Mojaloop TigerBeetle Integration

PI-18 OSS Community Meeting

26 April 2022

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Agenda

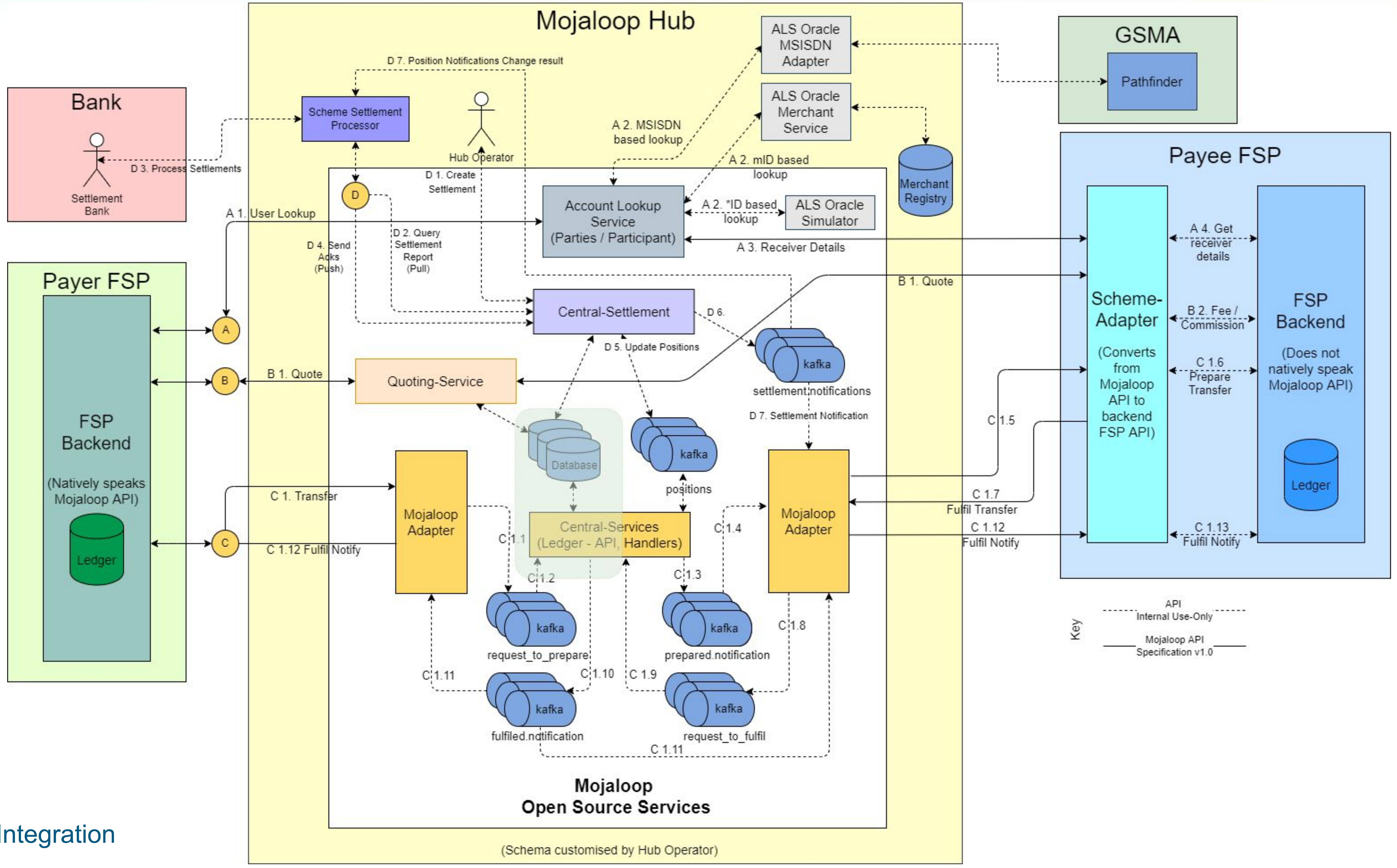
1. Progress Update
2. Hub Architecture
3. Solution Design
4. Components
5. Interaction
6. Data Migration

Progress Update

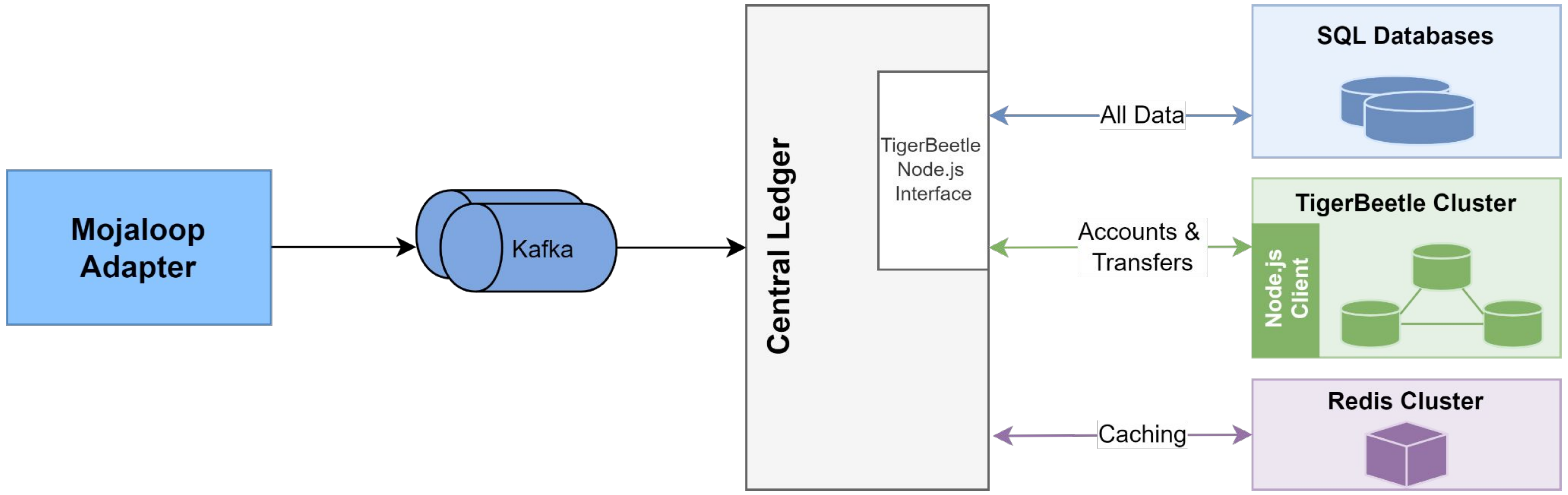
Key objectives	● Implement & test integration into Central-Ledger. ● Complete the design documentation.

Progress	**Documentation** ● Chart of Accounts for use-case subset [draft ready] ● Solution Design Document [80%] **Development** ● Implement & test the NodeJS Interface [75%] ● Integrate & test NodeJS client [75%] ● Finalise performance test suite [95%]

Hub Architecture - Example



Solution Design



Components

TigerBeetle Clients

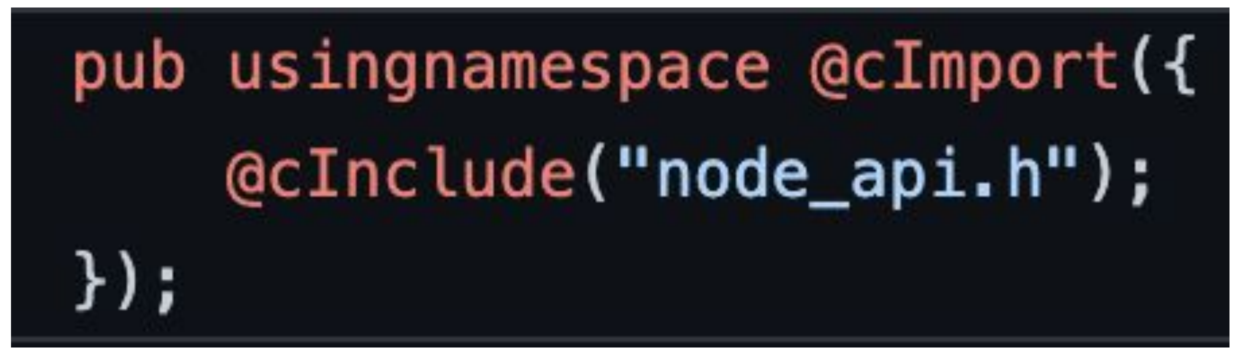
- Native client (`Zig`)
- C used to integrate language platform mappings
- Clients in NodeJS & Golang

