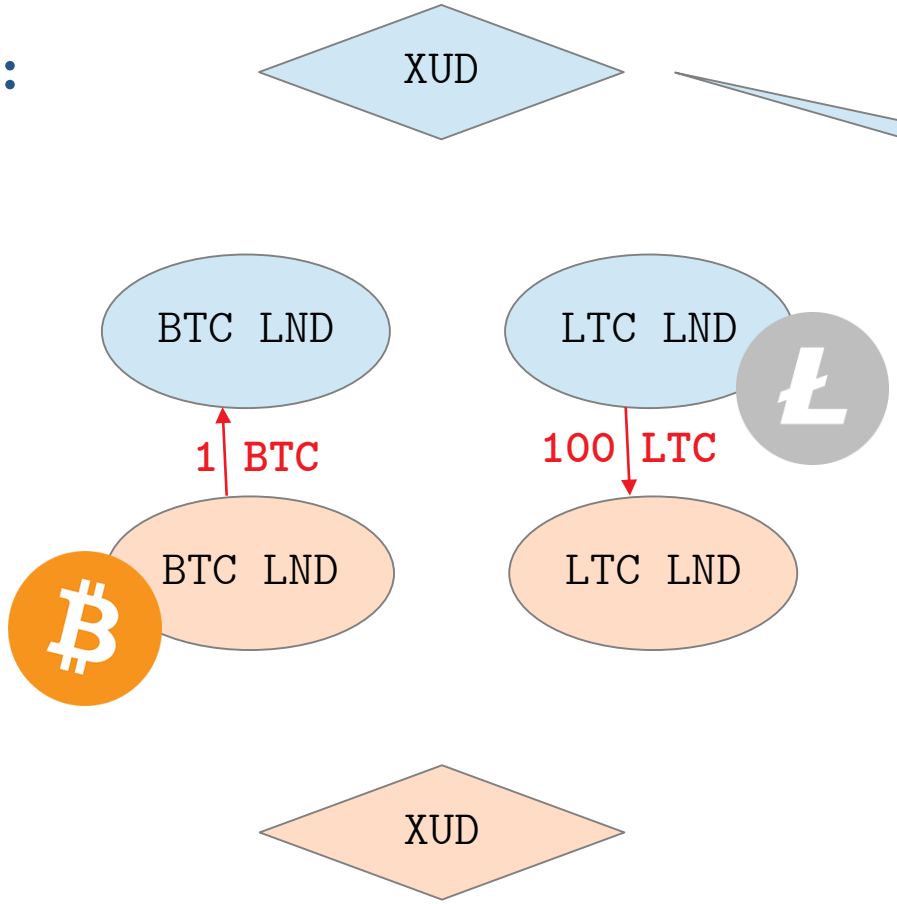

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But there is a BUT

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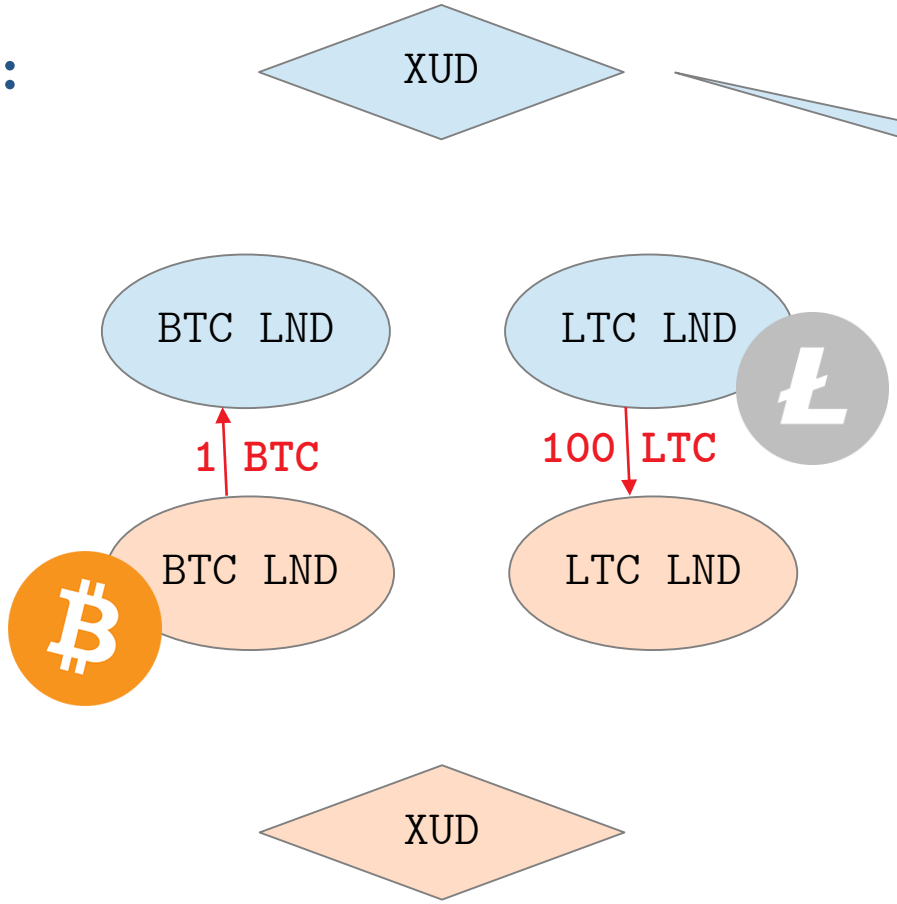

