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## **Guide to the Calculation of the FTSE DAR Digital Asset Prices and FTSE DAR Reference Prices In Association with Digital Asset Research v1.0**

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## Contents

<b>1.0</b>	<b>Introduction.....</b>	<b>3</b>
<b>2.0</b>	<b>Management Responsibilities .....</b>	<b>4</b>
<b>3.0</b>	<b>FTSE DAR Digital Asset Prices .....</b>	<b>6</b>
<b>4.0</b>	<b>FTSE DAR Reference Prices.....</b>	<b>9</b>



## Section 1

# Introduction

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### 1.0 Introduction

1.1 This document sets out the methodology for the calculation of the FTSE DAR Digital Asset Prices and the FTSE DAR Reference Prices. This document should be read in conjunction with the Guide to the Vetting of Digital Assets and Digital Asset Exchanges document which is available at [www.ftserussell.com](http://www.ftserussell.com).

1.1.1 A digital asset is a Cryptographically Secured Digital Instrument for which the issuance, transfer and ownership is recorded on a data structure commonly referred to as a Blockchain.

### 1.2 FTSE Russell

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1.3 FTSE Russell does not make any representation or warranty, express or implied, as to the accuracy, completeness or correctness of the FTSE DAR Digital Asset Prices or the FTSE DAR Reference Prices.

1.4 No liability whether as a result of negligence or otherwise is accepted by FTSE Russell (or any person concerned with the preparation or publication of this Guide to Calculation) for any losses, damages, claims and expenses suffered by any person as a result of:

- any reliance on this Guide to Calculation, and/or
- any errors or inaccuracies in this Guide to Calculation, and/or
- any non-application or misapplication of the policies or procedures described in this Guide to Calculation.



## Section 2

# Management Responsibilities

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## 2.0 Management Responsibilities

### 2.1 FTSE International Limited (FTSE)<sup>1</sup>

2.1.1 FTSE is responsible for the calculation, production and operation of the FTSE DAR Reference Prices.

2.1.2 FTSE is the administrator of the FTSE DAR Reference Prices – Benchmark Assets.

2.1.3 FTSE will:

- maintain records of the prices of all digital assets for which FTSE DAR Digital Asset Prices and FTSE DAR Reference Prices are calculated;
- make changes to the digital assets for which FTSE DAR Digital Asset Prices and FTSE DAR Reference Prices are calculated in accordance with the Guide to the Vetting of Digital Assets and Digital Asset Exchanges;
- publish changes to the digital assets for which FTSE DAR Digital Asset Prices and FTSE DAR Reference Prices are calculated resulting from their ongoing maintenance and in accordance to the Guide to the Vetting of Digital Asset and Digital Asset Exchanges;
- disseminate the prices.

### 2.2 Digital Asset Research

2.2.1 Digital Asset Research (DAR) is the calculation agent for the FTSE DAR Digital Asset Prices. DAR assesses the quality of pricing data, qualifies pricing sources, and supplies FTSE Russell with price feeds.

2.2.2 DAR is an independent, privately-owned research firm and data provider which partners with FTSE Russell in research into and providing data on digital assets.

2.2.3 DAR is responsible for the ongoing vetting of digital assets and of the Broker Dealer/Exchanges of digital assets as set out in the Guide to the Vetting of Digital Assets and Digital Asset Exchanges. DAR collects and validates the data it obtains as Principal to ensure both digital assets and Broker Dealer/Exchanges of digital assets pass a strict set of rules.

### 2.3 Amendments to this Guide to Calculation

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<sup>1</sup> The term administrator is used in this document in the same sense as it is defined in [Regulation \(EU\) 2016/1011 of the European Parliament and of the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds](#) (the European Benchmark Regulation).

- 2.3.1 This Guide to Calculation shall be subject to regular review by FTSE Russell to ensure that it continues to best reflect the aims of the FTSE DAR Digital Asset Prices and FTSE DAR Reference Prices. The feedback from these reviews will be considered by the FTSE Russell Product Governance Board before approval is granted for any change to the methodology.



## Section 3

# FTSE DAR Digital Asset Prices

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### 3.0 FTSE DAR Digital Asset Prices

#### 3.1 Overview

3.1.1 The FTSE DAR Digital Asset Prices are calculated by DAR for FTSE Russell and are used in the calculation of the FTSE DAR Reference Prices. The FTSE DAR Digital Asset Prices are calculated in US Dollars.

3.1.2 Digital assets are quoted in terms of a trading pair, similar to foreign exchange currency quotes. Transactions can be made from a fiat currency to digital asset or from digital asset to digital asset.

