cfbenchmarks
a Kraken company

CF On-chain Interest Rate Index

Version: 1.0

February 2025

Contents

1 Version History

Version	Date Issued	Summary of Change	Owner
v1.0	20 February 2025	Document Creation	CF Benchmarks Management

2 Overview

In traditional finance, interest rate markets operate with settlement cycles typically measured in days, exemplified by the overnight rate. On-chain finance fundamentally transforms this paradigm through blockchain technology, where transactions settle within seconds of execution. This rapid settlement creates interest rate markets that evolve at the pace of block production, approximately 12 seconds per block on the Ethereum network. The resulting market dynamics enable unprecedented fluidity and responsiveness, as interest rates adjust continuously with each new block, reflecting real-time supply and demand conditions. This represents a significant evolution in financial infrastructure, enabling capital efficiency and flexibility not previously possible in traditional systems where rate adjustments and settlements operate on longer timeframes.

Despite this technological advancement, the variable nature of interest rates persists. The On-chain Interest Rate Index translates these blockchain-native rates into a standardized index that reflects realized interest rates, providing market participants with a reliable benchmark to track these rates across time. This index facilitates price discovery, risk management, and the development of derivative instruments based on on-chain interest rates.

The CF On-chain Interest Rate Index tracks annualized interest rates across protocols on various blockchains, providing a daily benchmark derived from 24-hour observations. It offers transparent analytics for market participants to assess opportunities and costs associated with digital asset transactions.

This methodology document outlines the calculation methods, input data, contingency rules, and other relevant specifications for the index.

3 Definitions

- **API**: Application programming interface.
- **Calculation Day**: Any day for which the Reference Rate is published.
- **Observation Window**: The time period used to collect interest rates for index calculation. For the Reference Rate, this refers to the 24-hour period prior to the final observation time on the Calculation Day.
- **Publication Time**: The designated time on each Calculation Day when the Reference Rate value is published.
- **Observation Period**: The atomic time unit of the blockchain network, during which system state may change. This fundamental time interval is defined in the Index Parameter Table for each blockchain network (e.g., a Slot for Ethereum, which occurs every 12 seconds regardless of whether a block is produced).
- **Asset Pool**: A specific cryptocurrency or digital asset market within a protocol.
- **Block**: A group of transactions bundled together and added to the blockchain. Each block contains transaction data and a timestamp.
- **Blockchain**: A distributed ledger that records transactions across many computers in a decentralized manner, ensuring security and transparency.
- **Target Blockchain**: The specific blockchain network on which the protocol is deployed.
- **Protocol**: A smart contract-based system that facilitates transactions of digital assets.
- **Interest Rate**: The rate applied to users who transact digital assets through a protocol.
- **Smart Contract**: Self-executing contracts with the terms directly written into code.

4 Methodology

4.1 Qualitative Description

The Reference Rate is calculated based on the interest rates observed from the designated protocol's asset pool on the target blockchain within a 24-hour observation window. The calculation steps on any given Calculation Day are as follows:

1. Interest rates are collected from the specified asset pool on the designated protocol over the 24-hour observation window prior to the final observation time on the Calculation Day.
2. For any observation period (e.g., slot) where no new block is proposed on the target blockchain, the last valid rate from the most recent block is used to forward fill the missing observation. This approach is consistent with how the protocol itself calculates interest during periods without new blocks. Importantly, an observation period without a proposed block is not considered missing data but rather a valid observation using the most recent rate.
3. The time-weighted average of the observed interest rates is calculated to produce the daily average interest rate.
4. This daily rate is then annualized using a 365-day convention to produce the final Reference Rate value.
5. The calculated Reference Rate value is published at the Publication Time on the Calculation Day, after the final interest rate within the observation window has been collected.

4.2 Mathematical Representation

The following table shows the symbols used in the mathematical representation of the index.

Symbol	Name	Description	Type
T	Calculation Day	The day for Reference Rate calculation	Parameter
IR_i	Interest rate	The ith interest rate observed during the observation window	Input
t_i	Time interval	The time interval in hours between the ith and $(i+1)$th observation	Parameter
n	Number of observations	Total number of interest rates collected within the 24-hour window	Parameter
IR_{avg}	Average interest rate	The time-weighted average of all observed interest rates during the 24-hour window	Intermediate
AF	Annualization Factor	The factor used to convert the 24-hour cumulative rate to an annual rate. The formulas are calculated based on the following conventions: simple compounding, UK Money Market day count fraction (365/ACT)	Parameter
IRI_T	On-chain Interest Rate Index	The annualized interest rate index value on Calculation Day T	Output

The Reference Rate as of the Publication Time on Calculation Day T is given by:

$$IR_{avg} = \frac{\sum_{i=1}^{n-1} IR_i \times t_i}{\sum_{i=1}^{n-1} t_i} \quad \text{(Eq. 1)}$$

$$IRI_T = IR_{avg} \times AF \quad \text{(Eq. 2)}$$

where $AF = 365$ and n equals the number of interest rates observed within the 24-hour window.

