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Introduction

Objective

The CoinDesk Reference Rates provide real-time, USD-denominated reference rate prices for select digital assets ("Reference Rates"). The Reference Rates are determined based on the volume weighted average prices (VWAP) over a rolling 60-minute lookback period on at least two contributing exchanges to reflect trading in the relevant asset over this period. Contributing exchanges are weighted proportional to their trading volume during the lookback period.

Additional Details

This Reference Rate methodology ("Methodology") was developed by CoinDesk Indices ("CDI") to achieve the stated above Objective. There may be circumstances or market events which require CDI, in its sole discretion, to deviate from these rules to ensure each Reference Rate continues to meet its Objective. This document should be read in conjunction with the CoinDesk Digital Asset Indices Policy Methodology.

Eligibility Criteria

Digital asset eligibility

Eligible digital assets for which Reference Rates will be constructed and maintained will be determined based on meeting the eligibility criteria defined below.

CDI produces a number of multi digital asset index families all of which have their own methodology and eligible digital assets which require reference rates as inputs to the index calculation.

Exchange eligibility

To be eligible, an exchange must first meet the Exchange Eligibility criteria outlined in the CoinDesk Digital Asset Policy Methodology. For each single asset Reference Rate, the following additional criteria is used to establish eligible exchanges.

1. Must support USD-denominated trading for the single asset.
2. USD-denominated trading volume must be greater than zero for each of the 30 consecutive days leading up to and including the reference date. To reduce turnover, the trading volume for an existing contributing exchange must be greater than zero for at least 24 days of the 30-day period leading up to and including the reference date.
For each Reference Rate, the list of exchanges that pass all eligibility criteria listed above form the Selection Universe. The Index Committee reserves the right to relax the eligibility criteria based on market conditions.

**Reference Rate Construction**

**Contributing exchange selection**

For each digital asset Reference Rate, exchanges in the Selection Universe are included subject to a minimum of two and maximum of three contributing exchanges ("Contributing Exchanges").

1. Contributing Exchanges for each digital asset Reference Rate are determined each quarter based on the following process:
   1. Determine the 90-day notional volume in the USD-quoted market on each Eligible Exchange. If less than 90 days are available, all available data is used to determine the 90-day notional volume.
   2. Rank the results of Step 1 in descending order.
   3. The top two exchanges from Step 2 are automatically selected as Contributing Exchanges.
   4. If additional exchanges remain, the third Contributing Exchange will be selected from the remaining exchanges based on the following rules:
      a. If one of the remaining exchanges is an existing Contributing Exchange, it will remain a Contributing Exchange unless the third ranked exchange’s volume determined in Step 1 is 1.20 times the volume of the currently Contributing Exchange, in which case the third ranked exchange will be the third Contributing Exchange.

**Volume weighting**

The calculation of the Reference Rate is based on a 60-minute VWAP and, therefore, Contributing Exchanges are weighted proportional to their trailing 60-minute trading volume. CDI does not publish exchange weightings.

**Reference rate calculation**

Real-time Reference Rates for digital asset tokens are calculated approximately every 5 seconds by CDI using a volume weighted average price (VWAP) across Contributing Exchanges over the prior 60 minutes. Price and volume inputs are sourced and

---

1 Two Contributing Exchange minimum subject to ‘Inactivity’ section.
normalized from the Contributing Exchanges. Additional validations on the data inputs, such as outliers, are not performed.

Inactivity

There may be periods of trading inactivity on Contributing Exchanges. A digital asset’s Reference Rate will continue to be calculated provided at least one Contributing Exchange has an eligible trade during the prior 60-minute lookback period. In the event there are no trades on any of the Contributing Exchanges over the prior 60-minute period, CoinDesk will maintain the most recent calculated Reference Rate price until trading resumes. Contributing Exchanges that do not meet the minimum trading requirements defined in Eligibility Criteria will be removed at the next reconstitution.

Reference Rate Calculation Formula

$$Reference\ Rate_{i,t} = \frac{\sum_{i=1}^{n}(TradeVolume_{i,LB} \times TradePrice_{i,LB})}{\sum_{i=1}^{n}TradeVolume_{i,LB}}$$

Reference Rate<sub>i,t</sub> = Reference Rate of digital asset i at time t  
TradeVolume<sub>i,LB</sub> = Volume of each trade of digital asset i during the lookback period  
TradePrice<sub>i,LB</sub> = Price of each trade of digital asset i during the lookback period  
n = number of constituent exchanges  
LB = lookback period of 60 minutes from time t

Reference Rate Maintenance

Monthly Review

Each CoinDesk Reference Rate is reviewed on a monthly basis based on the rules described above. Any constituent exchange changes resulting from the monthly review are announced one week prior to the effective date and implemented on the second business day of the reconstitution month. Please see Table 4 for the reconstitution timings.

