COIN PAYMENT PROCESSOR BITCOIN PRICE INDEX (iBTC) Methodology Guide

Version: 1.2

Version Date: 2018.04.02.

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1. Version History

Version	Date	Changes
v1.0	2018.01.22.	initial creation
v1.1	2018.03.12.	representative exchange list
v1.2	2018.04.02.	representative exchange list

2. Definitions

API: Application programming interface.

Web Socket: Computer communications protocol, providing full-duplex communication channels over a single TCP connection.

Calculation Day: Any day on which the iBTC is published.

Representative Exchanges: A bitcoin trading venue elected by the PS Invest analytics research to serve as pricing source for the calculation of the BTC and fiat currency pair.

Representative Fiat currencies: Official currencies of the most important markets in a global bitcoin trading volume elected by the PS Invest analytics research to serve as pricing source for the calculation of the BTC Price Index.

Relevant Transaction: Any bitcoin versus Representative Fiat currency spot trade that occurs during the TWAP Period on a Representative Exchange and that is recorded on Price Index raw data base of Calculation Agent.

Retrieval Time: 00:00 p.m. GMT - London time on a given Calculation Day, as given by the server clock of the Calculation Agent.

TWAP Period: The 10 second period up to and including 00:00 p.m. GMT -London time on a given Calculation Day.

Calculation Agent: A company that makes Price Index operation fully transparent and open to public.

Price Index raw data base: A database with raw data recorded from Representative Exchanges.

3. Summary Description

The BITCOIN PRICE INDEX “iBTC” is a reference rate of the Representative Fiat currencies price of one bitcoin calculated over 10 seconds period of time. It is representative of the bitcoin trading activity on Representative Exchanges and is geared towards resilience and replicability.

Name	BITCOIN PRICE INDEX
Ticker Symbol	iBTC
Administrator	Professional Stock Invest Inc.
Calculation Agent	Professional Stock Invest Inc.
Description	Price of one Bitcoin in Representative fiat currencies (USD, EUR, KRW, JPY, CNY) calculated every 10 sec.
Calculation Methodology	Aggregation of trade executions occurring on Representative Exchanges with fiat currencies in real time, 24/7.
Dissemination Time	Every 10 seconds, every day of the year including weekends and holidays, 24/7/365.
Dissemination Process	0.01 (1/100)

4. Methodology and Rules

4.1 Methodology

4.1.1 Qualitative Description

The iBTC is calculated based on the Relevant Transactions of all Representative Exchanges.

Calculation steps for the iBTC on any given Calculation Day are as follows:

1. All Relevant Transactions are added to a raw database, recording the trade price and size for each transaction.
   Raw data consist of data in this form:

Date	Time	Type	Price	Amount	ID	Exchange
YYYY-MM-DD	HH-MM-SS	bid/ask	string	string	string	string

2. The data is partitioned into 6 equally-sized time intervals of 10 seconds each.

3. For each partition separately, the volume-weighted median trade price is calculated from the trade prices and sizes of all Relevant Transactions, i.e. across all Representative Exchanges. A volume-weighted median differs from a standard median in that a weighting factor, in this case trade size, is factored into the calculation.

4. The iBTC is then given by the equally-weighted average of the volume-weighted medians of all partitions.

4.1.2 Mathematical Representation

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

Symbol	Name	Description	Type
T	Effective time	The time as of which the *iBTC* is calculated	Parameter, set to 00:00 GMT London time
t	TWAP period length	The length of time period prior to the effective time during which transaction data is collected	Parameter, set to 1 minute
$\hat{t}$	Partition length	The length of time periods into which the TWAP period length is partitioned	Parameter, set to 10 seconds
X	TWAP period trades	The time-ordered collection of price/size trade pairs observed on all Representative Exchanges between T-t and T	Input
x_i	TWAP period trade	The i^{th} price/size trade pair	Input
p_i	TWAP period trade price	The price of the i^{th} price/size trade pair	Input
s_i	TWAP period trade size	The size of the i^{th} price/size trade pair	
K	Number of partitions	The number of partitions given by $K = t / \hat{t} = 6$	Output
k	Partition	The k^{th} partition	Output
WM_k	Weighted median	The weighted median trade price for a partition k	Output
$iBTC_T$	*iBTC*	The *iBTC* at time T	Output