TigerBeetle NodeJS Interface

- Configuration file (`default.json`)
- Data Mapping
- Protocol Translation
- Orchestrating interactions with TigerBeetle

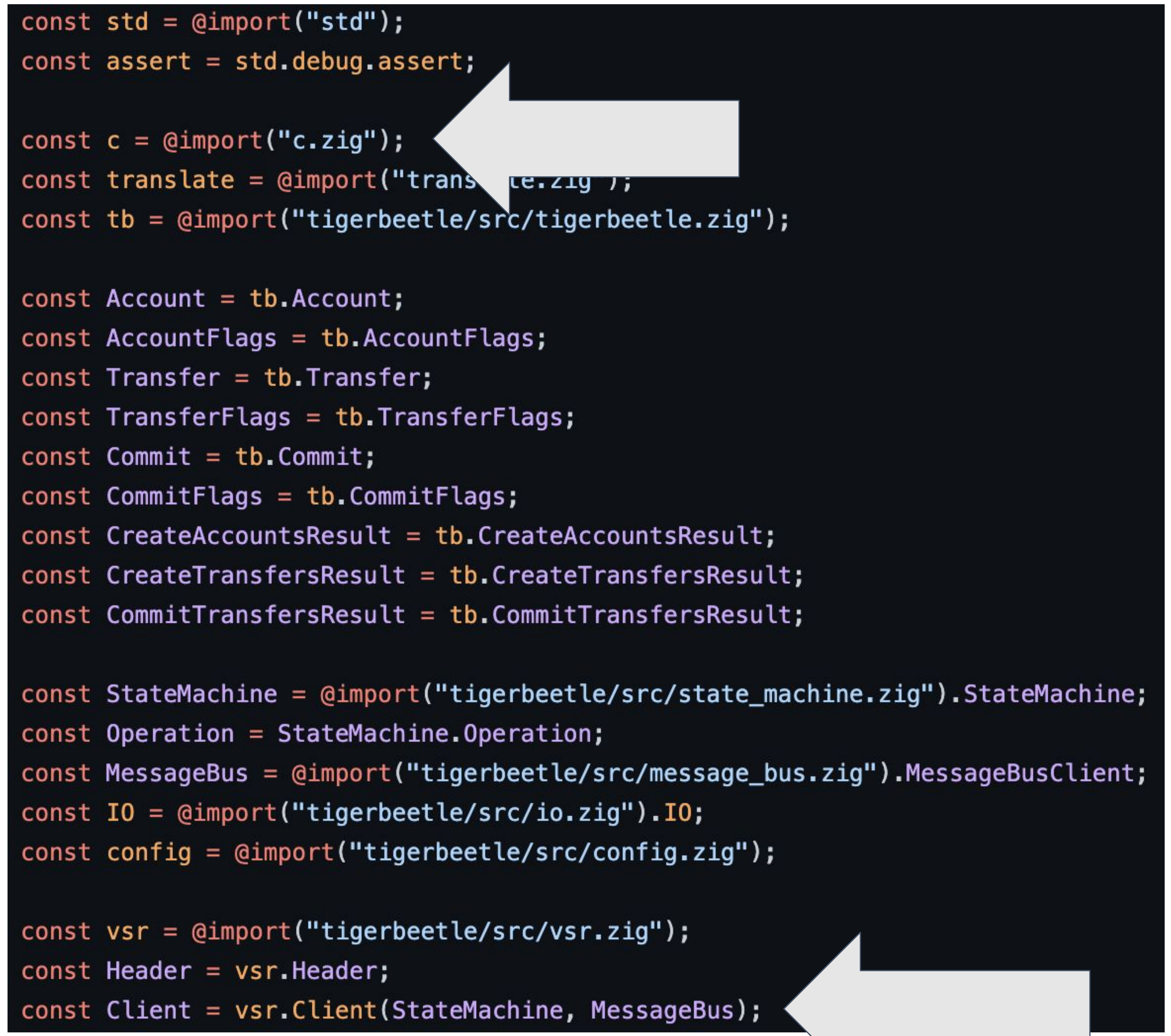
TigerBeetle NodeJS Client

Import Node C header into Zig (`c.zig`):



```
pub usingnamespace @cImport({
    @cInclude("node_api.h");
});
```

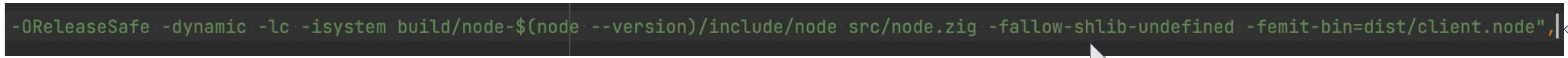
`node.zig` invoking the TigerBeetle Zig native client:



```
const std = @import("std");
const assert = std.debug.assert;

const c = @import("c.zig");
const translate = @import("trans   te.zig");
const tb = @import("tigerbeetle/src/tigerbeetle.zig");

const Account = tb.Account;
const AccountFlags = tb.AccountFlags;
const Transfer = tb.Transfer;
const TransferFlags = tb.TransferFlags;
const Commit = tb.Commit;
const CommitFlags = tb.CommitFlags;
const CreateAccountsResult = tb.CreateAccountsResult;
const CreateTransfersResult = tb.CreateTransfersResult;
const CommitTransfersResult = tb.CommitTransfersResult;

const StateMachine = @import("tigerbeetle/src/state_machine.zig").StateMachine;
const Operation = StateMachine.Operation;
const MessageBus = @import("tigerbeetle/src/message_bus.zig").MessageBusClient;
const IO = @import("tigerbeetle/src/io.zig").IO;
const config = @import("tigerbeetle/src/config.zig");

const vsr = @import("tigerbeetle/src/vsr.zig");
const Header = vsr.Header;
const Client = vsr.Client(StateMachine, MessageBus);
```

Build Process of the Client

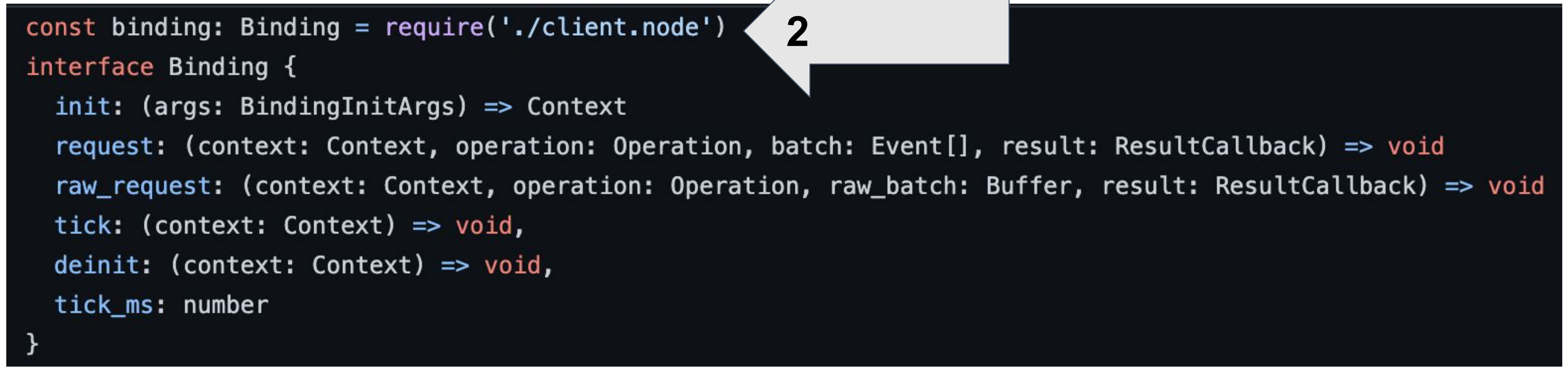
The `build:zig` script for `package.json` in tigerbeetle-node repo:



```
-OReleaseSafe -dynamic -lc -isystem build/node-$(node --version)/include/node src/node.zig -fallow-shlib-undefined -femit-bin=dist/client.node",
```

1

The binding for `client.node` in `index.ts`:

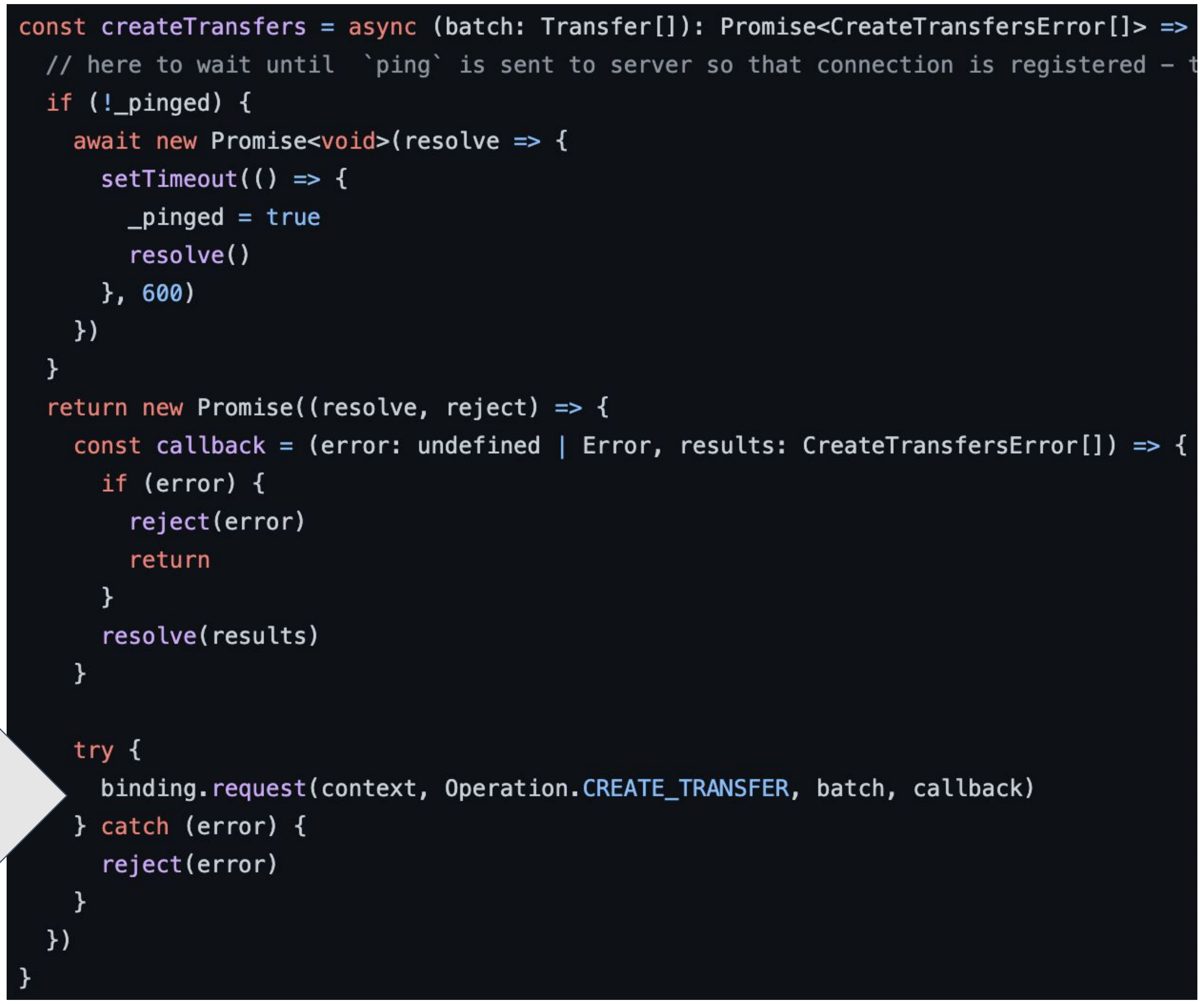


```
const binding: Binding = require('./client.node')
interface Binding {
  init: (args: BindingInitArgs) => Context
  request: (context: Context, operation: Operation, batch: Event[], result: ResultCallback) => void
  raw_request: (context: Context, operation: Operation, raw_batch: Buffer, result: ResultCallback) => void
  tick: (context: Context) => void,
  deinit: (context: Context) => void,
  tick_ms: number
}
```

2

3

Function example `createTransfers`:



```
const createTransfers = async (batch: Transfer[]): Promise<CreateTransfersError[]> =>
  // here to wait until  `ping` is sent to server so that connection is registered - t
  if (!_pinged) {
    await new Promise<void>(resolve => {
      setTimeout(() => {
        _pinged = true
        resolve()
      }, 600)
    })
  }
  return new Promise((resolve, reject) => {
    const callback = (error: undefined | Error, results: CreateTransfersError[]) => {
      if (error) {
        reject(error)
        return
      }
      resolve(results)
    }

    try {
      binding.request(context, Operation.CREATE_TRANSFER, batch, callback)
    } catch (error) {
      reject(error)
    }
  })
}
```

4

Components

TigerBeetle Clients

- Native client (`Zig`)
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- Clients in NodeJS & Golang

TigerBeetle NodeJS Interface

- Configuration file (`default.json`)
- Data Mapping
- Protocol Translation
- Orchestrating interactions with TigerBeetle

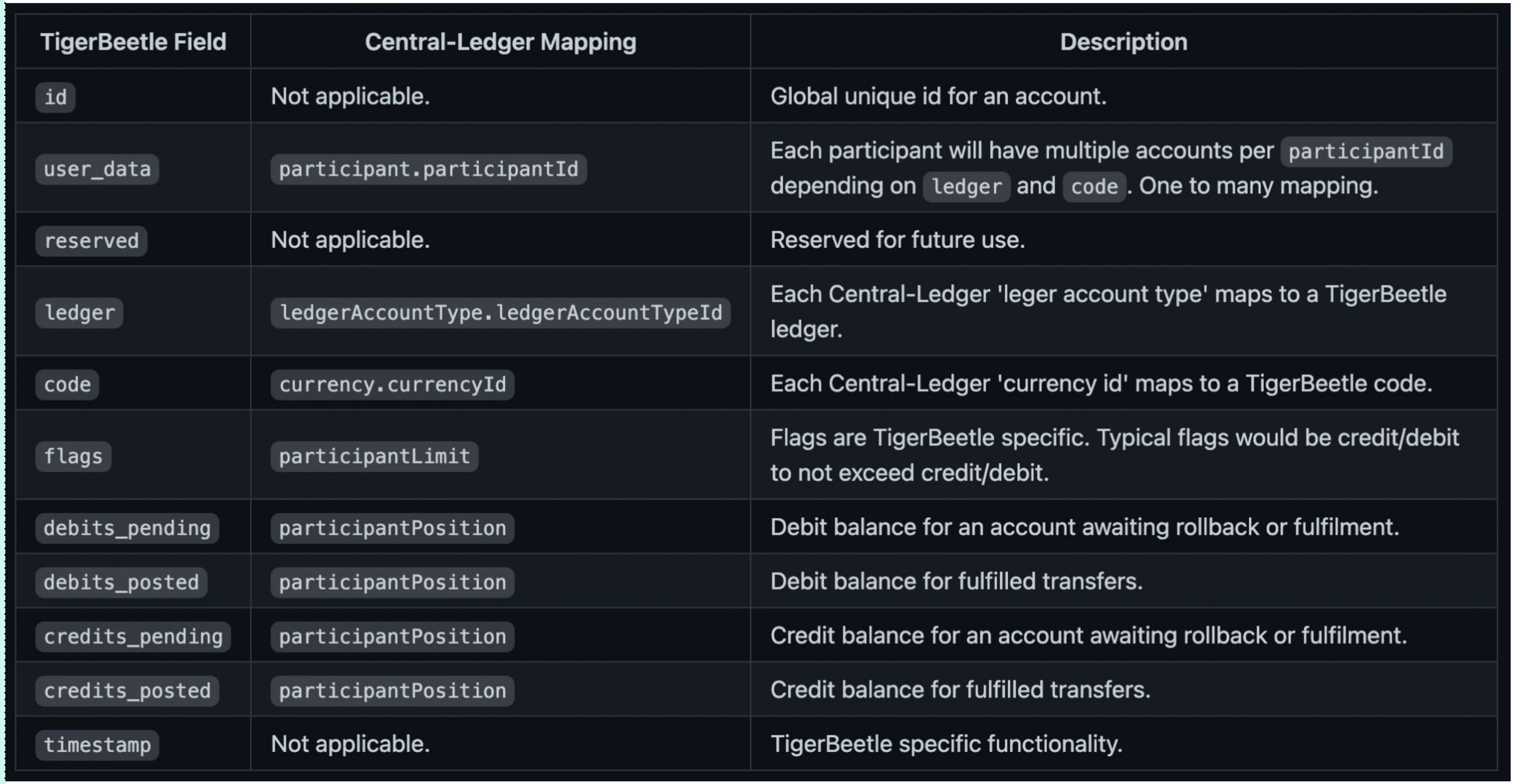
Configuration file

Update the `default.json` configuration file to enable/disable TigerBeetle:

```
"TIGERBEETLE" : {
  "ENABLED" : true,
  "ENABLE_BATCHING" : false,
  "DISABLE_SQL" : false,
  "BATCH_MAX_SIZE" : 2048,
  "CLUSTER" : 1,
  "REPLICA_ENDPOINT_01" : "localhost:5001",
  "REPLICA_ENDPOINT_02" : "localhost:5002",
  "REPLICA_ENDPOINT_03" : "localhost:5003"
},
```