Up to timeout (min hours, up to one week)

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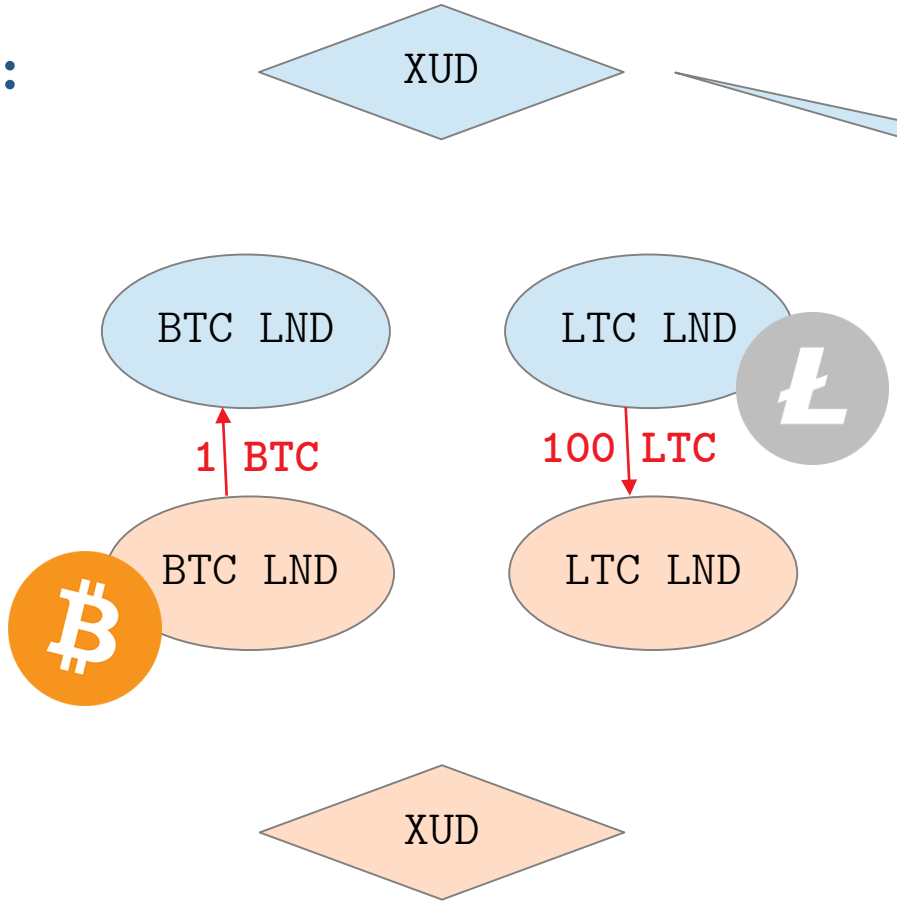
But there is a BUT

Step 5:



IF LTC vs. BTC went up
wait for timeout to get LTC back

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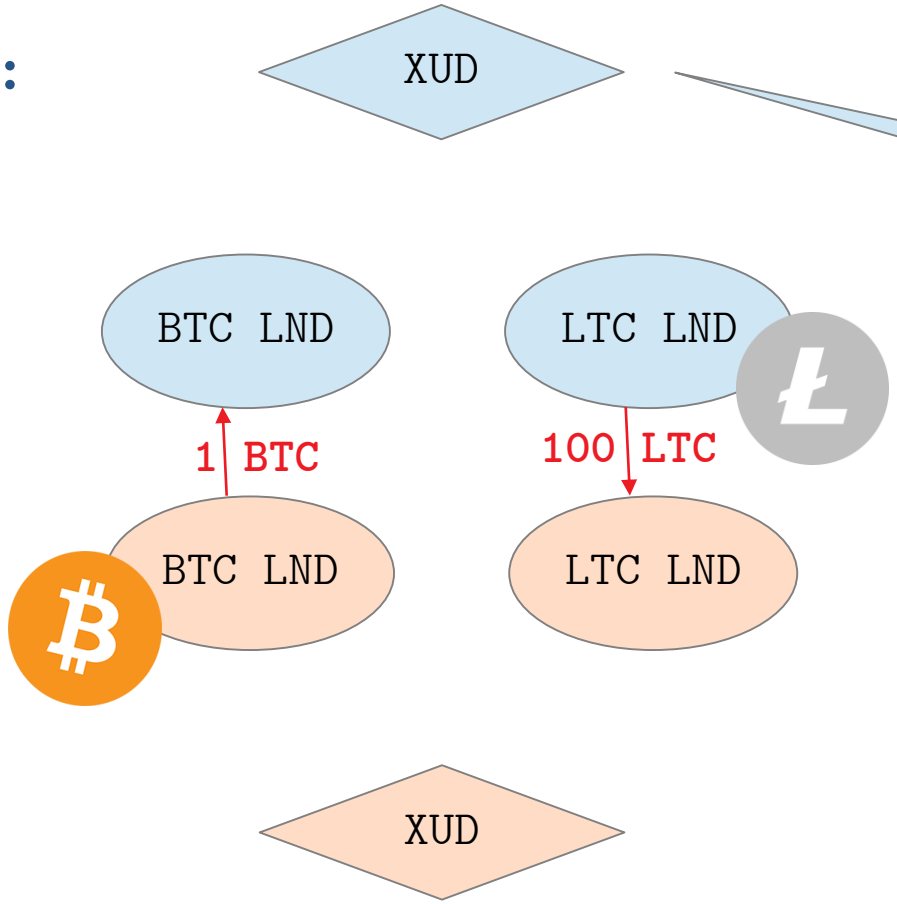
But there is a BUT

Step 5:



IF LTC vs. BTC went up
    wait for timeout to get LTC back
ELSE
    release preimage

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But there is a BUT

Option: right to execute a trade or not in the future

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But there is a BUT

Option: right to execute a trade or not in the future

The **problem**: it's for **free**

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But there is a BUT

Option: right to execute a trade or not in the future

The **problem**: it's for **free**

"Free Option Problem"

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Free Option Problem

Good news: Conceptually solved
for on-chain atomic swaps

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Free Option Problem

Good news: Conceptually solved for on-chain atomic swaps

Bad News: Still unsolved for lightning-based atomic swaps

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Free Option Problem On-Chain

Conceptually solved. How?

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Free Option Problem On-Chain

Punishment.

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Free Option Problem On-Chain

Punishment.

Both parties **A & B stake collateral** in target asset in additional HTLCs which use the **same preimage** as in atomic swap.

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Free Option Problem On-Chain

Punishment.

Both parties **A & B stake collateral** in target asset in additional HTLCs which use the **same preimage** as in atomic swap.

Both get collateral back, if preimage is released timely.

