Meridian

Starlight

A Layer 2 Payment Channel Protocol for the Stellar Network

Leigh McCulloch
Alec Charbonneau

Welcome

MEET LEIGH

Leigh McCulloch is a Principal Software Engineer at the Stellar Development Foundation (SDF), a non-profit organization that supports the development and growth of Stellar, an open-source network that connects the world's financial infrastructure. He leads forward-looking cross-functional engineering projects for Stellar.

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Welcome

MEET ALEC

Alec is a Software Engineer on the SDF Product Engineering team. Alec has been working on products for SDF for over a year, and has contributed to projects such as Laboratory, Vibrant, and Data. Currently Alec is focused on Stellar's Starlight project.

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Agenda

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1. Why Layer 2

2. What are Payment Channels?

3. Demo a Starlight Payment Channel on Stellar

WHY LAYER 2?

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The Stellar Network

Why Configure With An Artificial Limit?

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Configured Limit

1,000
operations
per ledger

- Voted on by network validators
- Promotes financial inclusion
- Promotes decentralization
- Preserves cost predictability
- Broadens who can run the network

The Stellar Network

Current Configuration

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Configured Limit

1,000
operations
per ledger

~5-10
seconds
per ledger

The Stellar Network

Current Configuration

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Configured Limit

1,000
operations
per ledger

~5-10
seconds
per ledger

≈ 200
transactions per
second (TPS)

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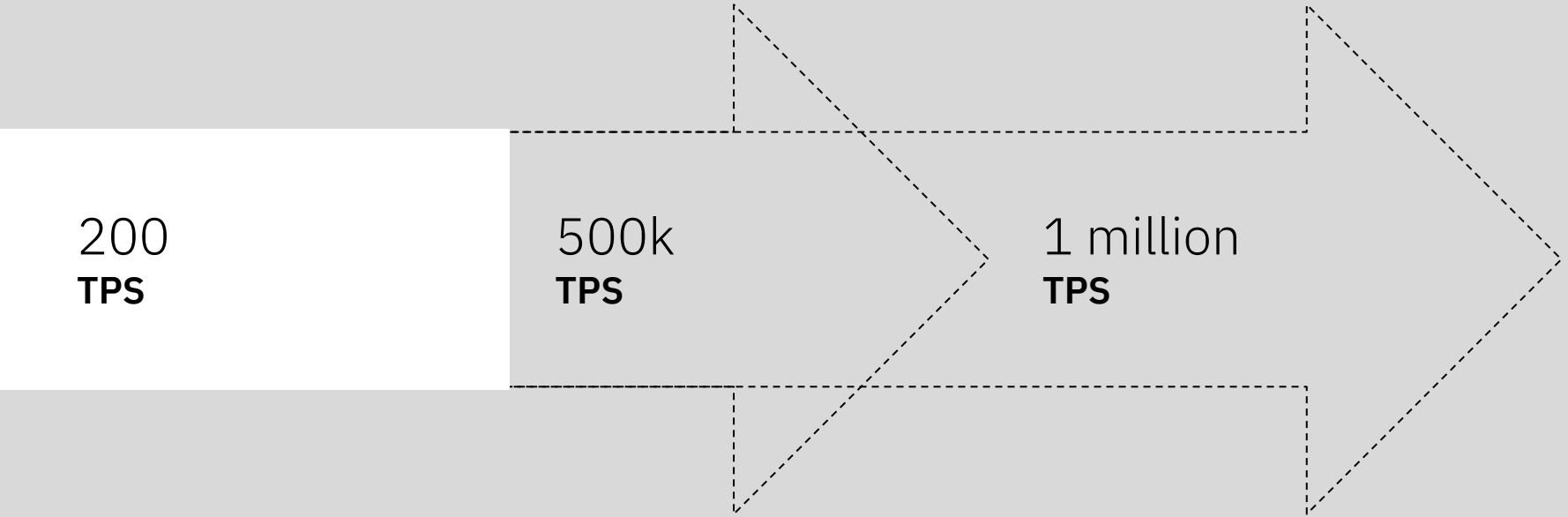

PAYMENT CHANNELS

A Layer 2 Technology

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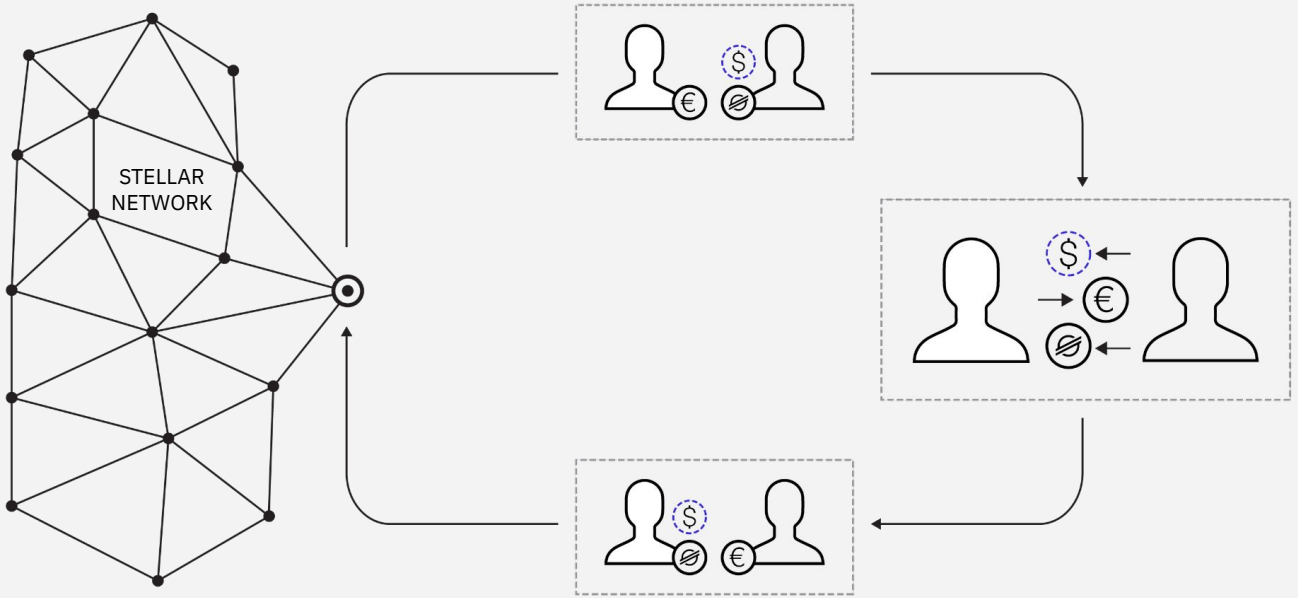
Payment Channels

Enable Fast Payments Between Two Parties



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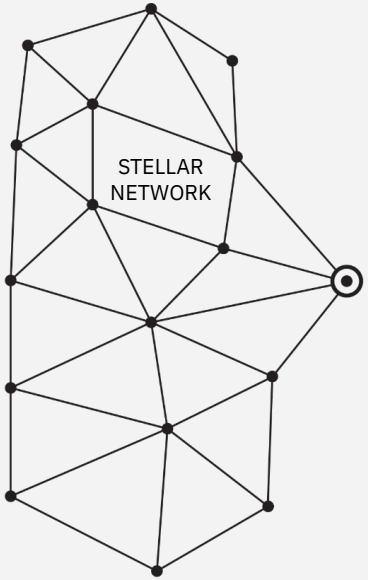
Payment Channels

Enable Fast Payments Between Two Parties



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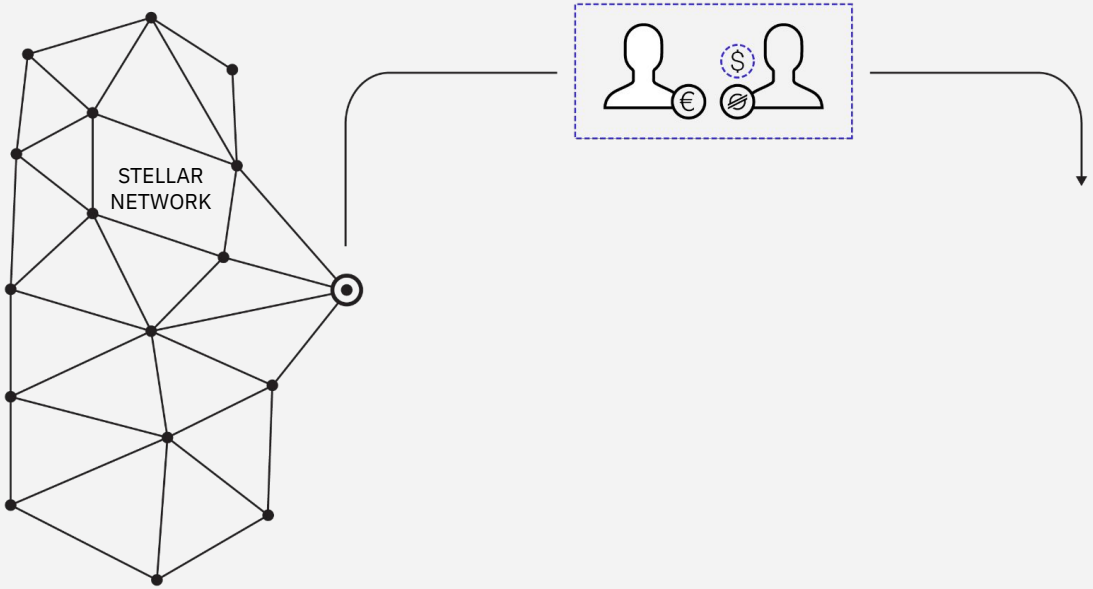
Payment Channels