Account Data Mapping

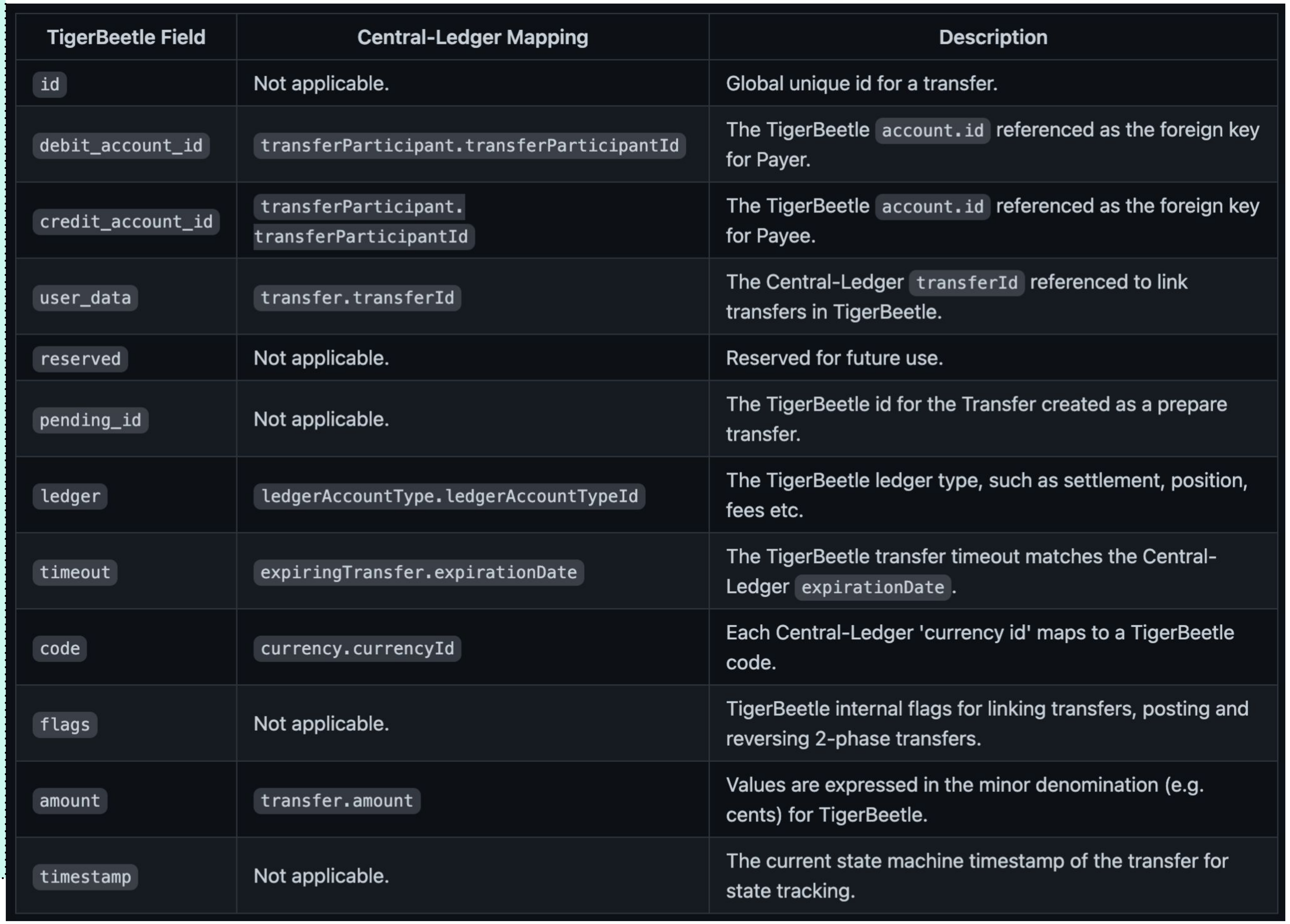
TigerBeetle NodeJS Interface



TigerBeetle Field	Central-Ledger Mapping	Description
`id`	Not applicable.	Global unique id for an account.
`user_data`	`participant.participantId`	Each participant will have multiple accounts per `participantId` depending on `ledger` and `code`. One to many mapping.
`reserved`	Not applicable.	Reserved for future use.
`ledger`	`ledgerAccountType.ledgerAccountTypeId`	Each Central-Ledger 'leger account type' maps to a TigerBeetle ledger.
`code`	`currency.currencyId`	Each Central-Ledger 'currency id' maps to a TigerBeetle code.
`flags`	`participantLimit`	Flags are TigerBeetle specific. Typical flags would be credit/debit to not exceed credit/debit.
`debits_pending`	`participantPosition`	Debit balance for an account awaiting rollback or fulfilment.
`debits_posted`	`participantPosition`	Debit balance for fulfilled transfers.
`credits_pending`	`participantPosition`	Credit balance for an account awaiting rollback or fulfilment.
`credits_posted`	`participantPosition`	Credit balance for fulfilled transfers.
`timestamp`	Not applicable.	TigerBeetle specific functionality.

Transfer Data Mapping

TigerBeetle NodeJS Interface



TigerBeetle Field	Central-Ledger Mapping	Description
`id`	Not applicable.	Global unique id for a transfer.
`debit_account_id`	`transferParticipant.transferParticipantId`	The TigerBeetle `account.id` referenced as the foreign key for Payer.
`credit_account_id`	`transferParticipant.transferParticipantId`	The TigerBeetle `account.id` referenced as the foreign key for Payee.
`user_data`	`transfer.transferId`	The Central-Ledger `transferId` referenced to link transfers in TigerBeetle.
`reserved`	Not applicable.	Reserved for future use.
`pending_id`	Not applicable.	The TigerBeetle id for the Transfer created as a prepare transfer.
`ledger`	`ledgerAccountType.ledgerAccountTypeId`	The TigerBeetle ledger type, such as settlement, position, fees etc.
`timeout`	`expiringTransfer.expirationDate`	The TigerBeetle transfer timeout matches the Central-Ledger `expirationDate`.
`code`	`currency.currencyId`	Each Central-Ledger 'currency id' maps to a TigerBeetle code.
`flags`	Not applicable.	TigerBeetle internal flags for linking transfers, posting and reversing 2-phase transfers.
`amount`	`transfer.amount`	Values are expressed in the minor denomination (e.g. cents) for TigerBeetle.
`timestamp`	Not applicable.	The current state machine timestamp of the transfer for state tracking.