5 Contingency Calculation Rules

5.1 Delayed Data and Missing Data

Delayed data and missing data for the Reference Rate are treated according to the following rules:

1. The Reference Rate requires a minimum of 80% of hourly observations within the 24-hour observation window.
2. If fewer than 80% of observations are available, a Calculation Failure Event shall be declared by the Administrator (see Section 5.5).
3. If between 80% and 99% of observations are available, the time-weighted average is calculated using the available observations, with appropriate adjustments to the time intervals.
4. For observation periods where no new blocks are proposed on the target blockchain, the last valid interest rate observed will be used to forward fill the data for these periods. This is considered valid data, not missing data, and is consistent with how the protocol calculates interest accrual during periods without new blocks. There is no maximum duration for which forward filling is applied when no new blocks are proposed.
5. If a block has been proposed but the interest rate cannot be retrieved or is unavailable for that block, this is considered missing data. No alternative data sources or methods are used to substitute or estimate missing data.
6. If data is delayed such that the Reference Rate cannot be calculated by the Publication Time, a Delayed Calculation Event is triggered (see Section 4.3).

5.2 Erroneous Data

All interest rate observations retrieved by the Administrator for the determination of the index are subject to basic validation according to the following rules:

1. If an interest rate observation shows a non-numeric value or a value outside the range of 0% to 100% (annualized), it is flagged as erroneous.
2. If an interest rate observation is reported in a format that deviates from the expected format such that it cannot be parsed, it is flagged as erroneous.

Interest rate observations flagged as erroneous are treated as missing data, and the provisions of Section 4.1 apply.

5.3 Delayed Calculation & Publication

Where for any reason the Administrator is not able to calculate and publish the Reference Rate at the Publication Time on any given Calculation Day, a Delayed Calculation Event shall be declared. When a Delayed Calculation Event occurs:

1. The Administrator shall clearly communicate to all licensees via Statuspage that calculation and publication has been delayed.
2. The Administrator will continue to attempt to retrieve the required data at regular intervals.
3. The Administrator will seek to publish the Reference Rate for that Calculation Day as soon as it is able to.
4. Should the Administrator not be able to calculate and publish the Reference Rate by 23:59:59 London time, then the provisions of Rule 4.5 shall come into effect.

5.4 Expert Judgment

The Administrator does not utilize expert judgment in the day-to-day calculation of the Reference Rate. In extraordinary circumstances, Expert Judgment may be exercised by the Administrator in accordance with its codified policies and processes, which are available upon request.

5.5 Calculation Failure

If the Reference Rate cannot be calculated for a given Calculation Day before 23:59:59 London time, for instance because:

- Fewer than 80% of the required interest rate observations within the 24-hour window are available (note that observation periods with no proposed blocks but with valid forward-filled rates are not considered missing data), or
- A sufficient number of the required interest rate observations are flagged as erroneous, or
- The protocol's smart contracts are temporarily non-functional or inaccessible, or
- Target blockchain network congestion or outages prevent reliable data collection, or
- Any other reason or circumstance that prevents the orderly calculation of the Reference Rate,

then no Reference Rate value will be published for that Calculation Day.

The occurrence of any Reference Rate calculation failure is reported to the management team. Any Calculation Failure events will be clearly communicated to all licensees via Statuspage.

6 Restatement & Republishing

The Administrator may restate and republish the Reference Rate value where the published value is found to be incorrect. This will only occur if both the below conditions are met:

1. Timeliness – where the Administrator can RESTATE and REPUBLISH the Reference Rate value before 23:59:59 London time of the given Calculation Day.
2. Materiality – where the RESTATED index value has an absolute variance greater than 0.20% compared to the previously published value for the given Calculation Day.

Example:

- The Reference Rate on a given Calculation Day is published as 3.75%
- The Reference Rate will only be RESTATED if the corrected value is:
  - Greater than 3.95%
    OR
  - Less than 3.55%

Where the above conditions are met, the Administrator shall clearly communicate to all licensees via Statuspage that a restatement and republishing of the Reference Rate will take place for that Calculation Day.

The Administrator shall restate the impacted index value as soon as possible and shall do so by overwriting the previously published value. This restated index value will carry no mark when published and will be final and not subject to any further change or republication.

7 Parameters

7.1 Reference Rate Parameters

Parameter	CF AAVE USDC On-chain Interest Rate Index
Ticker Symbol	AUIRR
Protocol	AAVE V3
Target Blockchain	Ethereum
Asset Pool Name	USDC Pool
Rate Type Observed	Borrowing Rate
Asset Pool Address	0x98C23E9d8f34FEFb1B7BD6a91B7FF122F4e16F5c
Observation Period	One Slot (12 seconds on Ethereum)
Observation Window	8:00 AM London time on day T-1 excluded to 8:00 AM London time on day T included
Observation Frequency	Once per day
Publication Time	Between 8 AM and 8.30 AM London time

8 Index Specifications

	On-chain Interest Rate Index
Administrator	CF Benchmarks Ltd
Calculation Agent	CF Benchmarks Ltd
Description	Annualized interest rate for the specified asset pool on the designated protocol based on interest rate observations over a 24-hour window
Dissemination Time	Once per day, on each Calculation Day, at the Publication Time
Dissemination Precision	0.0001%
Data Source	Protocol Smart Contract via blockchain RPC nodes
Smart Contract Address	As specified in the Index Parameter documentation

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