Enable Fast Payments Between Two Parties



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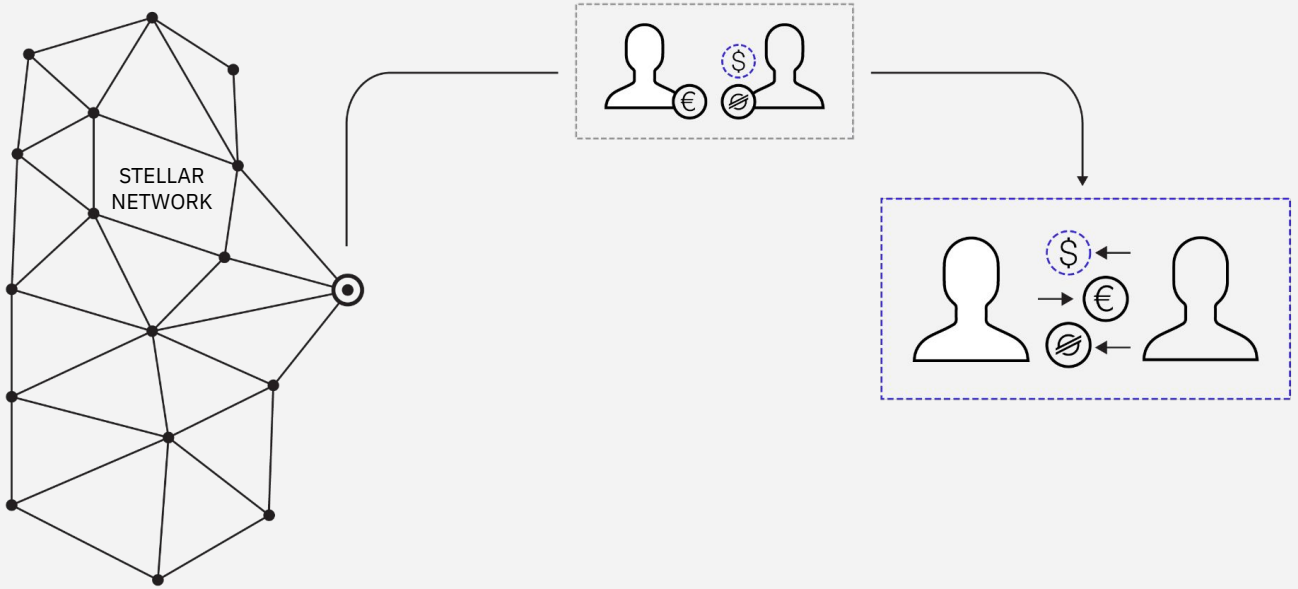
Payment Channels

Enable Fast Payments Between Two Parties



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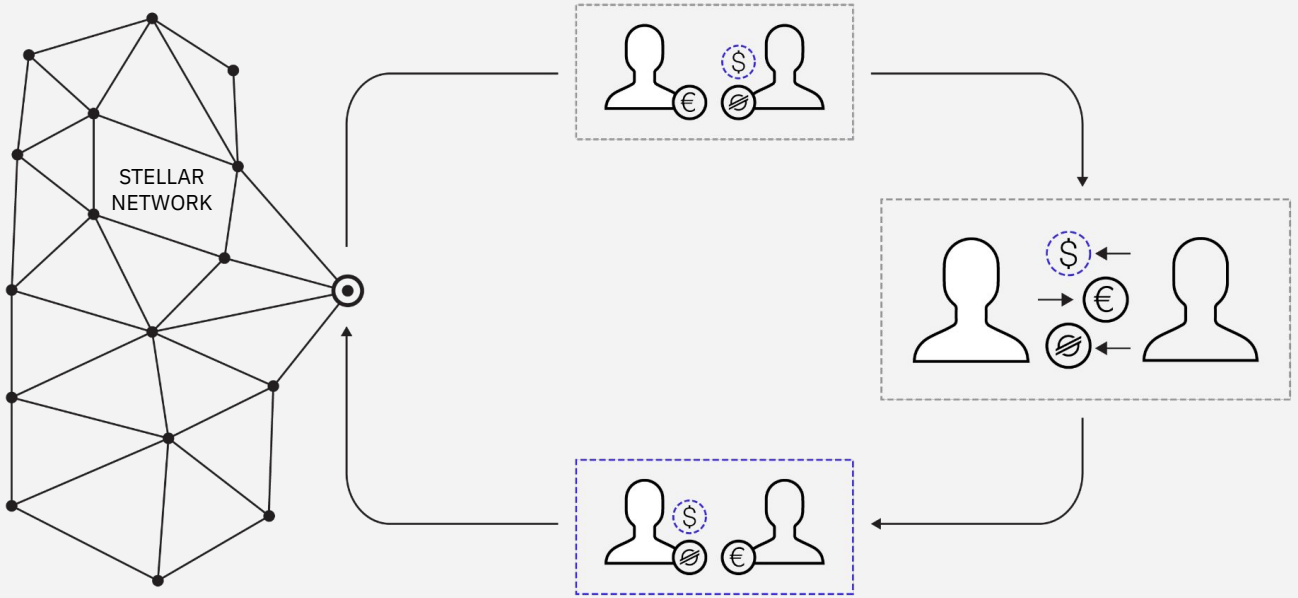
Payment Channels

Enable Fast Payments Between Two Parties



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Demo

PROTOTYPE OF A STARLIGHT PAYMENT CHANNEL

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OPENING A PAYMENT CHANNEL

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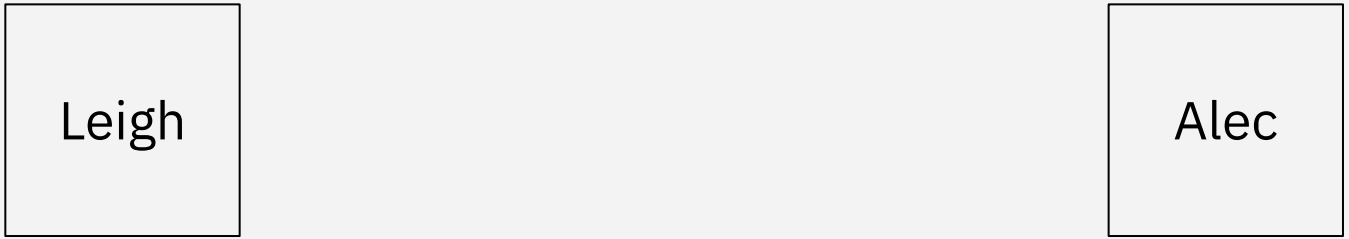
Opening a Payment Channel

Involves Signing Three Transactions



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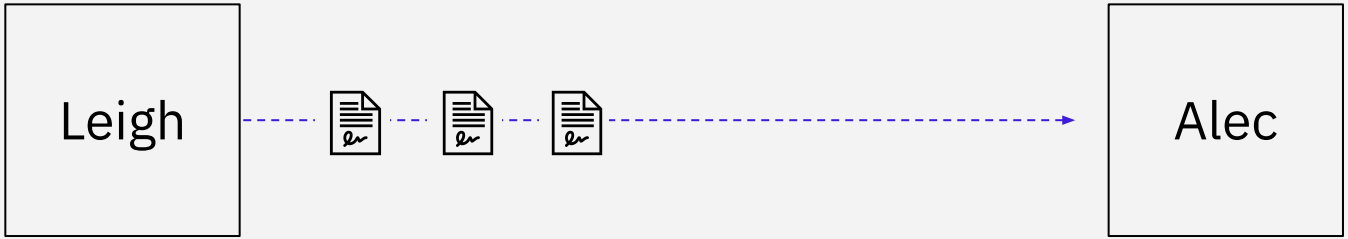
Opening a Payment Channel

Both Parties Sign Each Transaction to Authorize the Agreement



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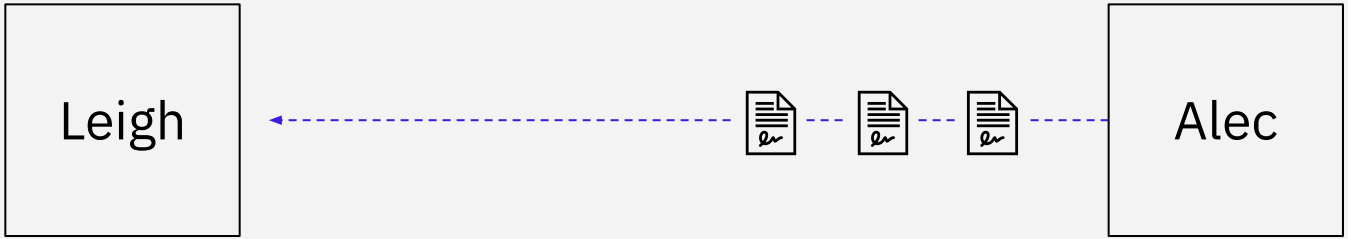
Opening a Payment Channel

Both Parties Sign Each Transaction to Authorize the Agreement



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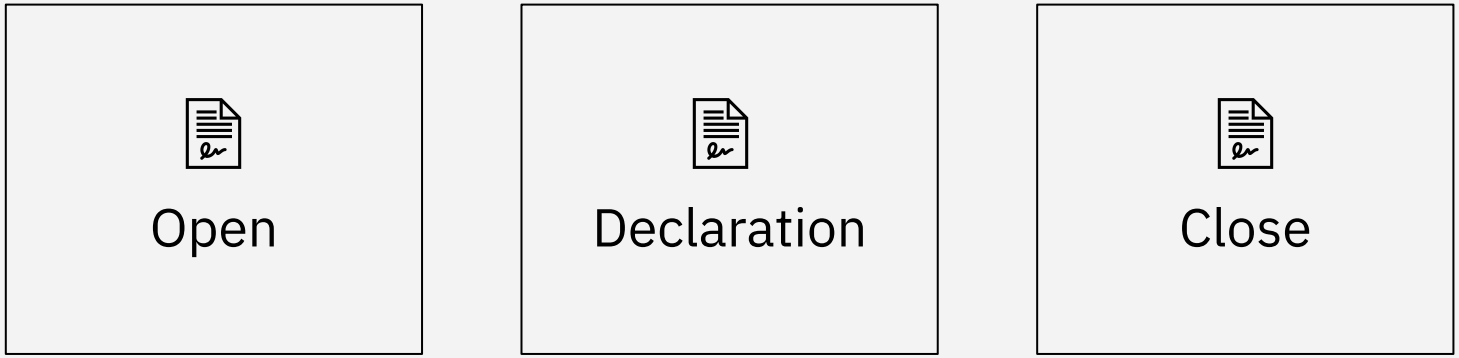
Opening a Payment Channel

Defining the Three Transactions



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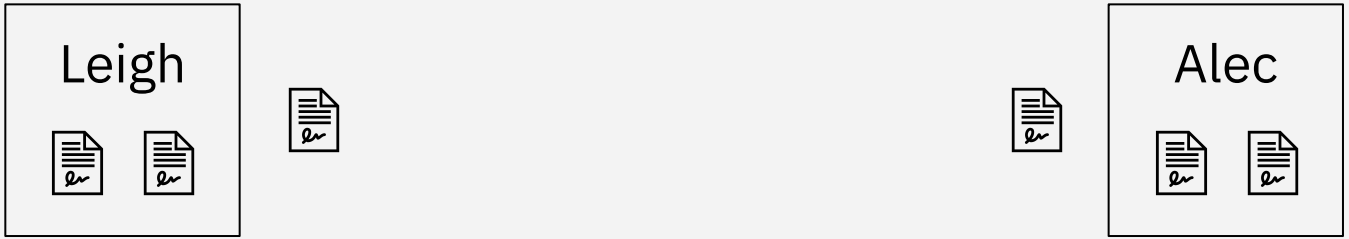
Opening a Payment Channel