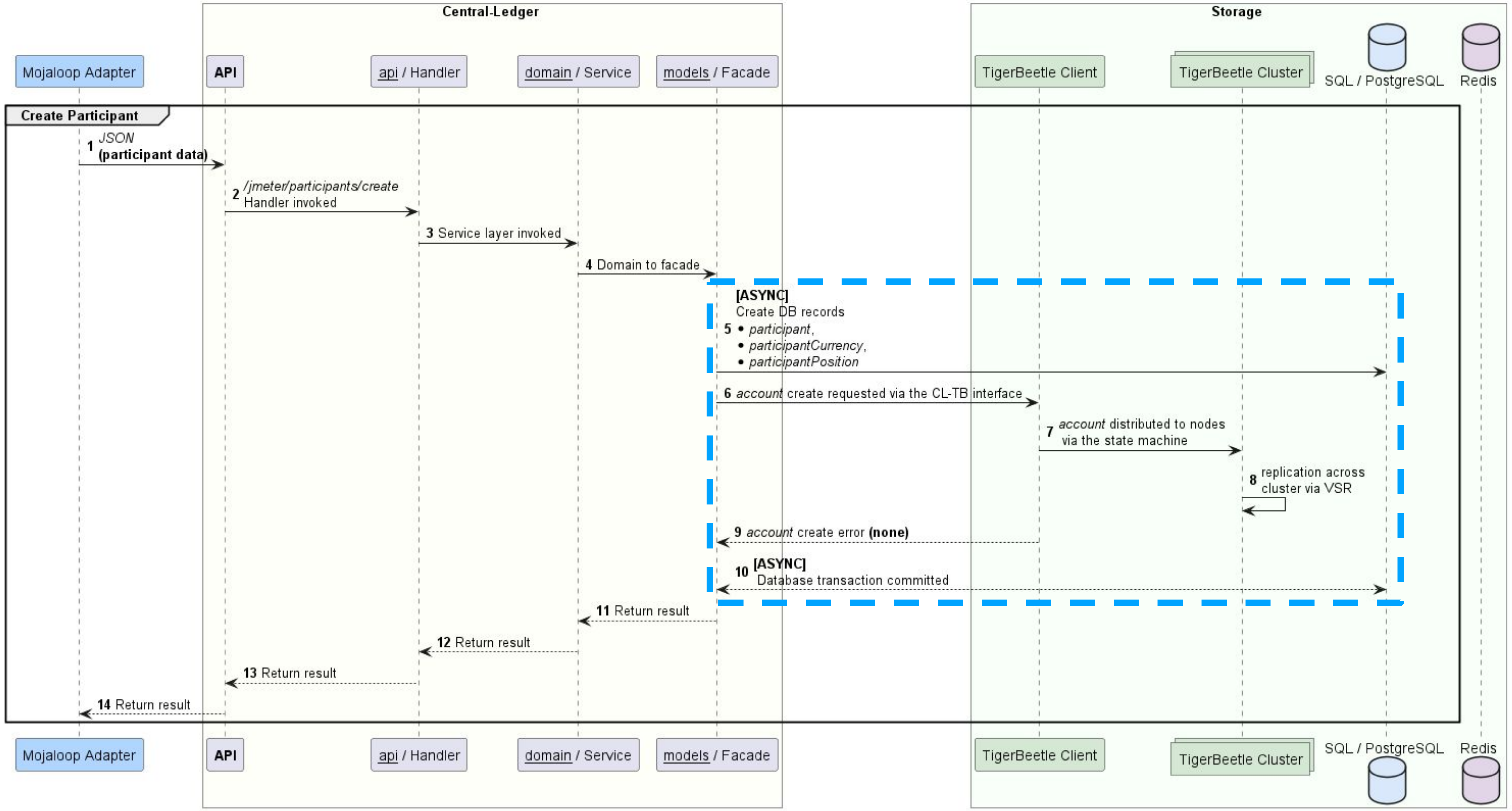
TigerBeetle NodeJS Interface

Protocol Translation Library

The `tb.js` interface transforms the Central-Ledger & TigerBeetle data models. Some of the main exposed functions are:

- **tbCreateAccount** → Create participant, currency, position and other related data
- **tbLookupAccount** → Lookup using participantId or participantCurrencyid
- **tbTransfer** → Create a transfer
- **tbPrepareTransfer** → Create a 2-phase transfer prepare (with a timeout)
- **tbFulfilTransfer** → Fulfil a 2-phase prepared transfer
- **tbRollbackTransfer** → Rollback a prepared transfer
- **tbLookupTransfer** → Lookup an existing transfer
- **tbTransferTimedOut** → Verify whether a 2-phase transfer has expired

Interaction - Create Participant



1 *JSON* **(participant data)**

2 */jmeter/participants/create* Handler invoked

3 Service layer invoked

4 Domain to facade

5 **[ASYNC]** Create DB records
- *participant*,
- *participantCurrency*,
- *participantPosition*