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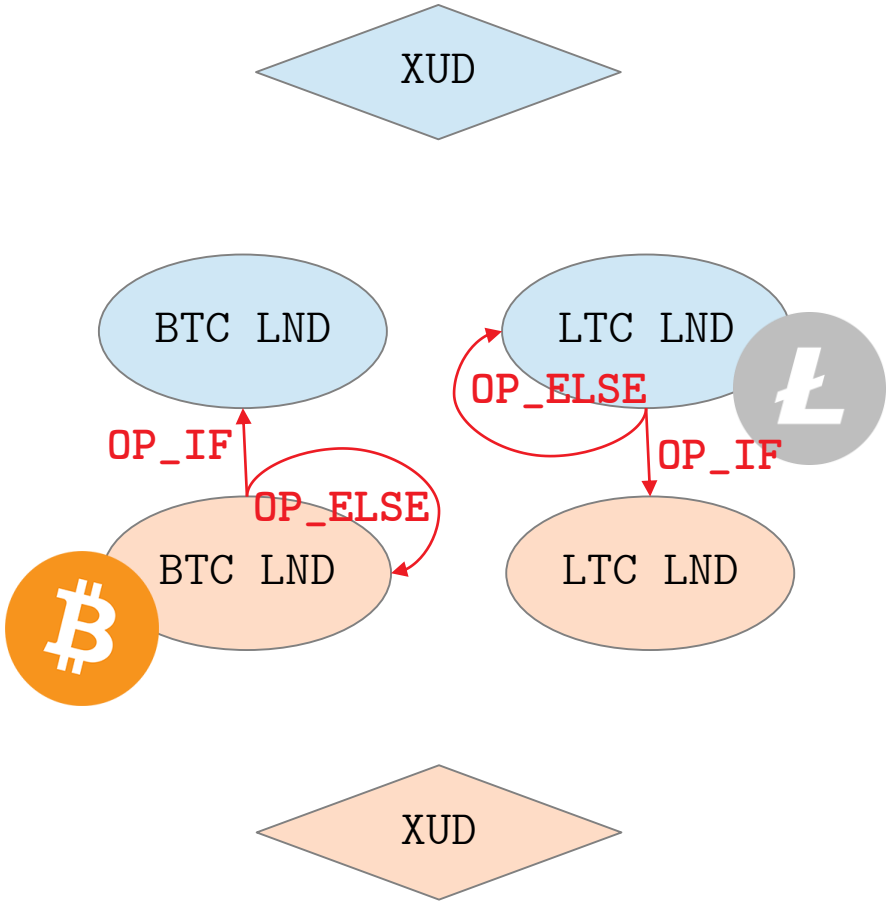
Free Option Problem On-Chain



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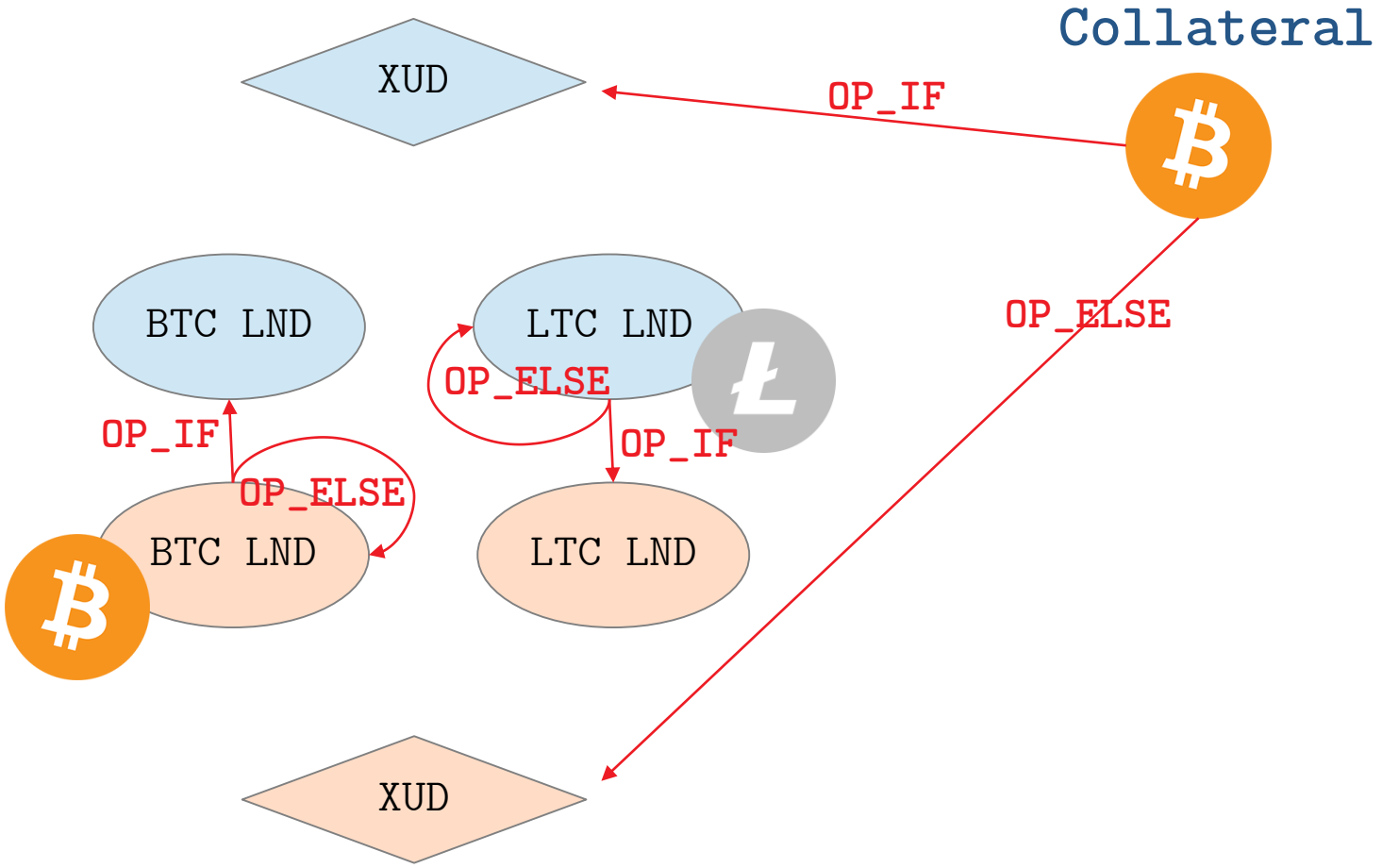
Free Option Problem On-Chain