Submit Open Transaction to the Network



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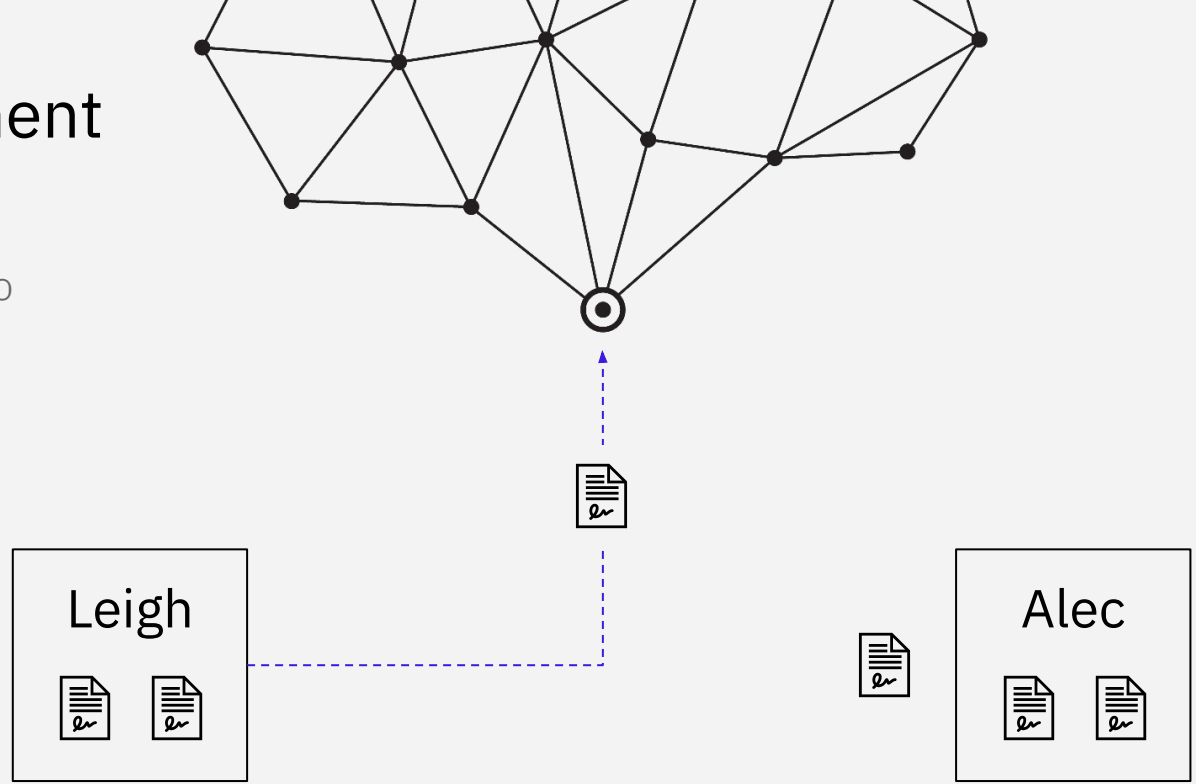
Opening a Payment Channel

Submit Open Transaction to the Network



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MAKING A PAYMENT

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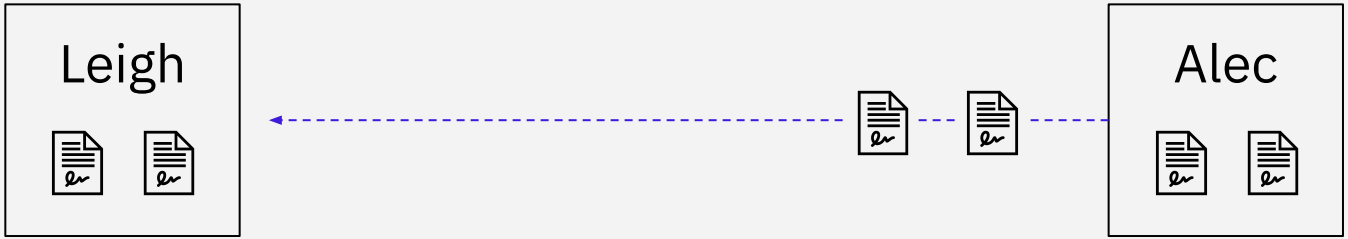
Making a Payment

Proposes a New Close Agreement



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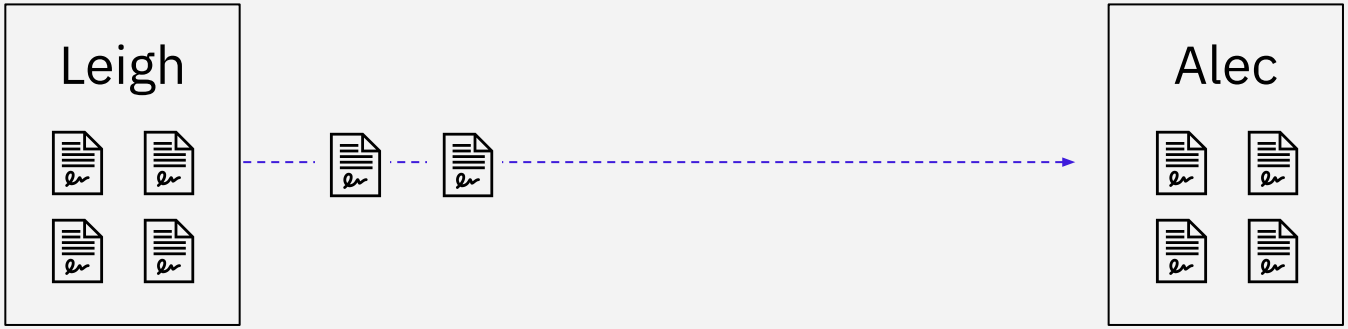
Making a Payment

Confirms the New Agreement



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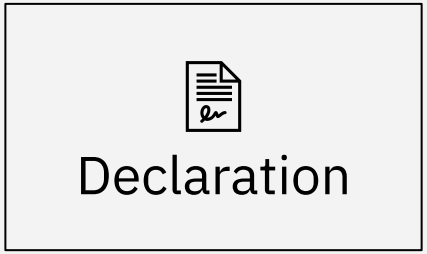
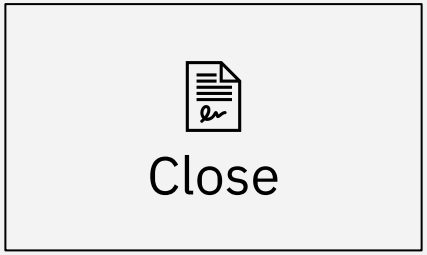
Making a Payment

A Close Agreement Is Two Transactions





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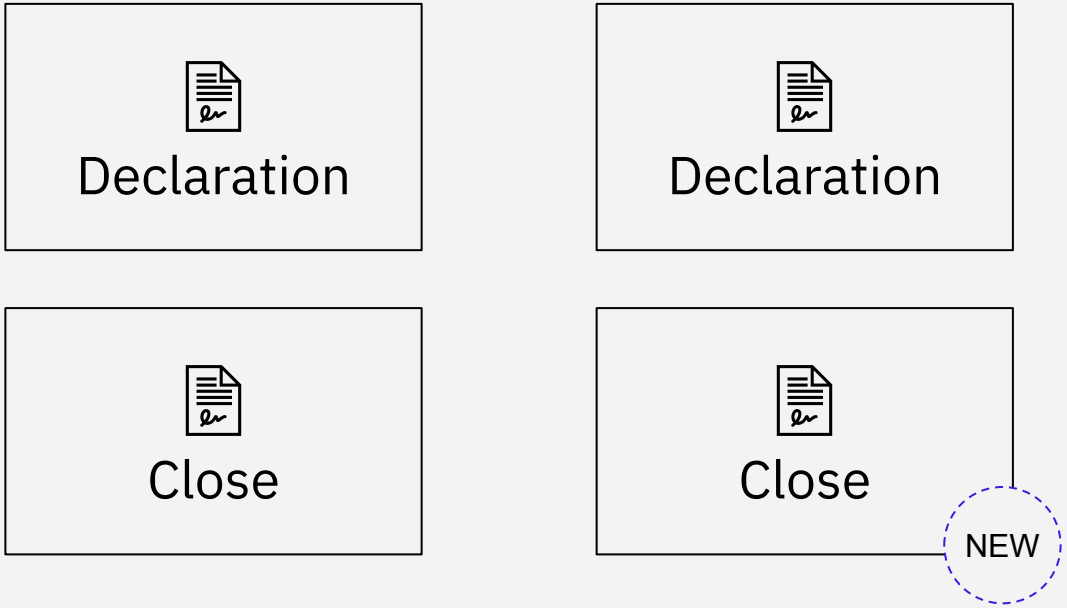
Making a Payment

A Close Agreement Is Two Transactions



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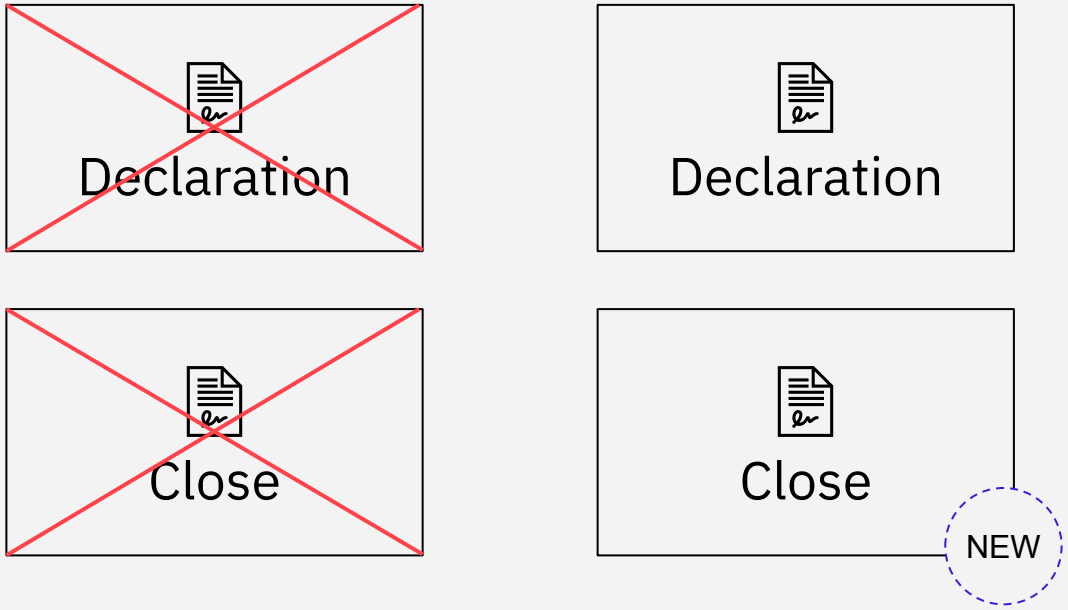
Making a Payment