3.1.3 As part of the FTSE DAR Digital Asset Price calculation, each digital asset price is converted into US Dollars using one or more of the following conversions, as necessary, in order of operations:

- a) The digital asset to US Dollars transaction if it is available;
- b) The digital asset to eligible Fiat currency transaction if it is available, then the Fiat to US Dollars;
- c) The digital asset to Bitcoin (BTC), Tether (USDT), or Ethereum (ETH) transaction and then the Bitcoin, Tether or Ethereum to US Dollars transaction;
- d) The digital asset to Bitcoin or Ethereum transaction, the Bitcoin or Ethereum to Tether quote, and then Tether quote to US Dollars.

3.1.4 Only transactions from eligible exchanges, as set out in the Guide to the Vetting of Digital Asset and Digital Asset Exchanges, are used in the calculation of the FTSE DAR Digital Asset Prices.

#### 3.2 Calculation

3.2.1 The calculation of the FTSE DAR Digital Asset Price consists of several steps and the use of four separate time windows of digital asset price and volume data from each eligible exchange.

1. One Hour Price Window – this is the most recent price and volume data on eligible exchanges over the last hour and is used if there are no previous VWAP price aggregations available for a digital asset. A set of data is obtained for each currency a digital asset price is quoted against (both Fiat and other digital assets). This data is used to create a 1-hour Initialization VWAP and is the source of data for shorter time windows.
2. Twenty Minute Price Window – consists of the most recent 20 minutes of price and volume extracted from eligible exchanges. This price and volume data are used to create the VWAP

Bitcoin to US Dollar and Ethereum to US Dollar conversion rates at the exchange level and across all eligible exchanges.

3. Ten Minute Price Window – is the most recent 10 minutes of data from eligible exchanges. This data provides the window from which outlier tests are applied.
4. Fifteen Second Price Window – is the most recent 15 seconds of data from eligible exchanges. This window forms the basis of the FTSE DAR Digital Asset Price

3.2.2 The FTSE DAR Digital Asset Price is the volume weighted average US Dollar price of a digital asset from all eligible exchanges:

$$FTSE\ DAR\ Digital\ Asset\ Price_i = \frac{\sum_x Volume_{x,i} \cdot Price\ in\ USD_{x,i}}{\sum_x Volume_{x,i}}$$

where  $Volume_{x,i}$  is the volume of the digital asset  $i$  traded on exchange  $x$  in units of the digital asset and  $Price\ in\ USD_{x,i}$  is the price in US Dollars digital asset  $i$  traded on exchange  $x$

### 3.3 Initialization VWAPs and Conversion VWAPs

3.3.1 In the absence of any previously aggregated prices, an initialization volume weighted average price is calculated from the raw price and volume data. The initialization VWAP is used as a reference if there is no previous FTSE DAR Digital Asset Price available.

3.3.2 An initialization VWAP is determined for each digital asset on each exchange as follows:

1. Retrieve raw trade data for the One Hour Price Window ( $t = -3600$  seconds to  $t = 0$  seconds).
2. Calculate a one-hour ( $t = -3600$  seconds to  $t = 0$  seconds) VWAP for each available digital asset-currency pair, on each eligible exchange; this is a 1-hour Initialization VWAP for the digital asset-currency.
3. Digital Assets that do not trade in an eligible fiat currency, but do trade in units of Bitcoin, Ethereum or Tether (USDT) or other Fiat currencies then use either the Exchange Conversion Rate or the Global Conversion Rate:
  - i. Exchange Conversion Rate - this is a 20-minute price window (period  $t = -1200$  seconds to  $t = 0$ ) VWAP for Bitcoin to US Dollars and Ethereum to US Dollars within each vetted exchange. On exchanges where Bitcoin and Ethereum do not trade in US Dollars but do trade in Tether, the 20-minute VWAP in Tether is then converted to US Dollars using the Global Conversion Rate (Rule 6.3.2 3 ii).
  - ii. Global Conversion Rate - this is a 20-minute price window (period  $t = -1200$  seconds to  $t = 0$ ) VWAP for Bitcoin and Ethereum in US Dollars across all Eligible Exchanges, and for Bitcoin and Ethereum in Tether across all Eligible Exchanges.
  - iii. Fiat to US Dollar exchange rates are currently sourced from Alpha Vantage ([www.alphavantage.co](http://www.alphavantage.co))
4. Convert all non-US Dollar Initialization VWAPs (step 2) to US Dollars using either the Fiat to US Dollar conversion, the Exchange Conversion Rate or, if no Exchange Conversion Rate is available, the Global Conversion Rate.
5. Calculate a one-hour Initialization VWAP in US Dollars for each digital across all eligible exchanges. This Initialization VWAP is used in the absence of any previously calculated FTSE DAR Digital Asset Price.

