CM Real-Time Reference Rates Methodology

Version 0

Last Revised: August 30, 2019

0 Change Log

Release	Date	Changes
Version 0	August 30, 2019	Finalized Real-Time Reference Rate Methodology v0 for Beta release.

1 Introduction

Coin Metrics produces the CM Real-Time Reference Rates (the "Real-Time Reference Rates"), a real-time price quoted in U.S. dollars for a set of cryptocurrencies. The Real-Time Reference Rates is designed to serve as a transparent and independent pricing source that promotes the functioning of efficient markets, reduces information asymmetries among market participants, facilitates trading in standardized contracts, and accelerates the adoption of cryptocurrencies as an asset class with the highest standards. The Real-Time Reference Rates is calculated using a robust and resilient methodology that is resistant to manipulation and adheres to international best practices for financial benchmarks, including the International Organization of Securities Commissions' (IOSCO) Principles for Financial Benchmarks. The Coin Metrics Oversight Committee (the "Oversight Committee") and an independent governance structure protect the integrity of the Real-Time Reference Rates and ensure the Real-Time Reference Rates serves as a source of transparent and independent pricing.

2 Description

The Real-Time Reference Rates are calculated once every second and represents the real-time price of one unit of the cryptocurrency quoted in U.S. dollars.

3 Coverage Universe

Coin Metrics produces the Real-Time Reference Rates for the following cryptocurrencies:

Name	Ticker
Bitcoin	btc
Ethereum	eth
Tether	usdt
Litecoin	ltc
Ripple	xrp
EOS	eos
Bitcoin Cash	bch
Dash	dash
ZCash	zec

Stellar	xlm
Monero	xmr
Qtum	qtum
Ethereum Classic	etc
TRON	trx
Binance Coin	bnb
NEO	neo
Bitcoin Cash SV	bsv
USD Coin	usdc
Cardano	ada
TrueUSD	tusd
OmiseGO	omg
Paxos Standard Token	pax
0x	zrx
Basic Attention Token	bat
Bitcoin Gold	btg
Augur	rep
NEM	xem
VeChain	vet
Zilliqa	zil
BitTorrent Token	btt
IOTA	miota
Status	snt
Ontology	ont
Waves	waves
ICON	icx
Dai	dai
Aeternity	ae
Enjin Coin	enj
Dogecoin	doge
Golem	gnt
Huobi Token	ht
BitShares	bts
IOST	iost

ELF	elf
Kyber Network	knc
Verge	xvg
ChainLink	link
Lisk	lsk
Tezos	xtz
Decentraland	mana
Crypto.com	mco
Mithril	mith
Steem	steem
Loopring	lrc
Storj	storj
Loom Network	loom
Polymath	poly
Bitcoin Diamond	bcd
Bytom	btm
Waltonchain	wtc
Theta Token	theta
Power Ledger	powr
Siacoin	sc
Stratis	strat
Nano	nano
Decred	dcr
Civic	cvc
Komodo	kmd
Nebulas	nas
WAX	wax
Bancor	bnt
DigiByte	dgb
Odyssey	ocn
FunFair	fun
HyperCash	hc_hypercash
Maker	mkr
Ardor	ardr

QASH	qash
TenX	pay
Metal	mtl_metal
iExec RLC	rlc
Raiden Network Token	rdn
Project Pai	pai
Gas	gas
Dent	dent
PIVX	pivx
Bytecoin	bcn
Arcblock	abt
Aion	aion
Eidoo	edo
GXChain	gxs
Enigma	eng
Groestlcoin	grs
Populous	ppt
Ripio Credit Network	rcn_ripiocreditnetwork
ZCoin	xzc
CyberMiles	cmt
Gemini Dollar	gusd
Matrix AI Network	man
Ethos	ethos
Cosmos	atom
Grin	grin
Gnosis	gno
Holo	hot_holo
MaidSafeCoin	maid
Nuls	nuls
QuarkChain	qkc
ReddCoin	rdd
Ravencoin	rvn
Horizen	zen
MonaCoin	mona

4 Data and Calculation Methodology

4.1 Data Sources

The input data source for the Real-Time Reference Rates are markets traded on cryptocurrency exchanges that are approved to serve as pricing sources by the Oversight Committee. The Oversight Committee evaluates markets using a Market Selection Framework that assesses markets along a wide set of criteria to determine if the data source reflects trading activity in a transparent and representative manner. The Oversight Committee evaluates new markets for inclusion as a selected data source and evaluates already selected markets using the Market Selection Framework on a quarterly basis or as market conditions warrant. Markets that are approved by the Oversight Committee are added to a list of selected markets (the "Selected Markets"). A separate list of Selected Markets is maintained for each Real-Time Reference Rates in the coverage universe.