A Close Agreement Is Two Transactions



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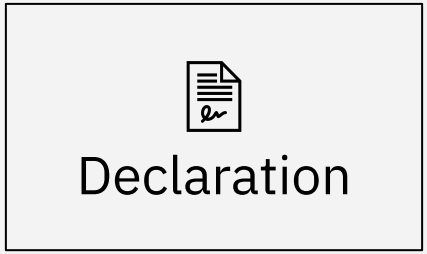
The Declaration Transaction

Understanding the Role of the Declaration



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The Declaration Transaction

Using and Extending Sequence Numbers

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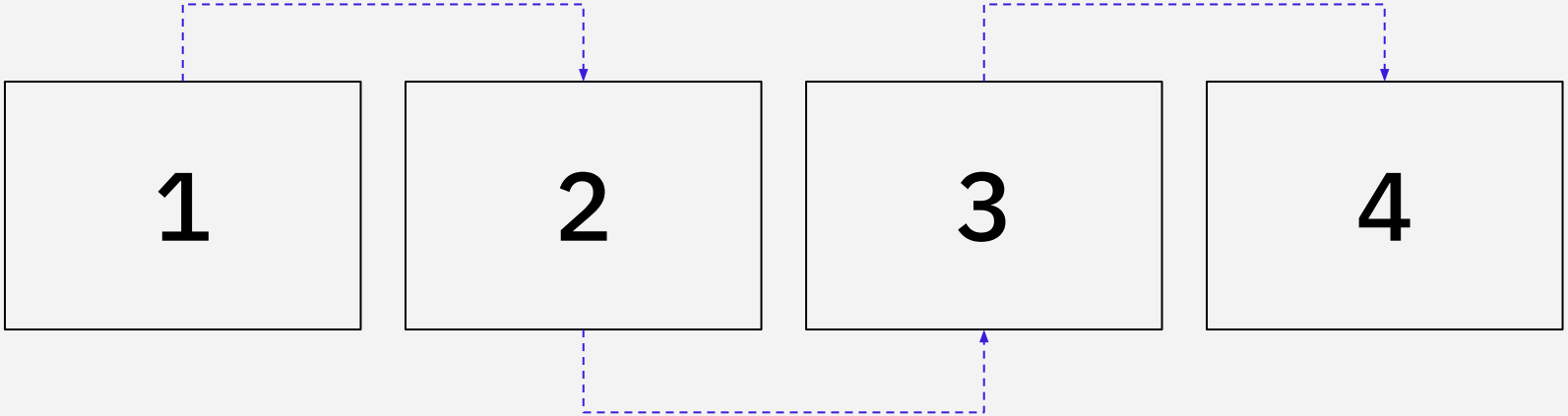
Sequence Numbers

- Feature of the Stellar Network today
- Provides an order for how transactions must be executed on the network
- Stored in transactions
- Increases by one for every transaction
- Extension proposed in CAP-21

Sequence Numbers

Traditional Sequence Numbers Require a Series of Transactions to Execute in Order



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Sequence Numbers

CAP-21 Allows for Sequence Numbers to Be Skipped

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Sequence Numbers

Opening a Payment Channel Created Three Transactions

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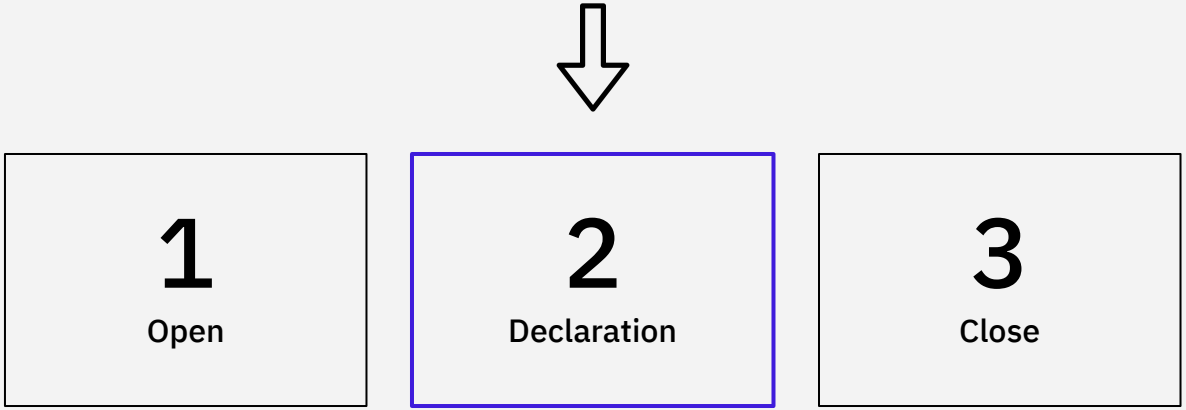
Sequence Numbers

Opening a Payment Channel Created Three Transactions



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Sequence Numbers

Opening a Payment Channel Created Three Transactions

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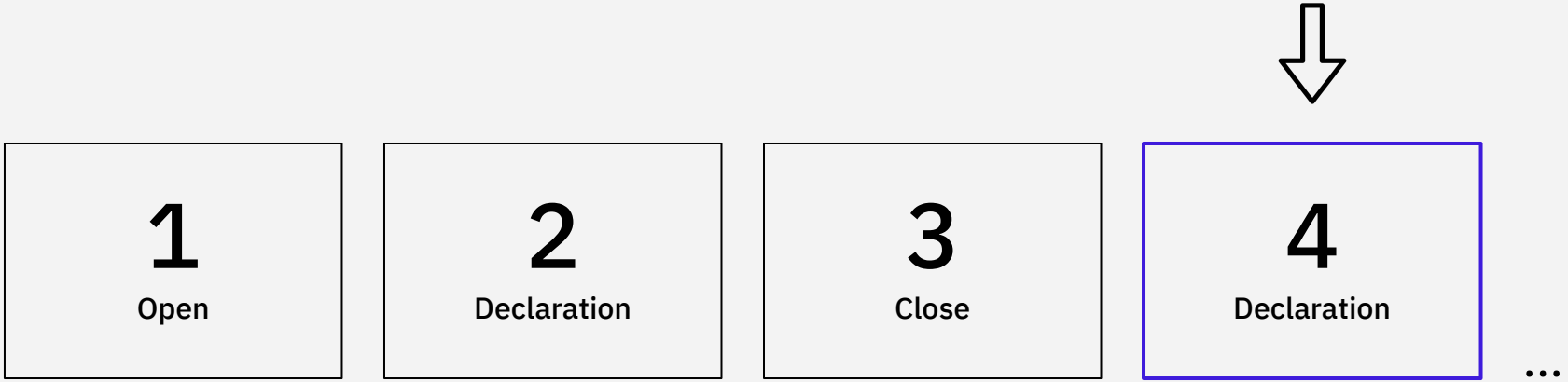
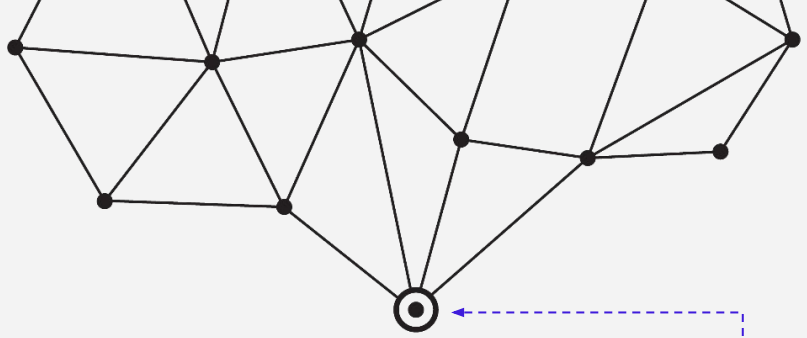
Sequence Numbers

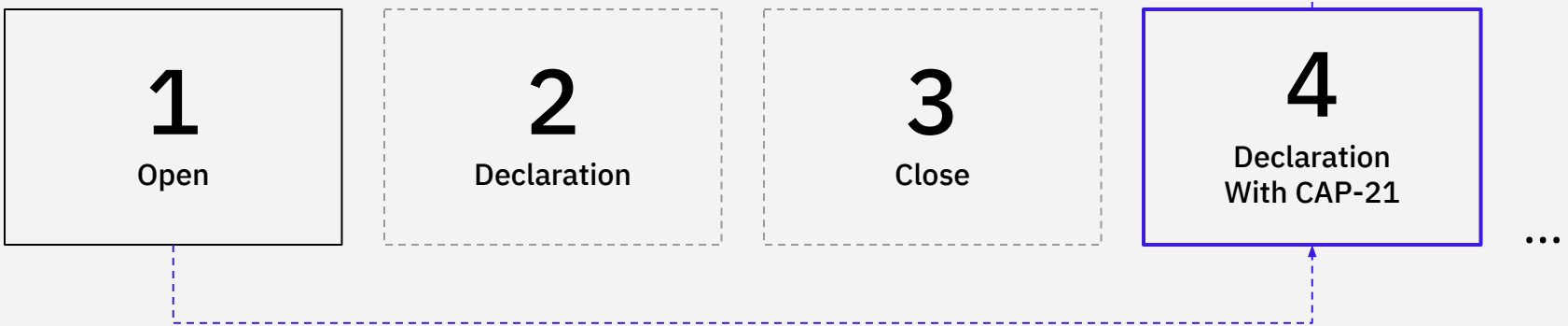
Making a Payment Creates a New Declaration and Close



Sequence Numbers

CAP-21 Permits the Close Process to Skip Ahead to the Most Recent Declaration





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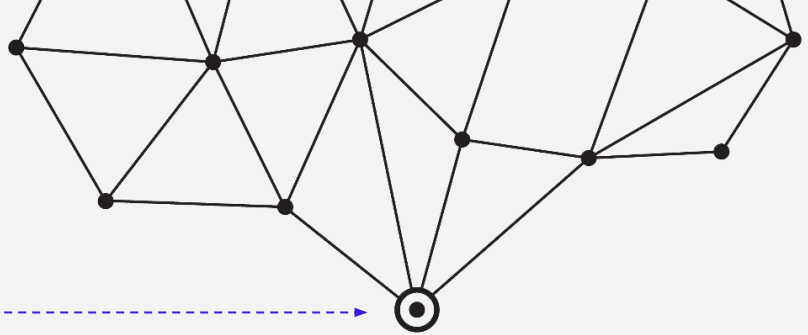
Sequence Numbers