6 *account* create requested via the CL-TB interface

7 *account* distributed to nodes via the state machine

8 replication across cluster via VSR

9 *account* create error **(none)**

10 **[ASYNC]** Database transaction committed

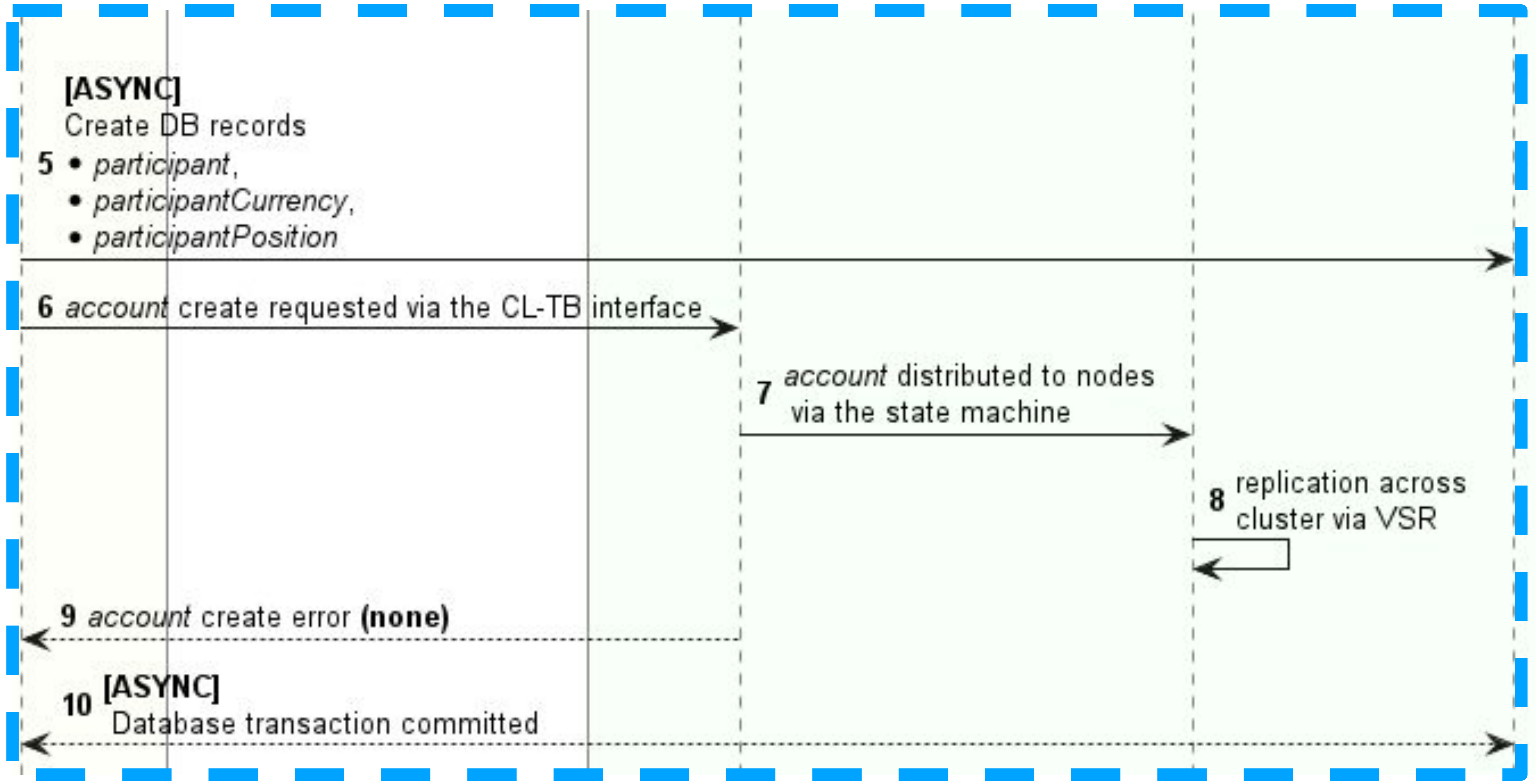
11 Return result

12 Return result

13 Return result

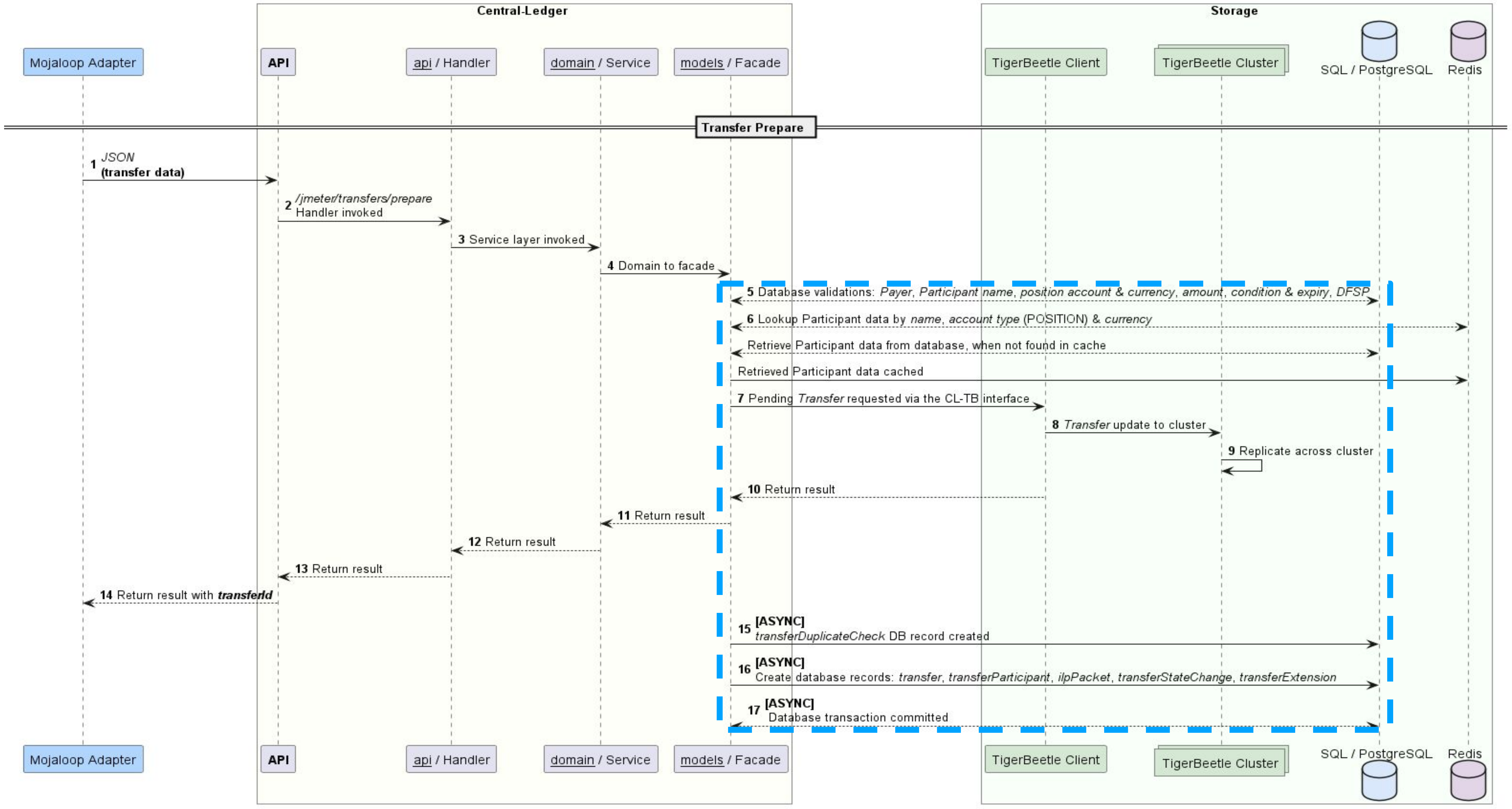
14 Return result

Interaction Detail - Create Participant



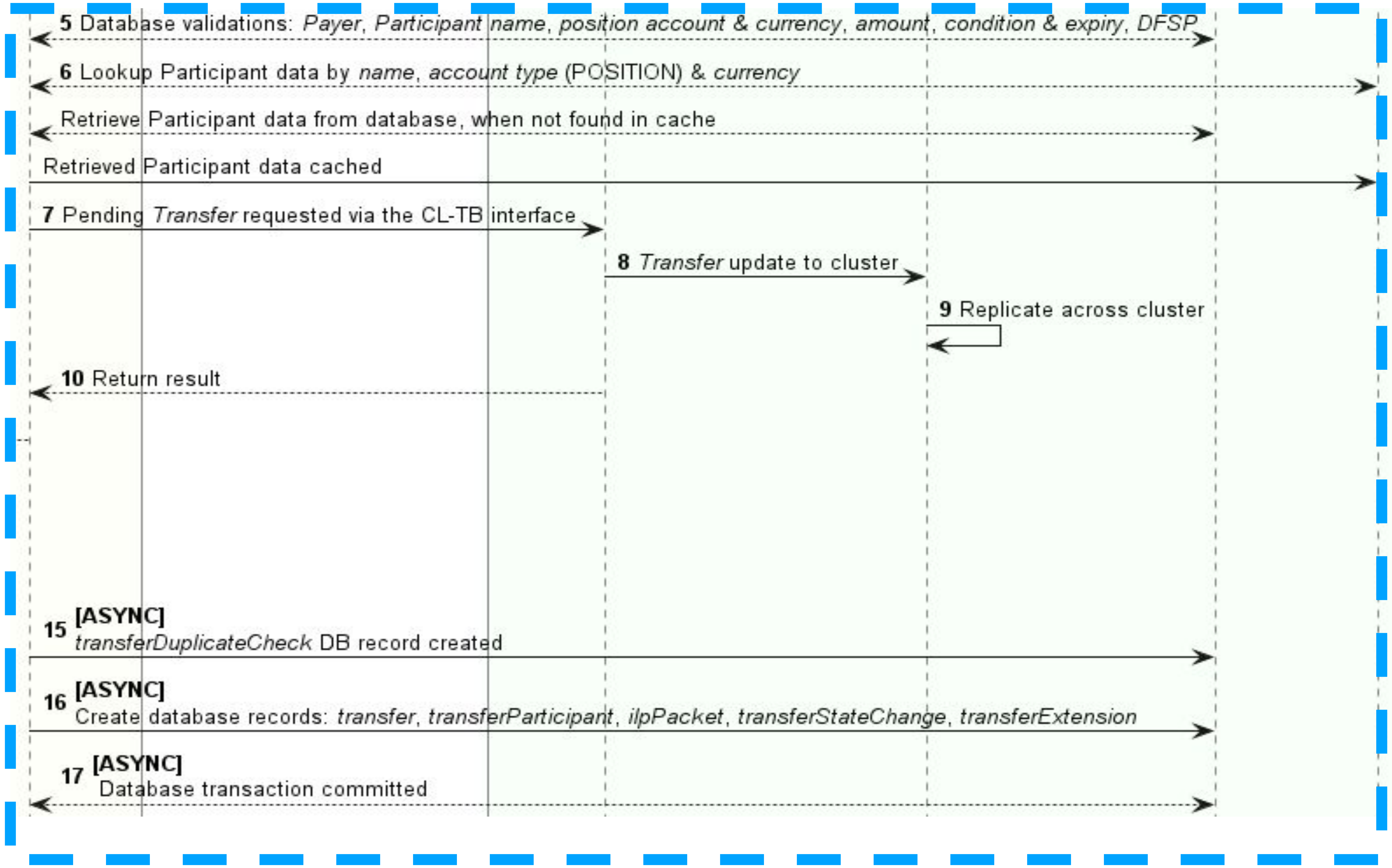
5 [ASYNC]
Create DB records
• *participant*,
• *participantCurrency*,
• *participantPosition*
6 *account* create requested via the CL-TB interface
7 *account* distributed to nodes via the state machine
8 replication across cluster via VSR
9 *account* create error **(none)**
10 [ASYNC]
Database transaction committed