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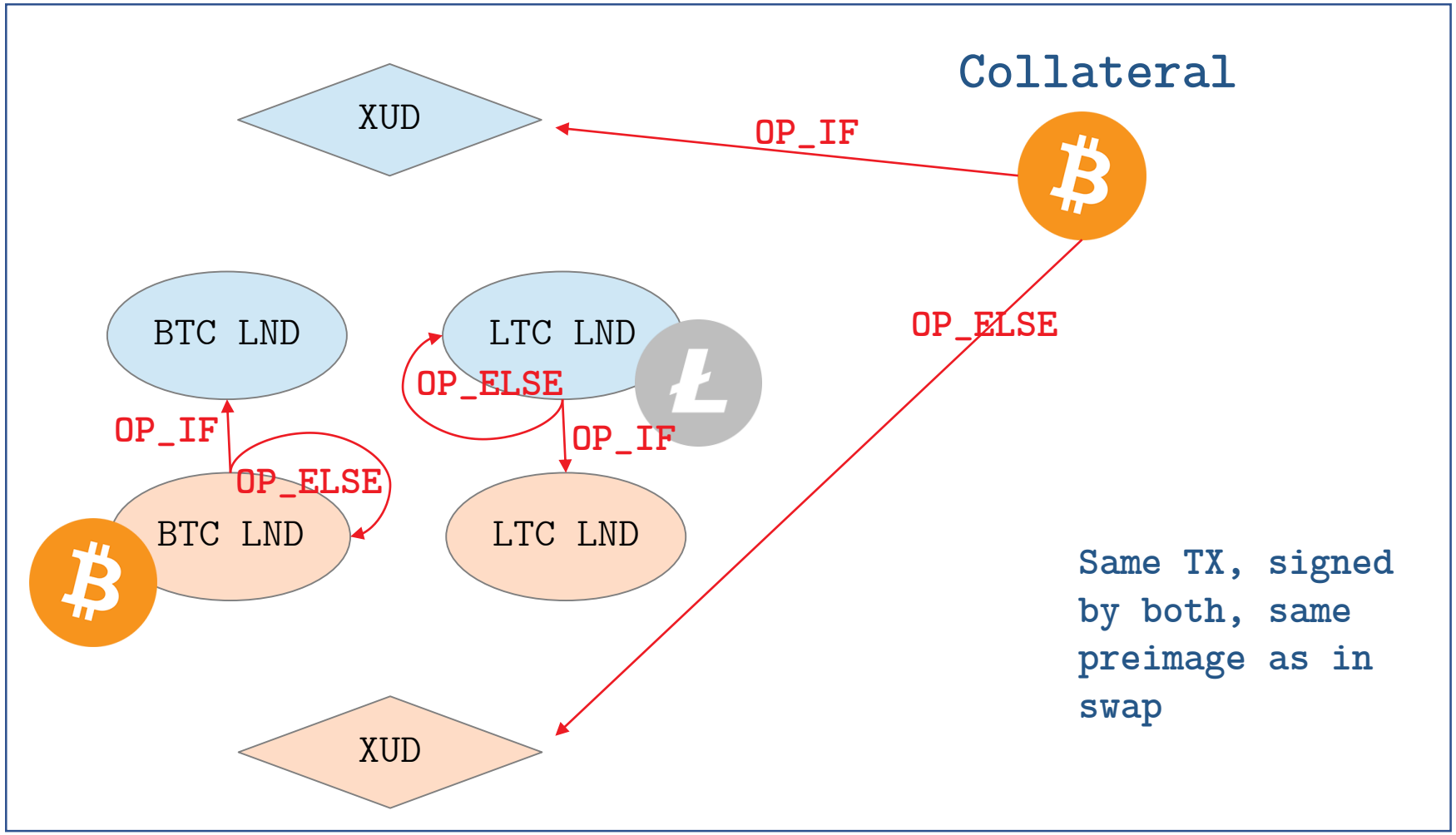
Free Option Problem On-Chain