A candidate market can be nominated for inclusion and an already selected market can be nominated for exclusion by any member of the public or member of the Oversight Committee. Public nominations for inclusion or exclusion of a market can be submitted in writing to support@coinmetrics.io. The Oversight Committee may convene to apply the Market Selection Framework to evaluate the inclusion or exclusion of a market between regularly-scheduled quarterly meetings if market conditions or circumstances warrant. Coin Metrics publishes a current list of Selected Markets for each of the Reference Rates, updates on inclusions or exclusions of exchanges, and the rationale for making any change.

4.2 Market Selection Framework

The Market Selection Framework consists of a fully-systematized process for evaluating markets to serve as input pricing sources for the calculation of the Reference Rates. It produces a unique set of candidate selected markets for each asset in the coverage universe that are then subsequently reviewed by the Oversight Committee. The market selection framework evaluates markets based on the following criteria:

1. Technology: An assessment of whether the technology infrastructure of the market's exchange provides sufficient availability and reliability for input data collection. Evaluates whether the exchange offers a REST API, Websocket feed, or FIX API suitable for data collection. Evaluates the performance of the API in terms of reliability and latency.

2. Legal and Compliance: An assessment of whether the market's exchange complies with laws and regulations. Evaluates the exchange's legal risk exposure, and whether it adheres to regulatory best practices. Evaluates whether the exchange has publicly-disclosed trading policies, uses market surveillance technology, and complies with national regulatory organizations, and enforces KYC and AML requirements. Evaluates whether the exchange has functioning fiat and cryptocurrency withdrawals processed within a normal timeframe. Evaluates whether a data sharing license can be executed with the exchange.

3. Business Model: An assessment of the market's exchange with respect to its business model, including its fee structure and asset listing standards.

4. Data Availability: An assessment of the available data the market's exchange offers for the given cryptocurrency, including the number of markets where the given cryptocurrency is the base currency, whether the markets are quoted in fiat currencies or other cryptocurrencies, and the type of markets offered.

5. Price: An assessment of the quality of the market's price data, including testing for the occurrence of price outliers and impactful price deviations from other markets, and implementing tests that determine whether the exchange's markets function as active markets in the underlying cryptocurrency and are anchored by observable transactions entered into at arm's length between buyers and sellers.

6. Volume: An assessment of the quality of the market's volume data, including testing for manipulated volume figures, and implementing tests that determine whether the exchange's markets function as active markets in the underlying cryptocurrency and are anchored by observable transactions entered into at arm's length between buyers and sellers. The size of the exchange's markets are also considered.

7. Order Book: An assessment of the quality of the market's order book data, including tests for manipulated orders, and implementing tests that determine whether the market function as active markets in the underlying cryptocurrency and are anchored by observable transactions entered into at arm's length between buyers and sellers. The liquidity of the market is also considered.

4.3 Data Inputs

The data inputs for the calculation of the Real-Time Reference Rates are observable transactions in an active market where the given cryptocurrency is traded. The pool of candidate markets that are evaluated by the Market Selection Framework are determined by a hierarchy of data inputs that varies depending on the given cryptocurrency. Coin Metrics publishes a list of current data inputs for each of the Real-Time Reference Rates, changes to the data inputs, and the rationale for making any change.

4.3.1 Bitcoin (BTC) and Ethereum (ETH)

The pool of candidate markets that are evaluated for the calculation of the Real-Time Reference Rates for Bitcoin (BTC) and Ethereum (ETH) are determined using the following data hierarchy:

1. The primary data input is observable transactions in an active market where the given cryptocurrency is the base currency and the quote currency is U.S. dollars.

2. Markets where the given cryptocurrency is the base currency and the quote currency is not U.S. dollars are not considered, including markets quoted in other fiat currencies or markets quoted in stablecoins.

4.3.2 Other Cryptocurrencies Excluding Stablecoins

The pool of candidate markets that are evaluated for the calculation of the Real-Time Reference Rates for other cryptocurrencies, excluding Bitcoin (BTC), Ethereum (ETH), and stablecoins are determined using the following data hierarchy:

1. The primary data input is observable transactions in an active market where the given cryptocurrency is the base currency and the quote currency is U.S. dollars.