Table 1: Reconstitution Timing

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Timing</th>
<th>Example Reconstitution Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstitution Reference Date</td>
<td>Announcement Date minus 7 business days</td>
<td>09/16/2022</td>
</tr>
<tr>
<td>Announcement Date</td>
<td>Effective Date minus 7 calendar days (following business day if this is a holiday)</td>
<td>09/27/2022</td>
</tr>
</tbody>
</table>
Effective Date | 4PM on the 2nd business day of the start of each quarter | 10/04/2022

In addition to the monthly process, each Reference Rate is monitored for trading disruptions. Out-of-review monitoring, which would require a modification, only applies in extraordinary circumstances.

Deletions

If a digital asset is delisted or no longer trading on a Contributing Exchange, the impacted exchange will no longer contribute to the calculation of the applicable Reference Rate (see Additions section).

Additions

There will be no additions to the Reference Rates between reconstitutions unless the number of exchanges contributing to the calculation of the Reference Rate drops below 2. If the constituent count drops below 2, the Index Committee will review the eligible universe and determine the appropriate action. The action may include adding an additional exchange prior to the next scheduled Reconstitution. In certain circumstances, a Reference Rate may be calculated with only one contributing exchange.

Reference rate termination

CDI reserves the right to terminate a Reference Rate for a digital asset, including in the event the required number of Contributing Exchanges cannot be met.

Data Distribution

Real-time reference rates values are calculated 24x7 at 5 second intervals and are available to subscribers via REST, WebSocket APIs and scheduled email updates.

Reference Rate Governance

The CoinDesk Index Committee ("Index Committee") provides ongoing governance of each Reference Rate and this Methodology. For more details on the Index Committee, please refer to the Index Governance section of the CoinDesk Digital Asset Indices Policy Methodology.
Appendix 1: Data sources

This section describes the data sources used to maintain, reconstitute and calculate the Indices. If data is not available for any reason from the sources described in this appendix, other data sources may be used.

**Price data**

Prices used to calculate Reference Rates are sourced from Eligible Exchanges.

**Volume data**

Volume data used to calculate Reference Rates are sourced from Eligible Exchanges.

**Reconstitution Data**

Daily notional volume is sourced from eligible exchanges. In the event an exchange does not explicitly provide daily notional, CDI will estimate daily notional for a digital asset using the following formula:

\[
\text{Daily Notional Volume} = \text{Daily trading volume} \times (\text{open price} + \text{close price})/2
\]
Appendix 2: Reference Rate VWAPs (24-hour)

CoinDesk Indices calculates a separate set-of Reference Rate VWAPs for certain digital asset tokens that are a cumulative VWAP from 4PM Eastern Time each day.

These VWAPs use the same set of exchanges as the applicable Reference Rate and are reset every day at 4PM Eastern Time. The Reference Rate VWAP begins calculating each day at 4PM Eastern Time and the lookback period continues to grow until it reaches 24 hours. At that point, the 4PM VWAP is finalized and resets for the next 24-hour period.
Appendix 3: Methodology Changes

The table below is a summary of modifications to this Methodology.

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Prior Treatment</th>
<th>Updated Treatment</th>
<th>Material Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/23/2023</td>
<td>Reference rates with three constituent exchanges were not updated on non-quarter-end reviews unless a contributing exchange failed the exchange eligibility criteria</td>
<td>All reference rates undergo a full review of each month. Any updates are announced and implemented based on the reconstitution timing</td>
<td>No</td>
</tr>
</tbody>
</table>
## Appendix 4: Document Revision History

<table>
<thead>
<tr>
<th>Timing</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/23/2023</td>
<td>Annual methodology performed including minor updates and clarifications and the modification included in the Methodology Changes appendix.</td>
</tr>
<tr>
<td>07/21/2023</td>
<td>Updates and clarifications to various sections.</td>
</tr>
<tr>
<td>2/16/2023</td>
<td>Inserted &lt;&lt;Monthly Review&gt;&gt; description under Reference Rate Maintenance section to provide additional clarification on potential additions/deletions of contributing exchanges between quarterly reviews.</td>
</tr>
<tr>
<td>12/21/2022</td>
<td>Clarification in Data Sources appendix related to the procedure to estimate notional volume.</td>
</tr>
<tr>
<td>10/9/2022</td>
<td>Minor edits</td>
</tr>
<tr>
<td>8/23/2022</td>
<td>Initial Version</td>
</tr>
</tbody>
</table>
Disclaimer

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