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Free Option Problem on LN

Why not do the same on LN?

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Free Option Problem on LN

Problem:

- Uniquely attribute fault

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Free Option Problem on LN

Problem:

- Uniquely attribute fault
- Needed: effective timeout of e.g. 10 seconds.
  Not hours or days.

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Free Option Problem on LN

Problem:

- Uniquely attribute fault
- Needed: effective timeout of e.g. 10 seconds. Not hours or days.
- https://lists.linuxfoundation.org/pipermail/lightning-dev/2018-December/001752.html

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Open Research Question

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Open Research Question

Join: gitter.im/exchangeunion/FOP

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Open Research Question

Join: gitter.im/exchangeunion/FOP

Slides: github.com/exchangeunion/docs

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Open Research Question

Join: gitter.im/exchangeunion/FOP

Slides: github.com/exchangeunion/docs

THX!

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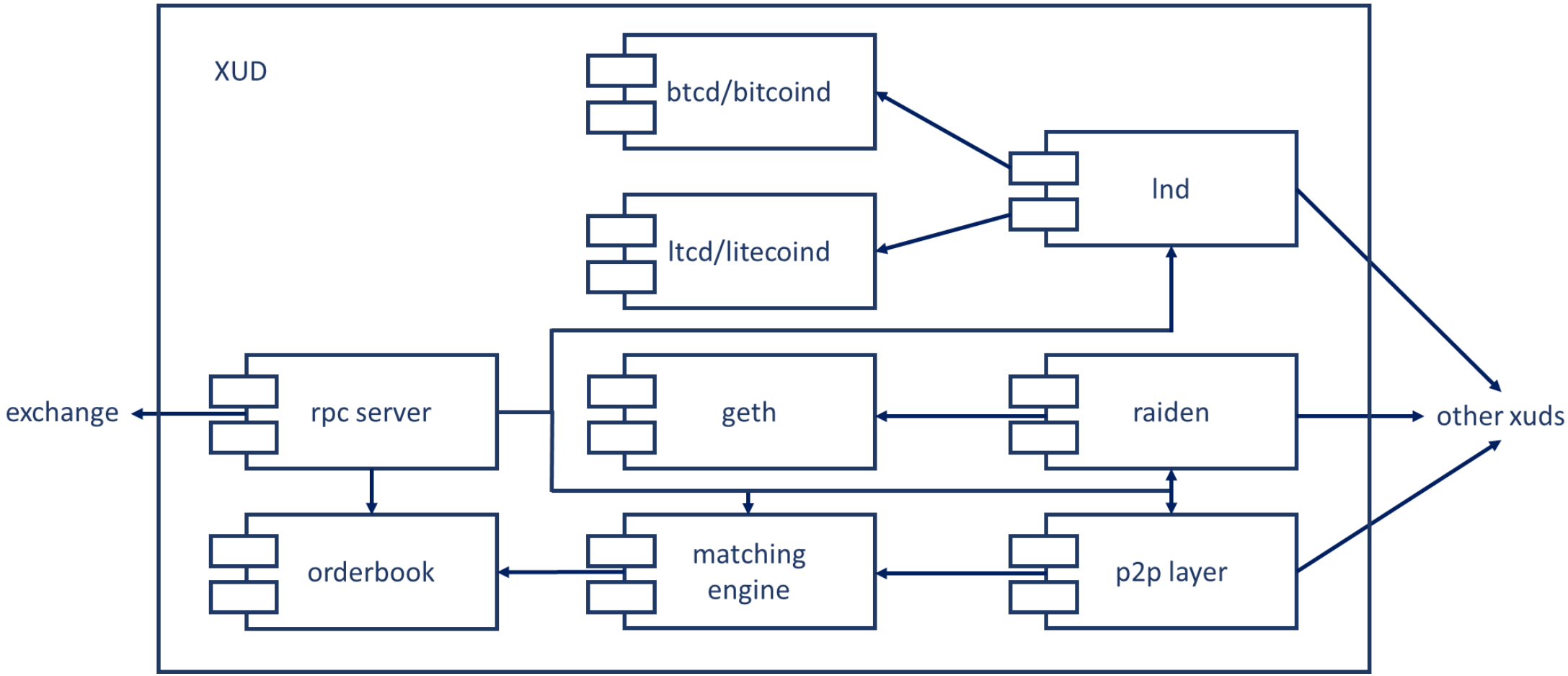
Backup