2. If the above data inputs do not exist or the Oversight Committee makes a determination that the above data inputs are insufficient to calculate the reference rate, the universe of data inputs will expand to include observable transactions in an active market where the given cryptocurrency is the base currency and quote currency is BTC.

3. If the above data inputs do not exist or the Oversight Committee makes a determination that the above data inputs are insufficient to calculate the reference rate, the universe of data inputs will expand to include observable transactions in an active market where the given cryptocurrency is the base currency and quote currency is ETH.

4.3.3 Stablecoins

The pool of candidate markets that are evaluated for the calculation of the Real-Time Reference Rates for stablecoins are determined using the following data hierarchy:

1. The primary data input is observable transactions in an active market where the given stablecoin is the base currency and the quote currency is U.S. dollars.

2. If the above data inputs do not exist or the Oversight Committee makes a determination that the above data inputs are insufficient to calculate the reference rate, the universe of data inputs will expand to include observable transactions in an active market where Bitcoin (BTC) is the base currency and quote currency is the given stablecoin.

3. If the above data inputs do not exist or the Oversight Committee makes a determination that the above data inputs are insufficient to calculate the reference rate, the universe of data inputs will expand to include observable transactions in an active market where Ethereum (ETH) is the base currency and quote currency is the given stablecoin.

The data hierarchy for stablecoins differs from other cryptocurrencies because market convention sets stablecoins as the quote currency for the majority of active markets. The following cryptocurrencies in the coverage universe are considered to be stablecoins:

Name	Ticker
Tether	usdt
USD Coin	usdc
TrueUSD	tusd

Paxos Standard Token	pax
Dai	dai
Gemini Dollar	gusd

4.4 Calculation Algorithm

The calculation algorithm of the Real-Time Reference Rates is described below.

1. Every second, extract the most recent observable transaction from each of the selected markets.

2. Every second, calculate the volume denominated in units of the cryptocurrency from observable transactions that occurred over the trailing 60 minutes for each of the selected markets.

3. The price of each observable transaction for one unit of the given cryptocurrency is converted to U.S. dollars if necessary using the Real-Time Reference Rates calculated for Bitcoin (BTC) or Ethereum (ETH).

4. The volume-weighted median price (VWMP) of the most recent observable transactions is calculated, where the volume weighting is based on volume calculated in step two. The volume-weighted median rate is calculated by ordering the transactions from lowest to highest price, and identifying the price associated with the trades at the 50th percentile of volume. The resulting figure is the published reference rate.

4.5 Data Contingency Rules

The following contingency rules are followed to address situations where data is delayed, missing, or unavailable due to periods of illiquidity, extraordinary market circumstances, or outside factors beyond the control of Coin Metrics.

1. If observable transactions from a selected market are unable to be collected due to technical problems specific to the selected market's exchange during the calculation of the Real-Time Reference Rates, the observable transactions from the selected market are not included in the calculation of the specific instance of the given reference rate.

2. If no observable transactions from selected markets exist during the trailing 60 minutes, the value of the Real-Time Reference Rates will be determined to equal the value calculated during the previous second.

4.6 Data Exclusion Rules

The calculation of the Real-Time Reference Rates does not rely on any data exclusion rules.

5 Reference Rate Revisions

If errors are discovered in observable transactions used to calculate the reference rate or in the calculation process subsequent to the publication of the reference rate, a revised reference rate may be published within 8 hours of the Publication Time. Revisions will only be effected within 8 hours of the Publication Time and only if the change in the rate exceeds 1 percent of the original reference rate. A footnote will be published to indicate the revision of any reference rate.

6 Administration

Coin Metrics serves as the administrator for the Real-Time Reference Rates and has primary responsibility for all aspects of the Real-Time Reference Rates determination process, including the development, definition, determination, dissemination, operation, and governance of the Real-Time Reference Rates. All aspects of the production of the Real-Time Reference Rates are carried out by Coin Metrics, and Coin Metrics does not rely on any third parties for the determination of the Real-Time Reference Rates.

Coin Metrics ensures that transparency regarding significant decisions and associated rationale are published and made available to external stakeholders. Data contingency and data exclusion rules are in place to handle certain extraordinary circumstances and external factors beyond the control of Coin Metrics. The Oversight Committee reviews and provides challenge on the Real-Time Reference Rates production process.