For each of $K = t / \hat{t} = 6$ partitions k, the volume weighted median trade prices WM_k across all Relevant Transaction is calculated :

$$WM_k = p_j \ \ where \ \ x_j \ \ satisfies \ \sum_{i=1}^{j-1} s_i < \frac{\sum_{i=1}^{I_k} s_i}{2} \ \ and \ \sum_{i=j+1}^{I_k} s_i \leq \frac{\sum_{i=1}^{I_k} s_i}{2}$$

$$If \ \sum_{i=j+1}^{I_k} s_i = \frac{\sum_{i=1}^{I_k} s_i}{2}, \ then \ \ WM_k = \frac{p_j + p_{j+1}}{2}$$

Where i is the i^{th} of a total of I_k price/size trade pairs observed in portion k.

The *iBTC* as of the effective time *T*, $iBTC_T$, is then given by:

$$iBTC_T = \frac{\sum_{k=1}^{K} WM_k}{K}$$

4.2 A Note on Properties

The calculation methodology immunizes the iBTC to a high degree against price anomalies, while being replicable through spot trading on Representative Exchanges. This is achieved through the following design choices:

Partitions

The iBTC is calculated as the equally-weighted average of the intermediate calculation steps for the 6 partitions. A single large trade or cluster of trades occurring in any of these partitions will therefore only have a limited effect on the iBTC.

Weighting of Partitions

Partitions are equally-weighted (as opposed to volume-weighted) to facilitate iBTC replication through trading on Representative Exchanges. A trader aiming to transact bitcoins at the iBTC can do so with little tracking error by transacting bitcoins during each partition.

Medians

Bitcoin spot prices have historically varied considerably across trading venues, in particular in times of high volatility. The use of medians to calculate the weighted median trade price for each partition (as opposed to averages) greatly reduces the iBTC susceptibility to price extremes on one or more Representative Exchanges.

Volume-Weighting of Medians

Bitcoin trading is driven to some extent by automated algorithms that are able to execute a high number of small trades. The use of volume-weighted medians to calculate the weighted median trade price for each partition (as opposed to simple medians) assures that the iBTC appropriately reflects large trades and that there are no effects on calculation results, whether an order is executed in parts or in full.

5. Contingency Calculation Rules

5.1 Delayed Data and Missing Data

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

1. Any Relevant Transaction for a given Calculation Day that, for any reason, cannot be retrieved by the Calculation Agent from a Representative Exchange's API or WEB Socket by the Retrieval Time is disregarded in the calculation of the iBTC for that Calculation Day.

2. If no Relevant Transaction occurs on a Representative Exchange on a given Calculation Day or one or more Relevant Transactions occur but for any reason cannot be retrieved by the Calculation Agent, the Representative Exchange is disregarded in the calculation of the iBTC for that Calculation Day.

3. If, for any of the 6 partitions of the TWAP Period, no Relevant Transaction occurs on any Representative Exchange or one or more Relevant Transactions occur but for any reason cannot be retrieved by the Calculation Agent, the partition remains empty and will be disregarded in the calculation of the iBTC for that Calculation Day. The denominator in Eq. 2 will then be decremented by the number of empty partitions.

4. If no Relevant Transaction occurs on any Representative Exchange on a given Calculation Day or one or more Relevant Transactions occur but for any reason no Relevant Transaction can be retrieved from any Representative Exchange by the Calculation Agent, an iBTC calculation failure occurs for that Calculation Day (see Section 5.4).