Interaction - Prepare Transfer



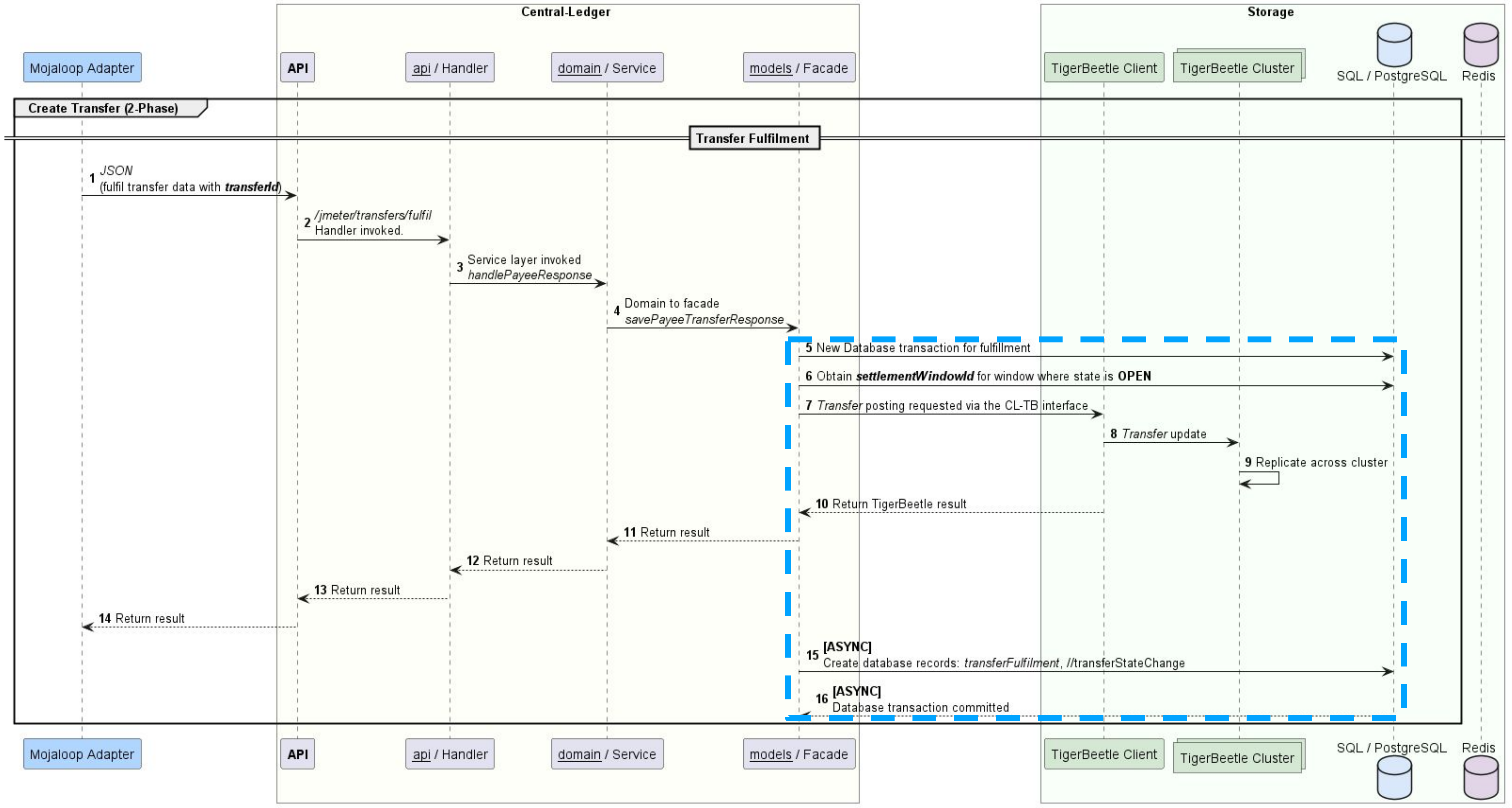
Central-Ledger
Storage
Mojaloop Adapter
API
api / Handler
domain / Service
models / Facade
TigerBeetle Client
TigerBeetle Cluster
SQL / PostgreSQL
Redis
Transfer Prepare
1 JSON (transfer data)
2 /jmeter/transfers/prepare Handler invoked
3 Service layer invoked
4 Domain to facade
5 Database validations: Payer, Participant name, position account & currency, amount, condition & expiry, DFSP
6 Lookup Participant data by name, account type (POSITION) & currency
Retrieve Participant data from database, when not found in cache
Retrieved Participant data cached
7 Pending Transfer requested via the CL-TB interface
8 Transfer update to cluster
9 Replicate across cluster
10 Return result
11 Return result
12 Return result
13 Return result
14 Return result with transferId
15 [ASYNC] transferDuplicateCheck DB record created
16 [ASYNC] Create database records: transfer, transferParticipant, ilpPacket, transferStateChange, transferExtension
17 [ASYNC] Database transaction committed

Interaction Detail - Prepare Transfer



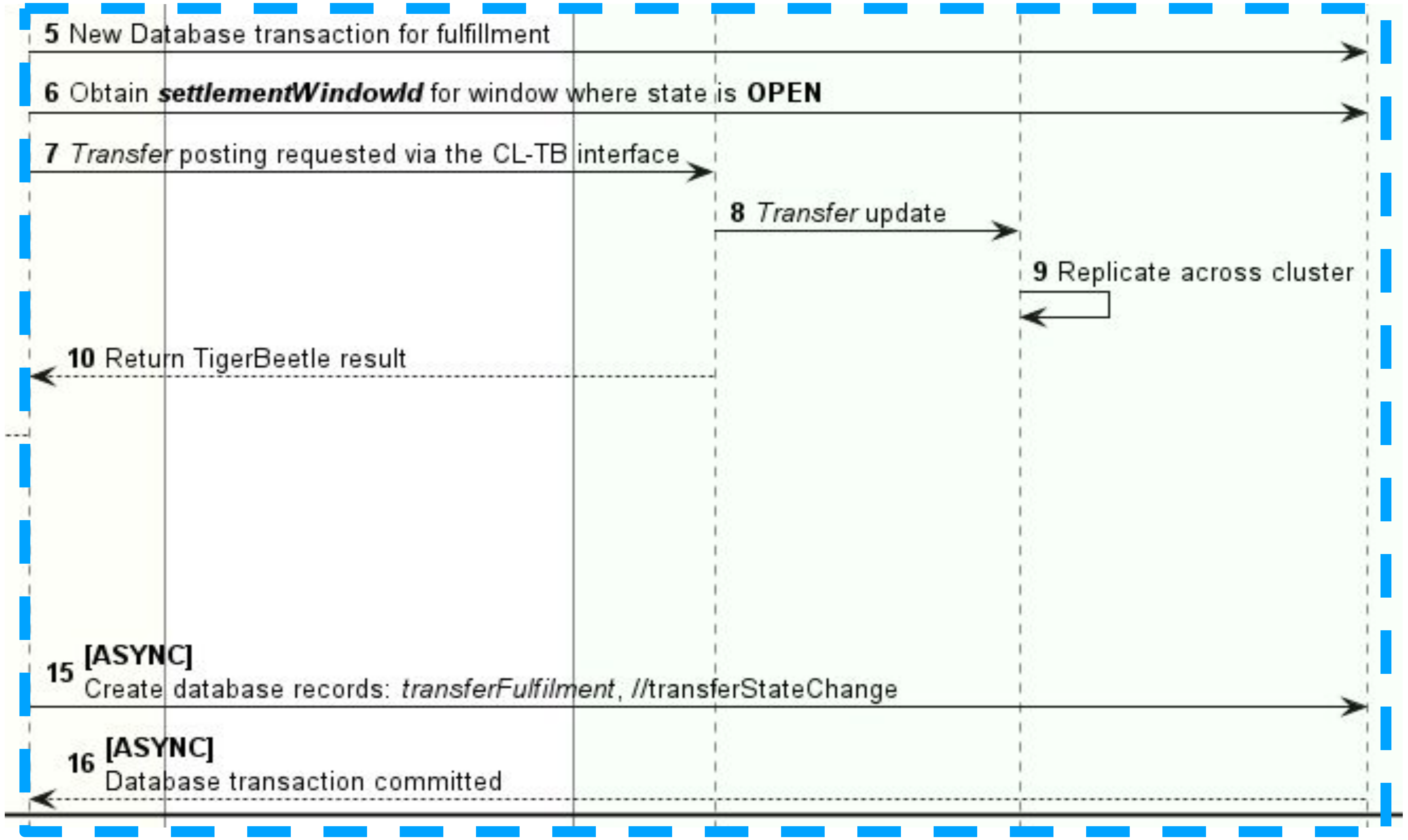
5 Database validations: *Payer, Participant name, position account & currency, amount, condition & expiry, DFSP*
6 Lookup Participant data by *name, account type* (POSITION) & *currency*
Retrieve Participant data from database, when not found in cache
Retrieved Participant data cached
7 Pending *Transfer* requested via the CL-TB interface
8 *Transfer* update to cluster
9 Replicate across cluster
10 Return result
15 [ASYNC] *transferDuplicateCheck* DB record created
16 [ASYNC] Create database records: *transfer, transferParticipant, ilpPacket, transferStateChange, transferExtension*
17 [ASYNC] Database transaction committed