7 Internal Oversight

The Oversight Committee provides independent oversight over the production of the Real-Time Reference Rates. The Oversight Committee's responsibilities include regular reviews of the Real-Time Reference Rates production process, the Real-Time Reference Rates definition and calculation methodology, the selection of data sources and data inputs, any uses of non-standard procedures, conflicts of interest, material changes to or termination of the Real-Time Reference Rates, reviewing the results of external and internal audits, and any complaints or questions regarding the Reference Rates from external stakeholders. Additional information regarding the responsibilities and membership of the Oversight Committee can be found in the Coin Metrics Operating Committee Charter document.

8 Conflicts of Interest

Coin Metrics enforces policies and procedures relating to conflicts of interest in connection with the production of the Real-Time Reference Rates. The conflicts of interest policy addresses the identification, disclosure, management, and mitigation of conflicts of interest. These policies and procedures are periodically reviewed by the Oversight Committee. Coin Metrics is committed to disclosing any material conflicts of interest to external stakeholders and to regulatory authorities.

9 Material Changes or Termination

Coin Metrics may initiate material changes to or terminate the Real-Time Reference Rates due to certain extraordinary market circumstances or external factors. These circumstances or external factors include, but are not limited to:

1. The Real-Time Reference Rates no longer serves, and could not be modified to serve, as a transparent and independent pricing source for the underlying cryptocurrency

2. The market liquidity in the underlying cryptocurrency declines to the extent that the input data sources no longer function as active markets

3. The underlying cryptocurrency experiences a contentious hard fork in which both forks survive

In such circumstances, Coin Metrics will review the Real-Time Reference Rates to ensure the Real-Time Reference Rates are properly reflecting their underlying cryptocurrencies, and if necessary, make changes to the methodology or definition of the Real-Time Reference Rates to properly account for changing market structure, circumstances, and conventions in the underlying cryptocurrency. Any such change or termination will be reviewed and approved by the Oversight Committee. Any approved change or termination will be publicly disclosed to external stakeholders with a detailed explanation of the rationale. In a manner appropriate to the circumstances, Coin Metrics will develop a plan to notify, solicit comments from, and consult with external stakeholders before implementing any material change or termination. Any change or termination will include a timeline explaining the timing of changes or termination and include steps to mitigate any negative effects on external stakeholders.

10 Internal Controls

Coin Metrics has implemented internal controls to protect the integrity of the Real-Time Reference Rates. These controls cover the selection of input data sources, the collection of data from input data sources, and maintaining the integrity of collected data. Staff involved with the production of the Reference Rates have been trained in the proper usage of the data and maintain proper segregation of responsibilities. Any exercise of non-standard procedures is subject to dual approval by staff members, and is logged and reported to the Oversight Committee which periodically reviews any incidents. In addition, Coin Metrics maintains a whistleblowing mechanism to facilitate the reporting of any potential misconduct.

11 Complaints

Complaints about the calculation methodology of the Real-Time Reference Rates or the value of a published Real-Time Reference Rates should be submitted in writing to support@coinmetrics.io. Coin Metrics will investigate any complaints and respond to the complainant in a fair and timely manner. Any investigation of the complaint will adhere to the following procedures:

1. The personnel receiving and investigating the complaint will be independent of any personnel who may have been involved in the subject of the complaint.

2. All records and documents submitted by the complainant and related to the investigation into the complaint will be retained for a period of at least five years and submitted to the Oversight Committee for review.

3. Any complaint that results in a change in the determination of the Real-Time Reference Rates, its calculation methodology, or its policies will be publicly disclosed that explain the action taken.

12 Internal Audit

The Oversight Committee appoints an independent internal auditor to review the Real-Time Reference Rates's adherence to its stated methodology, compliance with policies, and adherence to the IOSCO's Principles of Financial Benchmarks. The frequency of the independent internal audit is once annually.

13 Record Retention

Coin Metrics retains records, for at least five years, on the following items:

1. All market data that is collected and used in the calculation of the Real-Time Reference Rates

2. Any use of expert judgment in the calculation of the Real-Time Reference Rates

3. Any use of non-standard procedures in the calculation of the Real-Time Reference Rates

4. The identities of staff responsible for the calculation of the Real-Time Reference Rates

5. Any responses, questions, or complaints received in connection with the calculation of the Real-Time Reference Rates

14 Compliance

Coin Metrics maintains records and has processes in place to comply with requests for information from regulatory authorities. Coin Metrics commits to full cooperation with any regulatory authority in carrying out their regulatory or supervisory duties.