CAP-21 Allows Participants to Dispute Fraudulent Behavior



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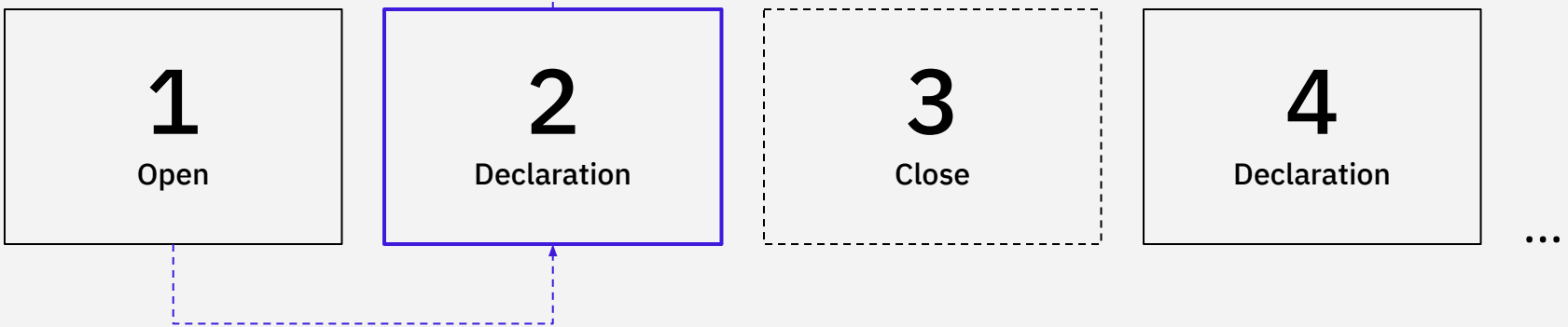
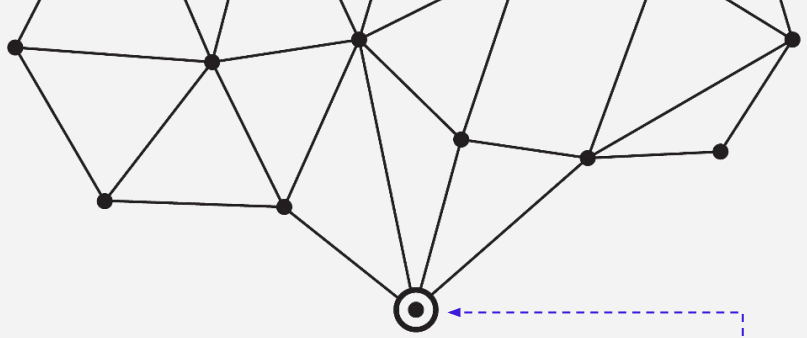
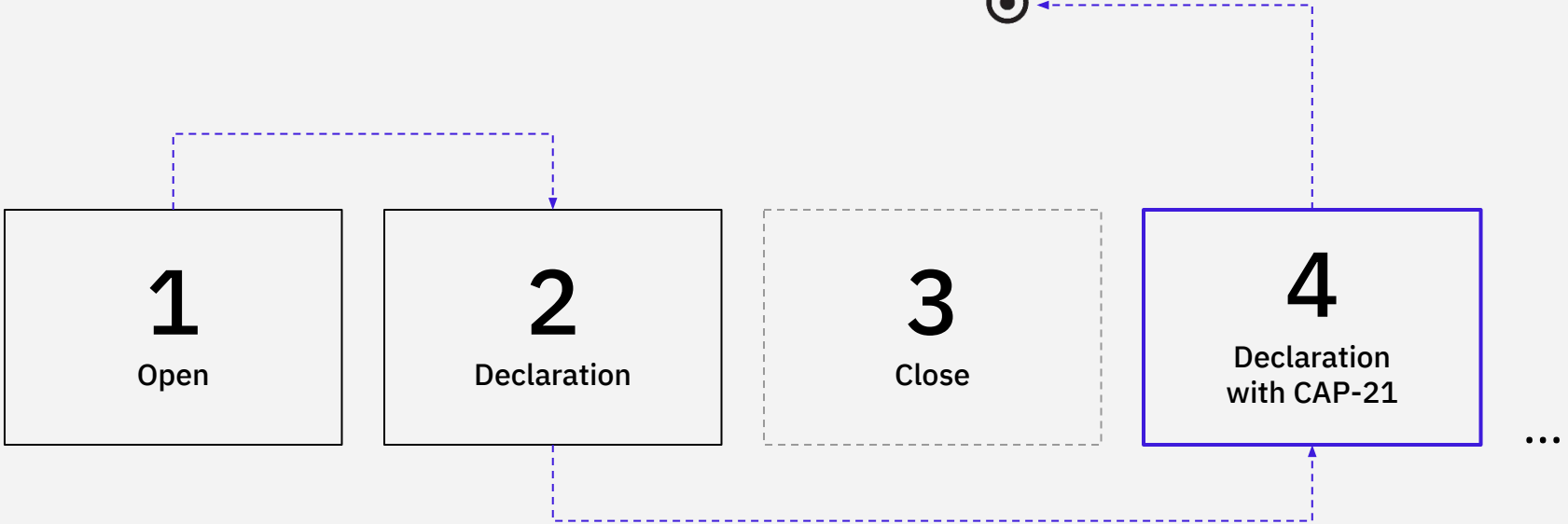


Sequence Numbers

CAP-21 Allows Participants to Dispute Fraudulent Behavior





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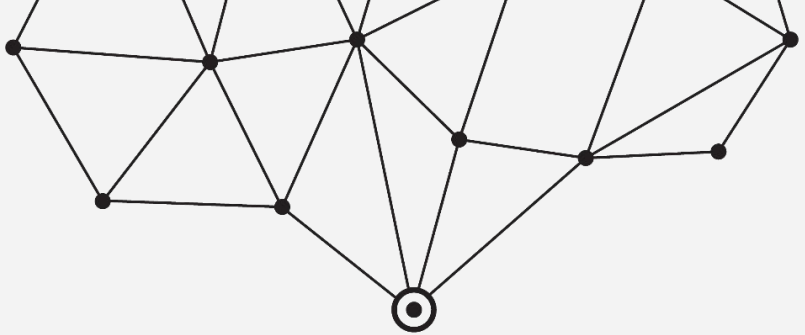
Sequence Numbers

Cap-21 Makes Channels Lightweight



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~~1~~
~~Open~~

~~2~~
~~Declaration~~

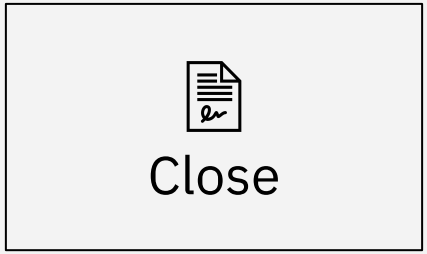
~~3~~
~~Close~~

4
Declaration
with CAP-21

...

The Close Transaction

Understanding the Role of the Close



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The Close Transaction

Contains a few operations

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Operations

- Payment – Distributes the net-settlement
- 2x Set Options – Modifies the signers of the accounts

The Close Transaction

Introducing a Transaction Time Delay

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Relative Time Lock

- New capability proposed in CAP-21
- Introduces a configurable delay between two transactions
- Delay is relative to when first transaction executes

Relative Time Lock

How It Works

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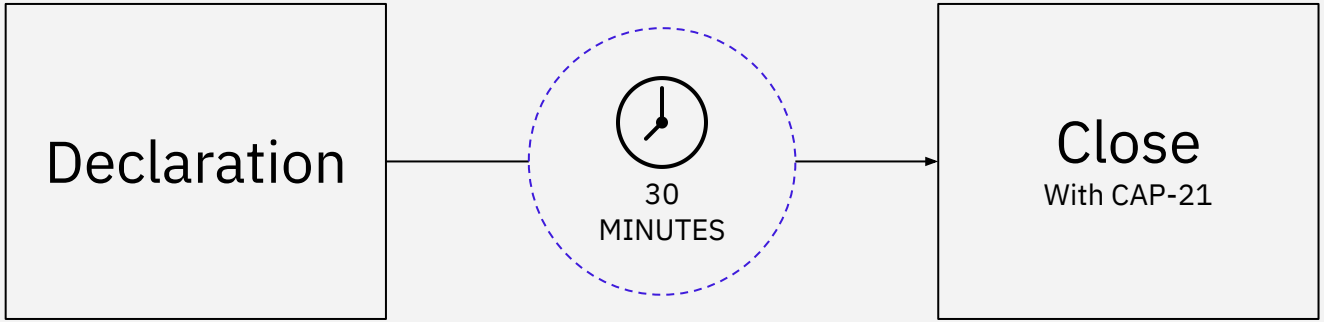
Relative Time Lock

How It Works



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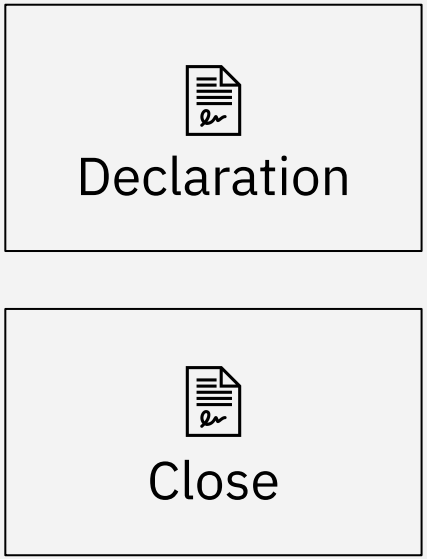
Making a Payment

A Close Agreement Is Two Transactions



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Atomic Signature Disclosure

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A capability in CAP-40 to safely share signatures for multiple transactions in a single message.