### 3.4 FTSE DAR Digital Asset Live Price

3.4.1 The live price is a 15 second VWAP, updated every 15 seconds, determined using the following:

1. Obtain the most recent ten-minute price window ( $t = -600$  to  $t = 0$  seconds).
2. Convert all non-US Dollar VWAPs from to US Dollar using either the Fiat to US Dollar conversion, the Exchange Conversion Rate or if no Exchange Conversion Rate is available, the Global Conversion Rate.
3. For each asset within an eligible exchange, regardless of pair, compare the most recent 15 Seconds Price Window ( $t = -15$  seconds to  $t = 0$  seconds) to the ten-minute price window from (1) and apply the following filters:
  - i. Remove all duplicate trades
  - ii. Remove trades that fall  $\geq 2.5$  standard deviations from the mean.
4. Update the most recent 15 seconds of data in the ten-minute price window with the filtered 15 seconds of data from Step 2.
5. Calculate a 15 second ( $t = -15$  seconds to  $t = 0$  seconds) VWAP for each available digital asset-currency pair, on each eligible exchange.
6. Calculate a 15 second VWAP in US Dollars for each digital asset across all eligible exchanges. This is the FTSE DAR Digital Asset Price.
7. If no trades have been made in the most recent 15 seconds, the previous FTSE DAR Digital Asset Price is used. If there is no previously available FTSE DAR Digital Asset Price the Initialization VWAP is used.
8. Repeat the process every 15 seconds.



## Section 4

# FTSE DAR Reference Prices

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### 4.0 FTSE DAR Reference Prices

4.1 The FTSE DAR Reference Prices are an hourly fixing of all digital assets for which a FTSE DAR Digital Asset Price is calculated.

4.1.1 The prices are separated into two files:

(1) The FTSE DAR Reference Prices – Benchmark Assets are calculated from prices sourced entirely from vetted exchanges as outlined in the Guide to the Vetting of Digital Assets and Digital Asset Exchanges. The FTSE DAR Reference Prices - Benchmark Assets can be used in the European Union (as “use” is set out in article 3(1)(7) of the EU Benchmark Regulation and the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds in the European Union) (the “EU BMR”).

(2) The FTSE DAR Reference Prices – Non-Benchmark Assets are calculated from prices not sourced entirely from vetted exchanges as set out in the Guide to the Vetting of Digital Assets and Digital Asset Exchanges. The FTSE DAR Reference Prices - Non-Benchmark Assets are not EU BMR compliant and are not to be used in the European Union (as “use” is set out in article 3(1)(7) of the EU Benchmark Regulation and the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds in the European Union) (the “EU BMR”) and accordingly, the EU BMR does not apply to the FTSE DAR Reference Prices – Non-Benchmark Assets. Consequently, supervised entities (as “supervised entities” is set out in article 3(1)(17) of the EU BMR) within the European Union are not permitted to use the FTSE DAR Reference Prices – Non-Benchmark Assets as benchmarks as set out in article 3(1)(7) of the EU BMR.

4.1.2 The FTSE-DAR Reference Price is determined as the volume time weighted average of the FTSE DAR Digital Asset Price over the 15-minute period before the fixing time. For example, the fix at 4.00pm would take all prices published every 15 seconds in the observation window from 3.45pm to 4.00pm inclusive (61 observations):

$$FTSE\ DAR\ Reference\ Price = \frac{\sum_{t=1}^{61} w_t \times FTSE\ DAR\ Digital\ Asset\ Price_t \times Volume_t}{\sum_{t=1}^{61} w_t \times Volume_t}$$

Where *FTSE DAR Digital Asset Price<sub>t</sub>* is the price of the digital asset at time, *t* and *Volume<sub>t</sub>* is the volume traded in the digital asset in the 15 second period over which the

**FTSE DAR Digital Asset Price<sub>t</sub>** is determined. The integer **t** corresponds to the observation, counting down from **t = 61** at the start of the observation period to **t = 1** at the fixing time.

- 4.1.3 The weights,  $w_t = \frac{w'_t}{\sum w'_t}$ , where the un-normalized weights  $w'_t = \left\{ \frac{1}{61}, \frac{1}{60}, \dots, \frac{1}{2}, \mathbf{1} \right\}$  are inversely proportional to the time **t**.



## Appendix A: Further Information

Further information on the FTSE DAR Digital Asset Prices and the FTSE DAR Reference Prices is available from FTSE Russell.

For contact details please visit the FTSE Russell website or contact FTSE Russell client services at [info@ftserussell.com](mailto:info@ftserussell.com).

Website: [www.ftserussell.com](http://www.ftserussell.com)

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