MATERA

Using Digital Twin to Complement a Financial Institution's Core - General Concepts

Digital Twin is software installed in the cloud, adjacent to a Financial Institution's Core. It's architected to hold minimal logic and perform few, but critical functions, to achieve extremely high throughput and response times while maintaining resiliency. It doesn't consume unnecessary resources; it scales up or down as needed.

Select account balances are replicated to Digital Twin from the Core. When consumers want to send and receive money in these accounts, Digital Twin authorizes the transactions in real-time. Balances are updated immediately in the digital channels, and the Core credits/debits the accounts in the system of record. If the Core is down, transactions are queued to be executed when back online.

Digital Twin is not a Core. It's a high performance ledger designed to make it easy for Financial Institutions to move transaction authorization to the cloud for select accounts.

Below are key terms and concepts related to the operation of Digital Twin.

Account types

Digital Twin can hold many different types of accounts. Examples include, but aren't limited to:

- DDA
- Savings
- Credit card
- Loan
- Loyalty points
- Cryptocurrency

Financial institutions can decide what account types to replicate to Digital Twin; the desired account types are established during Digital Twin setup.

Balances

Multiple balances can be assigned to accounts replicated on Digital Twin. These assigned balances may be considered when deciding whether to authorize a transaction. For example, the combined value of the actual account balance and the available overdraft balance may determine whether to approve a transaction.

In a practical scenario, an account with a $90 actual balance and a $10 overdraft limit successfully approves a $100 debit by using $90 from the actual balance and $10 from the overdraft.

Balances may also be expressed as currencies like cryptocurrencies or loyalty points.

Limits

Limits can be configured for each balance, and are considered when authorizing transactions.

For example, one account may have a daily limit of $1,000 for instant payments, and an available total balance of $5,000. If the accountholder initiates a $1,000 instant payment the instant payment balance goes to 0 (zero) and the available account balance is reduced to $4,000.

Currency

Digital Twin is multi-currency and is not limited to currency with 2 decimal points so can accommodate applications such as currency trading and cryptocurrency.

Identifying an account

Digital Twin identifies accounts by the bank account and routing number. Financial Institutions that don't want to retain the bank account and routing number in Digital Twin, can assign a Unique ID to be used instead.

Digital Twin is designed to hold minimal personally identifiable information. It does include a unique account identifier (which can be tokenized). There is an optional field to include name to support applications like Confirmation of Payee.

Creating new accounts and modifying existing accounts

When new accounts are opened at a Financial Institution, they are established first on the Core and then communicated to Digital Twin. When the status and limits of these accounts are modified on the Core, those changes must be communicated to Digital Twin as well.

Transactions

All transactions related to accounts replicated to Digital Twin must be authorized by Digital Twin first before being credited or debited to the account on the Core. This includes fees or rebates that may originate in the Core system. Before these fees, rebates or similar can affect the Core balance, they must first be authorized by Digital Twin.

A Legacy Core Adapter (required to integrate Digital Twin to the Core) is responsible for routing the request from the Core to Digital Twin to enable these transactions to be processed.[1] Other transactions (e.g. ACH, ATM) transactions that previously were sent to the Core must be redirected to Digital Twin. The Legacy Core Adapter is also responsible for intercepting these transactions to get authorized by Digital Twin first before posting to the account on the Core.

Every transaction is immutable

Once a transaction is recorded, it cannot be deleted to allow for perfect journaling. Digital Twin tracks exactly what happened and when to every transaction. For example, if a send transaction fails, it's not deleted. The transaction is cancelled and a new transaction is added.

[1] Legacy Core Adapter is not included in Digital Twin software

Transaction Codes

Transactions codes are defined during the setup process of Digital Twin. Most banks use the same transaction codes on Digital Twin that they use on their Core, but it's not required. Transaction codes can simply be defined as "credit" or "debit" or more granularly defined as "cash disbursement from DDA" or "bank2bank transfer credit."

Transaction authorization

Before authorizing a transaction, Digital Twin checks:

- If the account has enough funds, considering the available balance and pending transactions
- If the account is in an active status and eligible to execute the transaction
- If the transaction amount falls within the allowable limits

Important Data on Transactions

- **asOfDate**

  This is the date on which the transaction should appear in the statement, regardless of the date on which the transaction is recorded. While this date is merely informational for Digital Twin, when passing it to the Core, the system may adjust this date to match an applicable one.

  Most Cores process transactions relative to business days. D+1 is the next business day. D+0 is the current business day. D-1 is the previous business day. If a transaction is dated outside this window (e.g., too far in the past or future), the system adjusts the transaction date to stay within the range of D-1 (yesterday) and D+1 (tomorrow).