Atomic Signature Disclosure

The Problem This Solves

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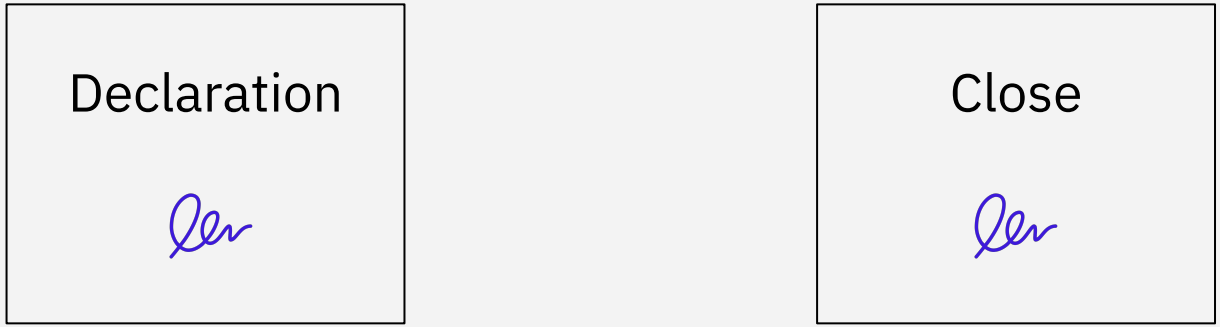
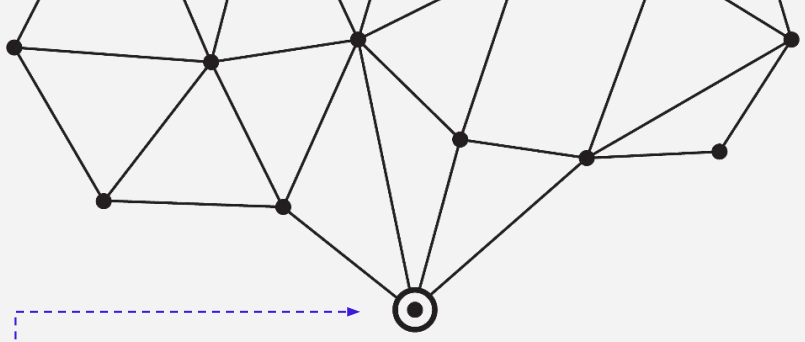
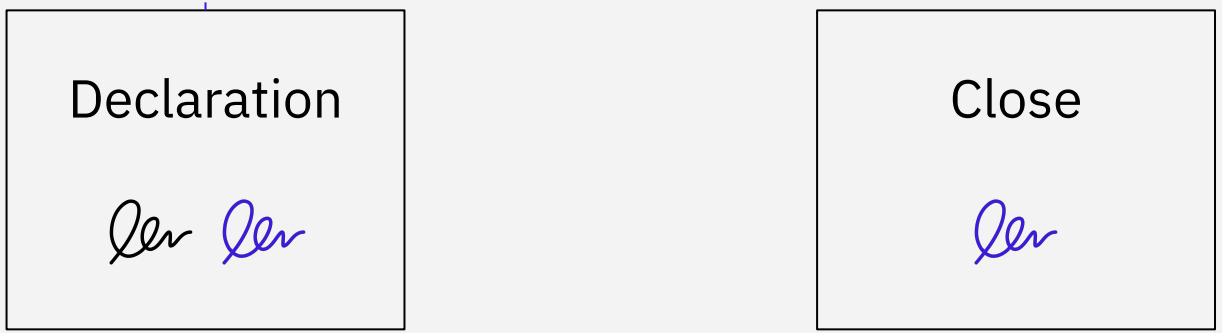


Atomic Signature Disclosure

The Problem This Solves





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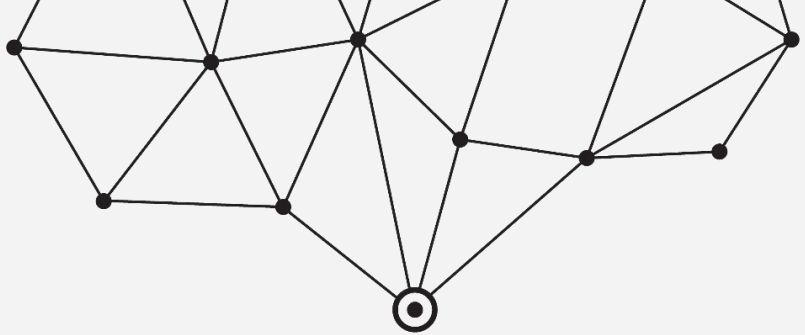
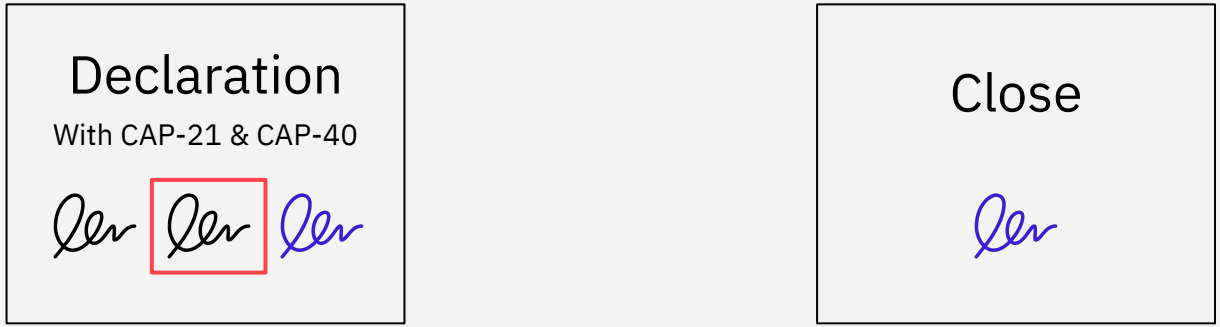
Atomic Signature Disclosure



The Solution: CAP-40 and CAP-21 Require the Signature of the Close Within the Declaration



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Atomic Signature Disclosure

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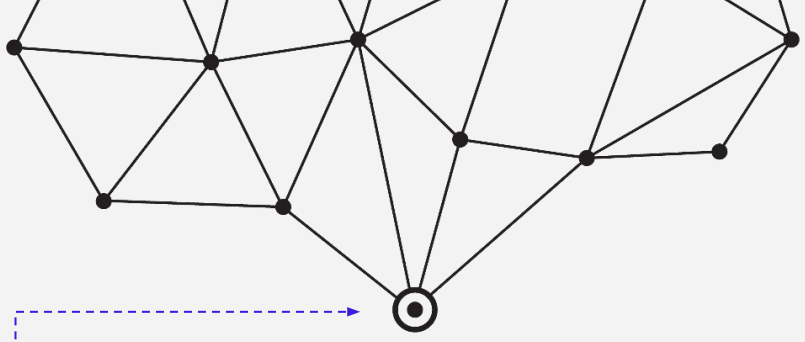

Declaration

With CAP-21 & CAP-40

Close

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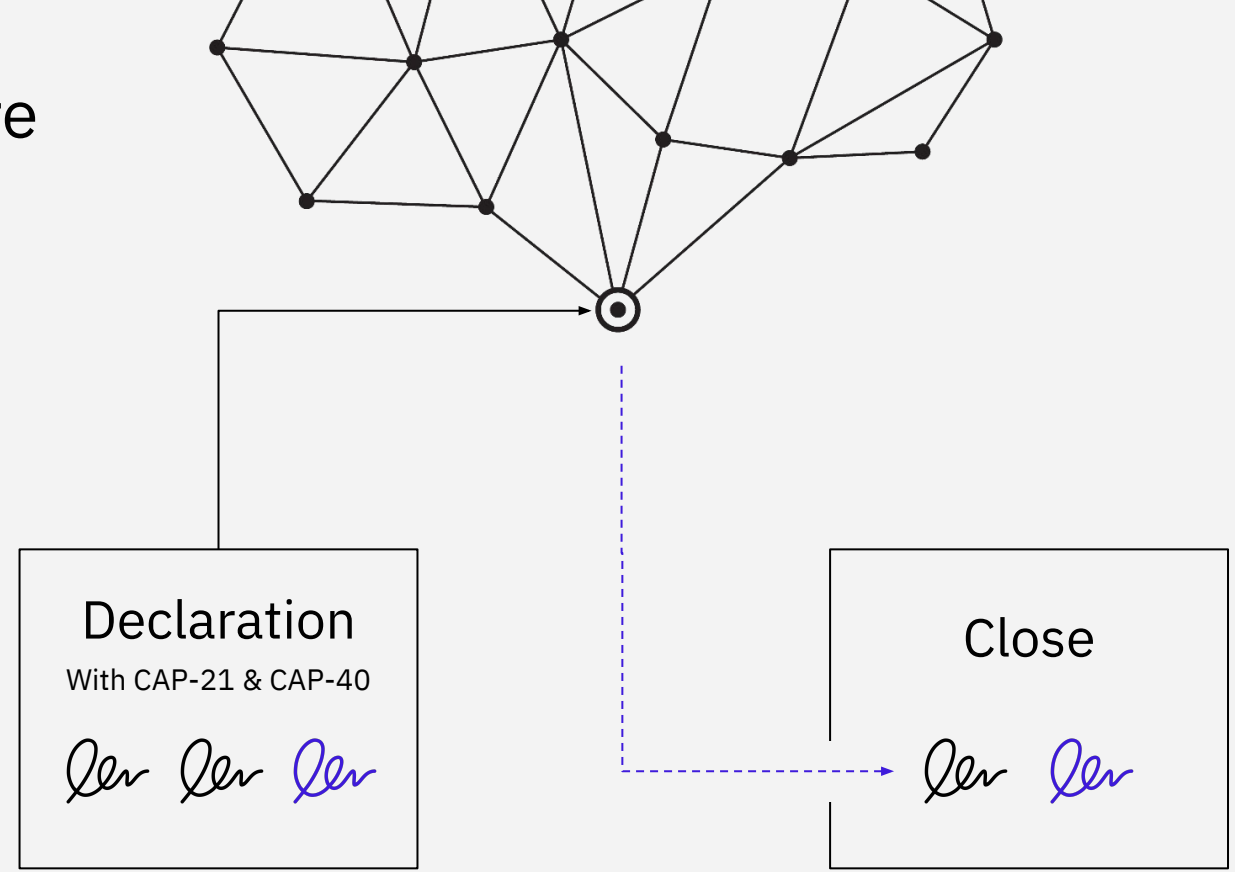
Atomic Signature Disclosure

The Solution: CAP-40 and CAP-21 Require the Signature of the Close Within the Declaration



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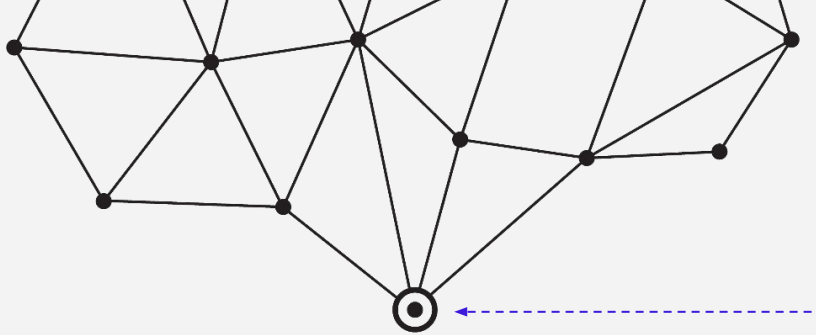
Atomic Signature Disclosure

Allowing the Other Participant to Copy the Embedded Signature and Submit the Close