Interaction - Fulfil Transfer



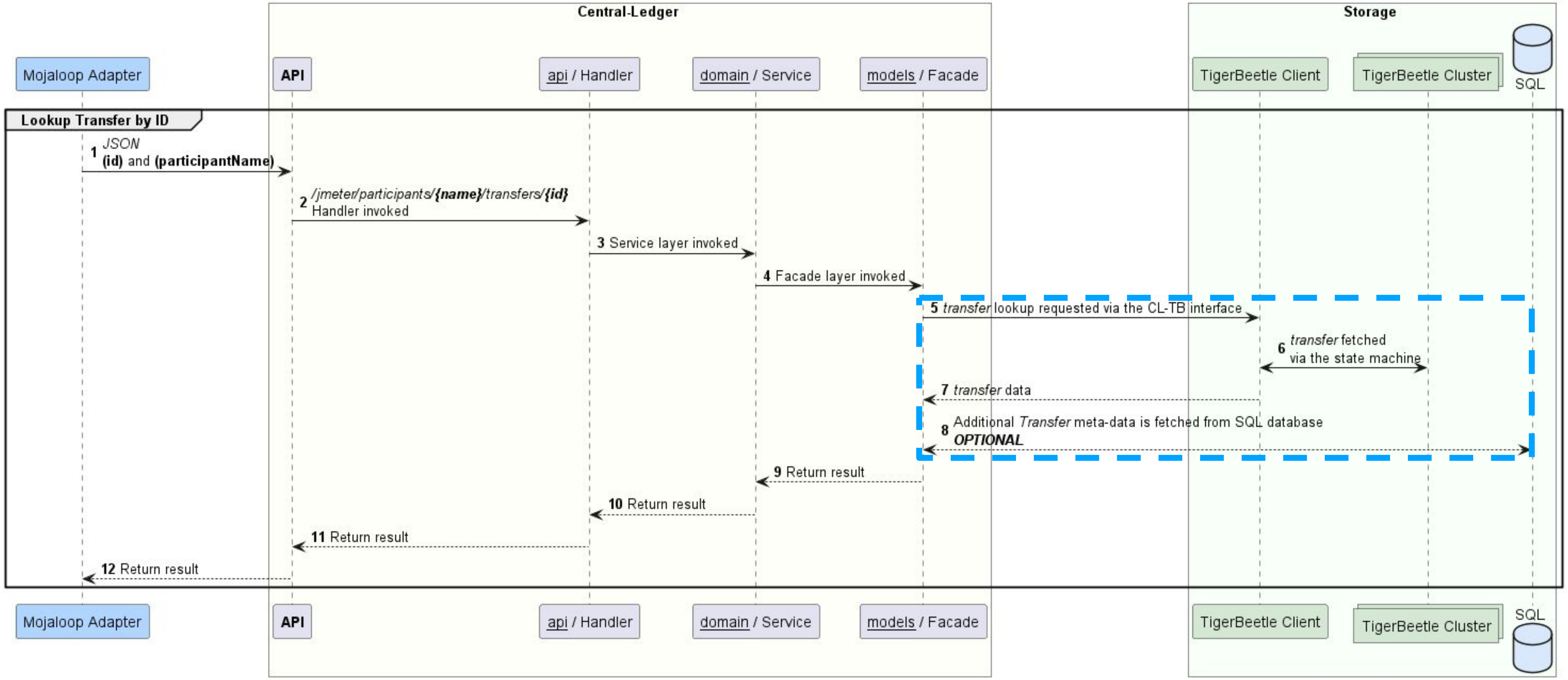
Central-Ledger
Storage
Mojaloop Adapter
API
api / Handler
domain / Service
models / Facade
TigerBeetle Client
TigerBeetle Cluster
SQL / PostgreSQL
Redis
Create Transfer (2-Phase)
Transfer Fulfilment
1 JSON (fulfil transfer data with ***transferId***)
2 */jmeter/transfers/fulfil* Handler invoked.
3 Service layer invoked *handlePayeeResponse*
4 Domain to facade *savePayeeTransferResponse*
5 New Database transaction for fulfillment
6 Obtain ***settlementWindowId*** for window where state is **OPEN**
7 *Transfer* posting requested via the CL-TB interface
8 *Transfer* update
9 Replicate across cluster
10 Return TigerBeetle result
11 Return result
12 Return result
13 Return result
14 Return result
15 **[ASYNC]** Create database records: *transferFulfilment*, //transferStateChange
16 **[ASYNC]** Database transaction committed

Interaction Detail - Fulfil Transfer

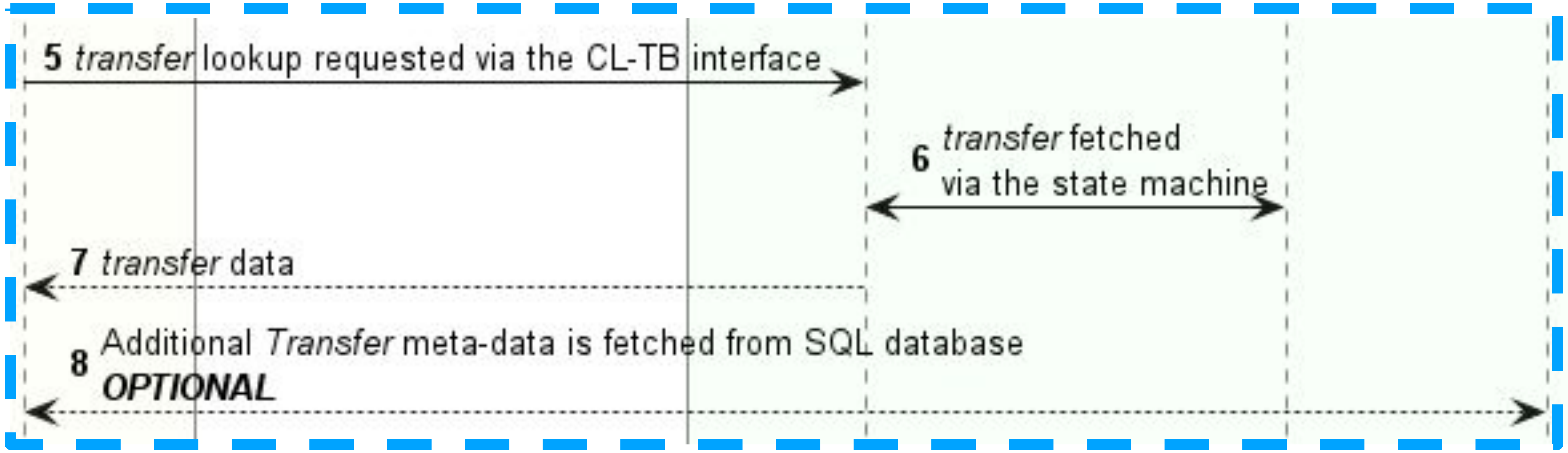


5 New Database transaction for fulfillment
6 Obtain ***settlementWindowId*** for window where state is **OPEN**
7 *Transfer* posting requested via the CL-TB interface
8 *Transfer* update
9 Replicate across cluster
10 Return TigerBeetle result
15 [ASYNC] Create database records: *transferFulfilment*, //transferStateChange
16 [ASYNC] Database transaction committed

Interaction - Lookup Transfer



Interaction Detail - Lookup Transfer



5 *transfer* lookup requested via the CL-TB interface
6 *transfer* fetched via the state machine
7 *transfer* data
8 Additional *Transfer* meta-data is fetched from SQL database ***OPTIONAL***

Data Migration

1. Default scripts: summary; migrate; verify
2. Process:
    a. Execute data summary scripts - accounts, balances & transfers
    b. Configure & execute migration scripts
    c. Execute verification scripts

Upcoming focus

For the next cycle	1. Design documentation community input → update & finalise 2. Implement & showcase Central-Settlement integration 3. Implement rich queries (batch, date range, entities) 4. Release JMeter Central-Ledger test suite 5. Demo integration

Questions

COMMUNITY
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MEETING

Thank you.