  For example, in FedNow, the cutoff is 7pm, and RTP is midnight. Transactions between 7pm and midnight may have different dates depending on the rail. Digital Twin is prepared to handle different cycle dates across various systems.

- **metaData**

  The metaData field in Digital Twin is a free-form field used for information exchange between systems. It allows additional information exchange between systems/modules. For example, a system sending a transaction request to the Digital Twin can include notes in this field. These notes are forwarded to the Core banking system and could be considered during decision-making.

  The metadata field often includes transaction counterparties for bank statements. It must not contain data protected by regulation (e.g. California Consumer Privacy Act (CCPA)).

- **correlationID**

  In Digital Twin, the correlationID is a unique identifier for a transaction. It is essential for identifying and reversing transactions and for reconciling between Digital Twin modules to

ensure data synchronization. It also manages the idempotency of requests to prevent duplicate transactions.

It is created by combining the source system that initiated the transaction with a specific ID. While each source system can have multiple correlation IDs, every source/correlationId pair is globally unique within the system.

- **Settlementinfo**

  When requests to credit or debit an account are sent to Digital Twin, they can be partially filled or must be filled entirely. This option is indicated in the Settlementinfo Fulfillment field - the value for this field is either TOTAL or PARTIAL.

  In the case of PARTIAL, a range of acceptable values must be provided. For example, if an account has a balance of $1,000 and a TOTAL debit request of $1,500 is made, that request will be denied due to insufficient funds. However, if a PARTIAL debit request is made for an amount between $200 and $1,500 the request will be processed, returning a success response with a debit of $1,000.

- **Amount**

  In Digital Twin, all values are stored as integers. Decimal points are handled only by systems that need to display or process these values. For example, “1” in the value field corresponds to a monetary value of “0.01,” while “100 represents “1.00”

- **Enrichment**

  Digital Twin operates 24/7, while most Core banking systems go down for processing nightly. If a transaction occurs on Digital Twin while the Core is down, the Core processes it on the next business day. In this case, an enrichment event is generated by the Core system.

  Enrichment actions enable information to be added or modified on transactions, such as:

  - Adding or changing supplementary data.
  - Adding new identifiers (e.g., correlation IDs).
  - Adjusting commercial dates for accuracy.

Important Processing Considerations

- **5xx/503 Error Handling**

  Digital Twin APIs may return 5xx error codes, particularly 503.

  A 5xx return indicates the system was unable to provide a successful or error-specific response. It doesn’t confirm whether the request was processed.

  In most cases, a 503 response indicates that the request was not processed, but that the caller should retry, as the chance of success on a second attempt is high. If Digital Twin

recognizes it cannot respond to a request in a timely manner because the thread handling the request is under heavy processing load, then it may respond with a 503. This allows the system to horizontally scale threads to handle a second attempt.

We recommend implementing a standardized handling process for 5xx responses to ensure optimal system performance. And, we recommend making at least three retry attempts before proceeding with compensation via refund or cancellation.

- **How some transactions impact multiple balances**

  A single transaction can affect multiple balances. Digital Twin determines which balance will be impacted during an operation based on the transaction type. For instance, a transaction that unblocks a certain amount affects the blocked balance.

  - Example: if a certain amount is temporarily held or "blocked." During this time, the blocked balance increases by the blocked amount, while the actual account balance decreases by the same blocked amount. When the blocked amount is released, the reverse occurs, and the blocked balance decreases, while the actual account balance increases.
  - Example: when a customer checks into a hotel, the hotel temporarily "blocks" $100 on their credit card as a security deposit. The customer's blocked balance increases by $100, reducing their available balance, while their actual account balance decreases by the same amount. When they check out, the $100 block is released, and the blocked balance decreases, while their actual account balance increases by $100.

- **Reconciliation (Balance snapshot event)**

  Reconciliation is performed via event exchange in the Kafka topic. This process captures current account balances across systems or modules. A balance snapshot event can be generated in three ways:

  1. **Probability:** If you set a probability of 50%, and there are 10 batch transactions, a snapshot might be generated for all, some, or none of the 5 transactions that occur. This process is probabilistic, meaning the
  2. **Forced Snapshot:** While processing a request, you can configure a balance snapshot to be generated for that specific transaction, bypassing probability or other configurations. The Digital Twin API includes a header method where you can specify that a snapshot should be created for the request.
  3. **Triggered by Other Systems:** Snapshots are typically generated by Digital Twin's *Transaction* module, which manages balances, statements, and postings. However, other modules, such as the *Registry,* can also trigger a balance snapshot. When the Transaction module processes a snapshot triggered by the Registry, it generates and returns its own corresponding snapshot.