Declaration

With CAP-21 & CAP-40

Close

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Adding Hash Signers Directly to Transactions

Another CAP-21 Capability: Stateless HTLCs

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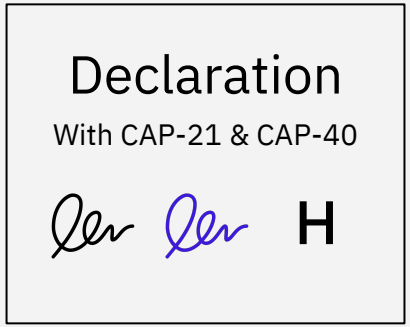
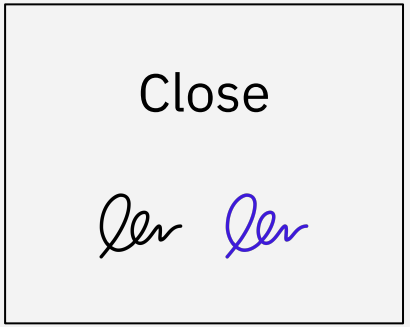
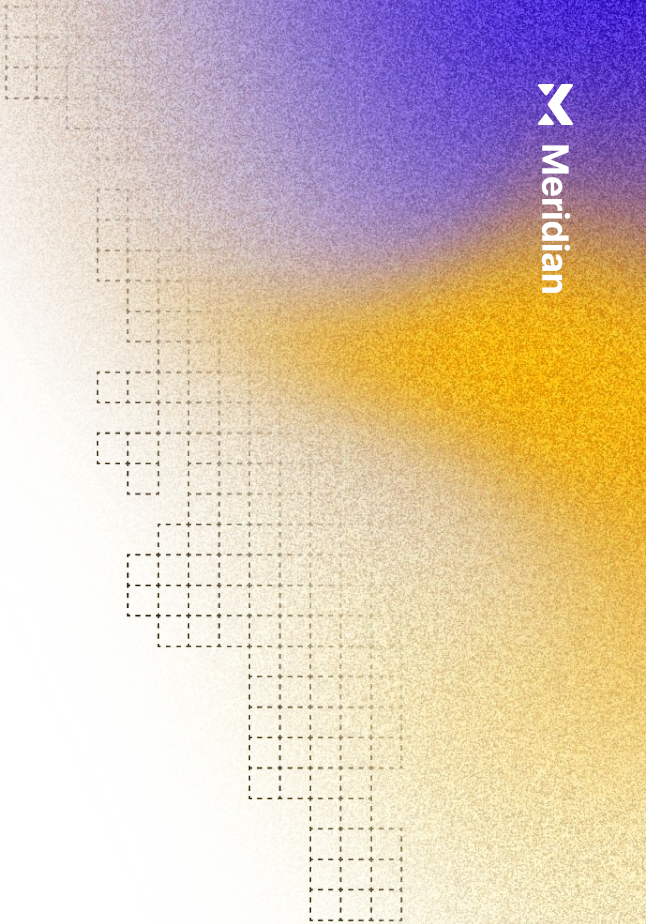




BUFFERING PAYMENTS



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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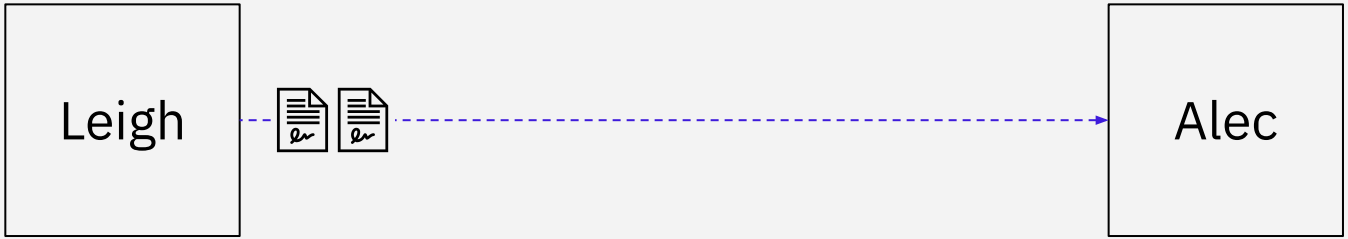
Buffer = 0 payments



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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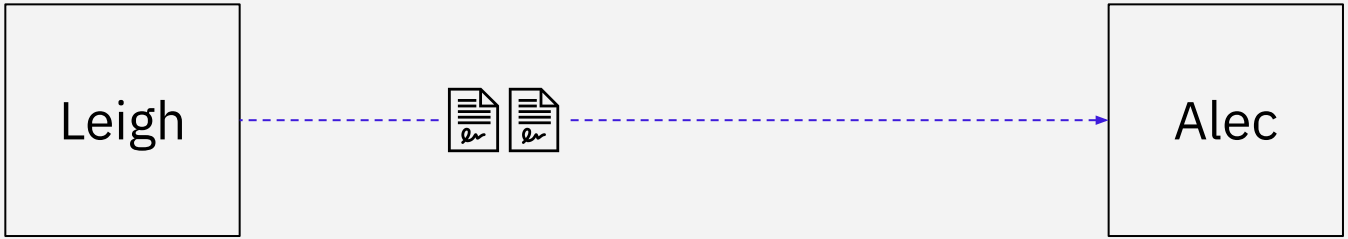
Buffer = 23 payments



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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Buffer = 63 payments

Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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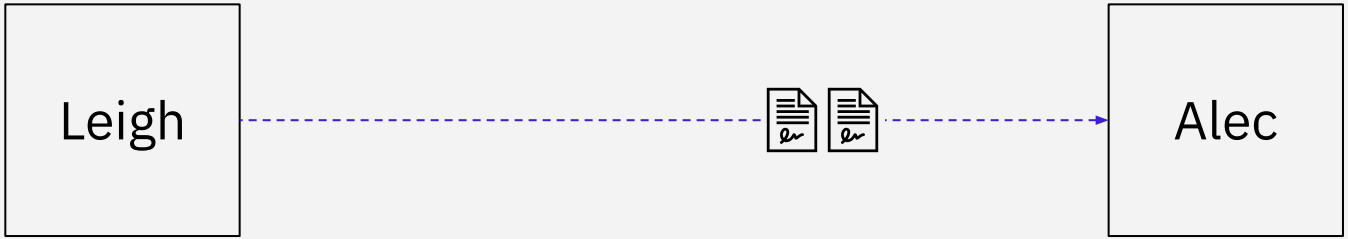
Buffer = 407 payments



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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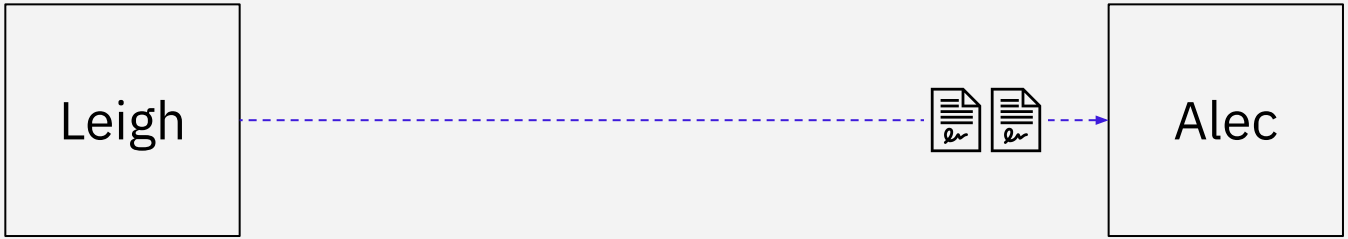
Buffer = 614 payments



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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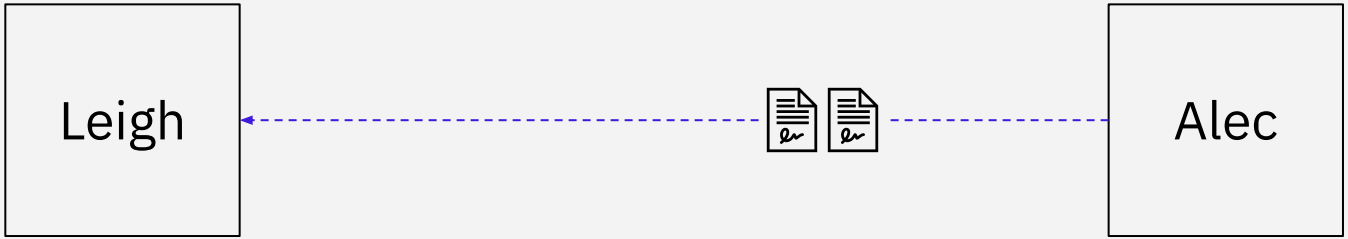
Buffer = 768 payments



Buffering Payments

Collect Payments While an Agreement Is Being Authorized

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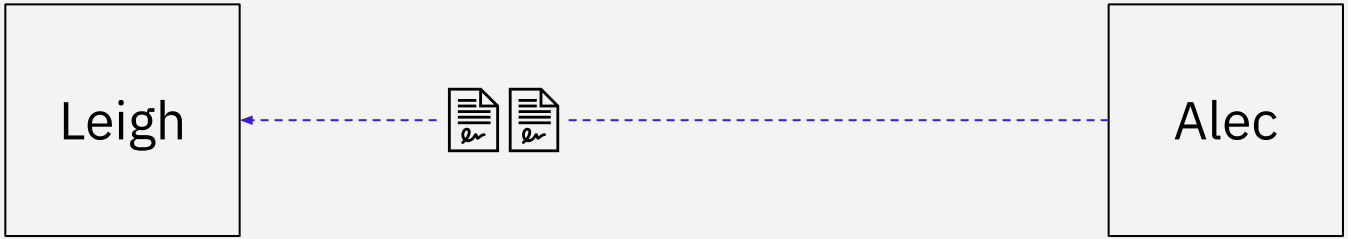
Buffer = 1092 payments