5.2 Erroneous Data

All Relevant Transactions retrieved by the Calculation Agent for a given Calculation Day are subject to an automated screening for erroneous data according to the following rules:

1. If a Relevant Transaction shows a non-numeric or non-positive trade price or trade size, it is flagged as erroneous.

2. If a Relevant Transaction is reported in a format that deviates from the expected format such that it cannot be parsed, it is flagged as erroneous.

Relevant Transactions flagged as erroneous for a given Calculation Day are disregarded in the calculation of the iBTC for that Calculation Day.

If all Relevant Transactions of all Representative Exchanges are flagged as erroneous for a given Calculation Day, an iBTC calculation failure occurs for that Calculation Day (see Section 5.4).

5.3 Potentially Erroneous Data

All Relevant Transactions retrieved by the Calculation Agent for a given Calculation Day are subject to an automated screening for potentially erroneous data according to the following rules:

1. For each Representative Exchange individually, the volume-weighted median trade price across all Relevant Transactions of that Constituent Exchange is calculated.

2. For each Representative Exchange, the absolute percentage deviation of the volume-weighted median trade price, as calculated in the previous step, from the median of the volume-weighted median trade prices of all Representative Exchanges is calculated.

3. If for any Representative Exchange the absolute percentage deviation, as calculated in the previous step, exceeds 25%, all Relevant Transactions of that Representative Exchange are flagged as potentially erroneous.

Relevant Transactions flagged as potentially erroneous for a given Calculation Day are disregarded in the calculation of the iBTC for that Calculation Day. The occurrence of any such flag is reported to the Oversight Committee.

If all Relevant Transactions of all Representative Exchanges are flagged as potentially erroneous for a given Calculation Day, an iBTC calculation failure occurs for that Calculation Day (see Section 5.4).

5.4 iBTC Calculation Failure

If the iBTC cannot be calculated for a given Calculation Day, for instance because:

1. no Relevant Transaction occurs on any Representative Exchange on that Calculation Day, or
2. one or more Relevant Transactions occur but for any reason cannot be retrieved by the Calculation Agent, or
3. all Relevant Transactions retrieved by the Calculation Agent are flagged as erroneous or potentially erroneous (see Section 5.2); or
4. any other reason or circumstance that prevents the orderly calculation of the iBTC,

Then the iBTC for that Calculation Day is given by the iBTC published on the previous Calculation Day. The occurrence of any iBTC calculation failure is reported to the Oversight Committee.

Apendix 1. - REPRESENTATIVE EXCHANGE LIST

No.	Exchange	WEB Socket	Rest API	BTC/ USD	BTC/ EUR	BTC/K RW	BTC/ JPY	BTC/C NY
1.	Binance	NO_2	OK	X				
2.	BitBay	NO_1	OK	X	X			
3.	Bitfinex	OK_1		X				
4.	bitFlyer	OK_3					X	
5.	Bithumb	NO_1	OK			X		
6.	Bitstamp	NO_1	OK	X	X			
7.	Bittrex	NO_2	OK	X				
8.	BTC Box		OK				X	
9.	CEX io	NO_2	OK	X	X			
10.	Coinnest	NO_1	OK			X		
11.	Coinone	NO_1	OK			X		
12.	Exmo	NO_1	OK	X	X			
13.	Exx	OK_1		X				
14.	Fisco	OK_1					X	
15.	Gate io	NO_1	OK	X				
16.	GDAX	OK_1		X	X			
17.	Gemini	OK_1		X				
18.	HitBTC	OK_1		X				
19.	Korbit	NO_1	OK			X		
20.	Kraken	NO_1	OK	X	X			
21.	Kucoin	NO_1	OK	X				
22.	LakeBTC	NO_1	OK	X			X	
23.	Liqui	NO_1	OK	X				
24.	Livecoin	NO_1	OK	X	X			
25.	OKEx	OK_1		X				
26.	Poloniex	OK_1		X				
27.	Quolne	NO_1	OK	X	X		X	X
28.	WEX	NO_1	OK	X	X			
29.	YoBit	NO_1	OK	X				
30.	Zaif	OK_1					X	
31.	zbcom	OK_1		X				

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