XUD, The Software



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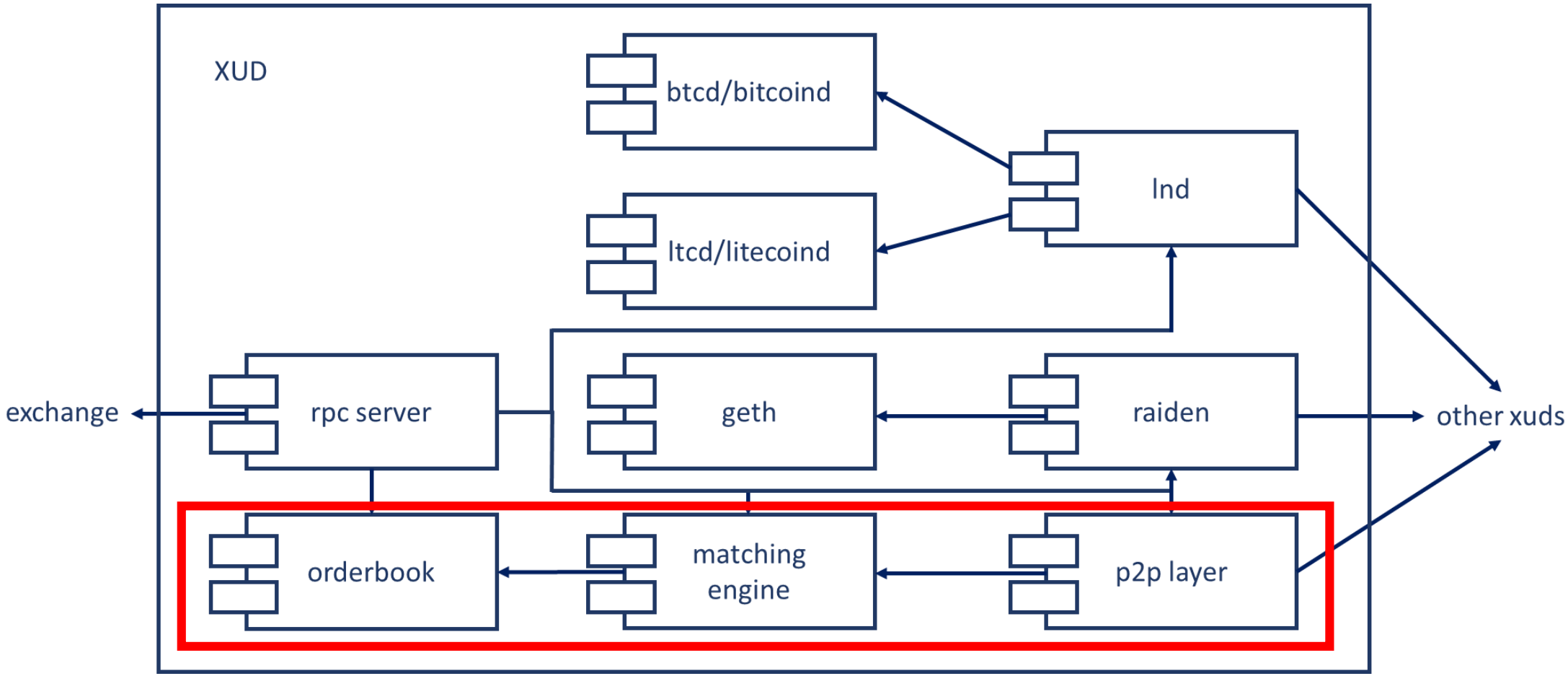
XUD, The Software



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