Buffering Payments

Collect Payments While an Agreement Is Being Authorized

Meridian

Buffer = 1250 payments

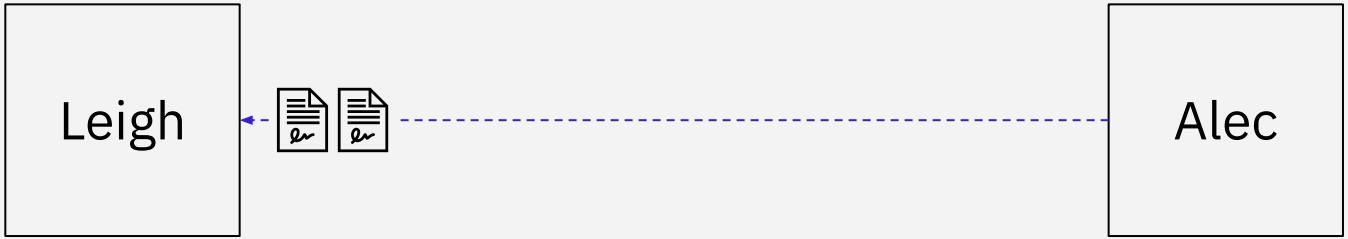


Buffering Payments

Collect Payments While an Agreement Is Being Authorized

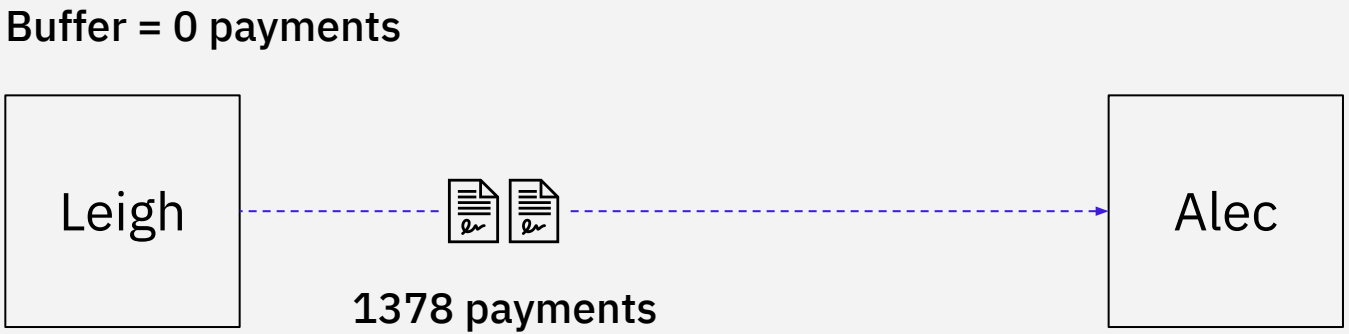
Meridian

Buffer = 1378 payments



Buffering Payments

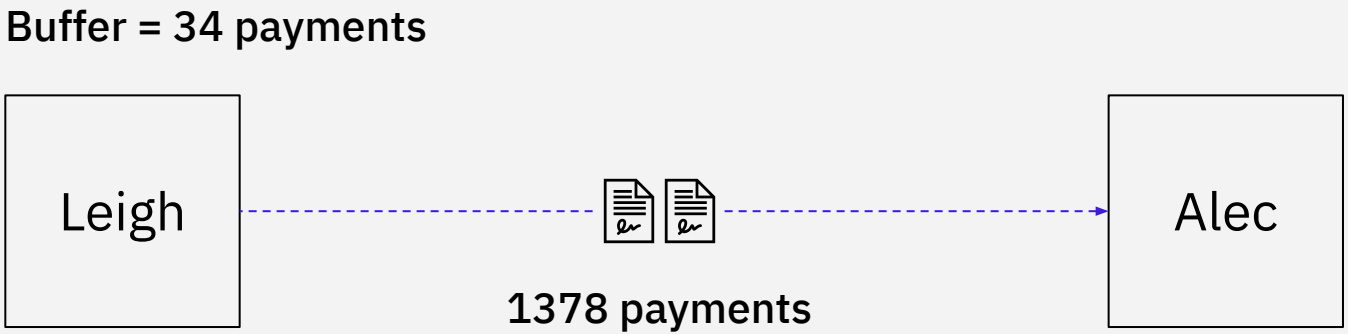
Propose a New Agreement With the Payments Previously Buffered



Buffering Payments

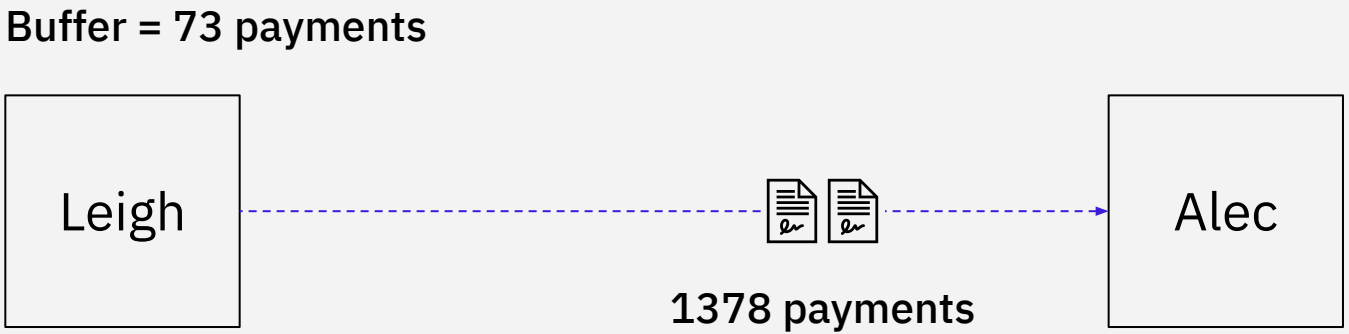
Propose a New Agreement With the Payments Previously Buffered

Meridian



Buffering Payments

Each Subsequent Agreement Will Contain All
Payments Buffered During the 30 Millisecond Wait

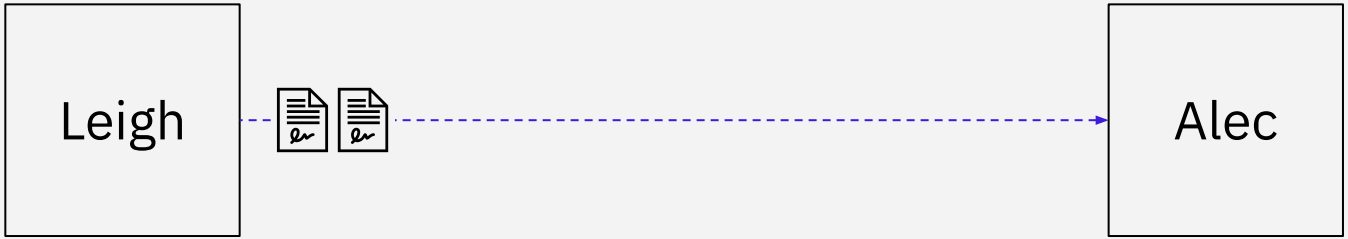


CLOSING THE PAYMENT CHANNEL

Meridian

Closing the Payment Channel

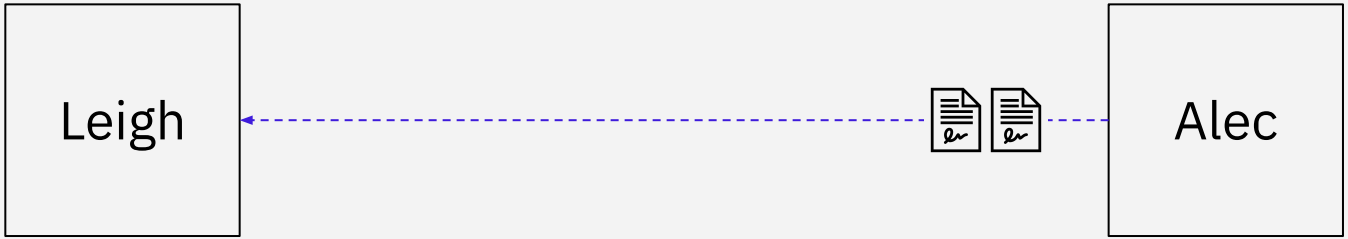
Both Parties Sign to Authorize the Agreement



Meridian

Closing the Payment Channel

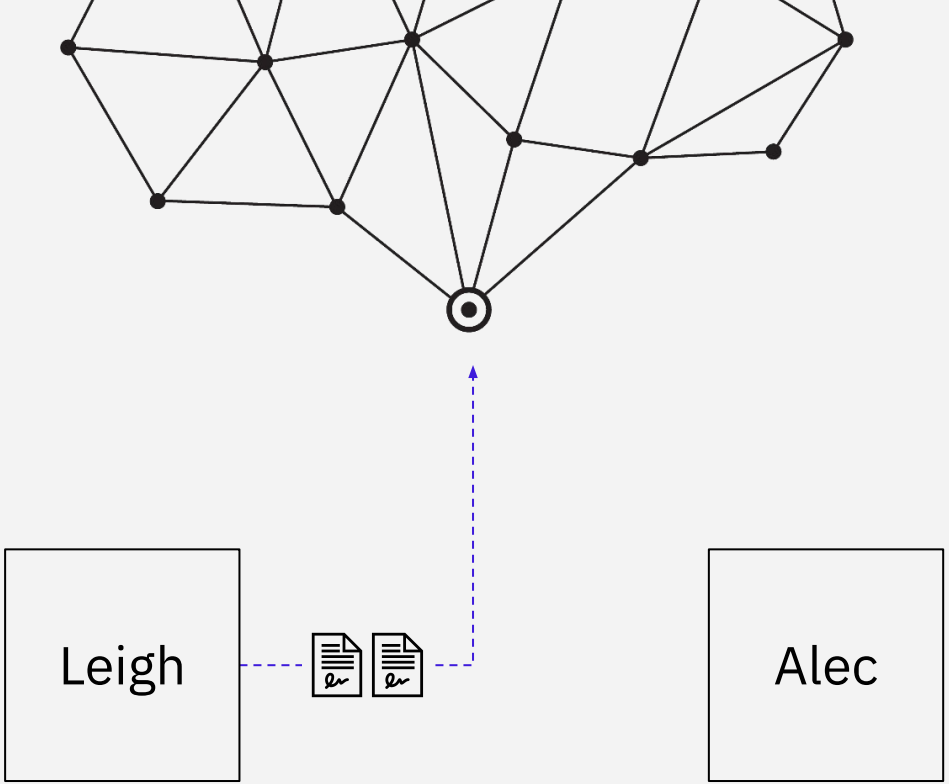
Both Parties Sign to Authorize the Agreement



Meridian

Closing the Payment Channel

Submit to the Network



Meridian

Starlight Demo

A Summary

Meridian

1

We Opened and Closed a Channel

- Performed millions of payments
- Closed the channel quickly because the Stellar network is fast

2

We Did It Efficiently

- Stored only the most recent agreement leveraging CAP-21
- Used single message in either direction to exchange signatures using CAP-40

3

We Can Recover

- Able to dispute fraudulent behavior using CAP-21
- Able to recover signatures not shared using CAP-40

WHAT’S NEXT?

Meridian

Check Out Starlight

Public and Open Source

Meridian

Open Source

github.com/stellar/starlight

- Docker image runs a network with prototypes of CAP-21 and CAP-40
- Starlight Go SDK
- Example code

THANK YOU

github.com/stellar/starlight

Meridian