



DIGITAL  
ASSET  
RESEARCH

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# DAR Intraday Price Methodology

v1.3

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# 1. Overview

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The DAR Intraday Price is a volume-weighted average price (VWAP) derived from eligible, non-outlier trades that occur within a 15-second window. Prices are calculated for each of the following intervals within a given minute: 0:00, 0:15, 0:30, 0:45.

The DAR Intraday Principal Market Price is a volume-weighted average price (VWAP) derived from eligible, non-outlier trades that occur on the exchange with the highest trading volume within a 15-second window. Prices are calculated for each of the following intervals within a given minute: 0:00, 0:15, 0:30, 0:45.

This methodology provides a glossary of key definitions and details on price tiers, conversion, trade outlier filtration, and the intraday price calculation.

## 2. Key Definitions

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Term	Definition
Asset	The digital asset that is being priced
DAR Intraday Price	The value of an Asset as of a specific time at the end of an Intraday Time Window, as derived from eligible pairs across Eligible Exchanges using the calculation described in this document.
DAR Intraday Principal Market Price	The value of an Asset on the Principal Market as of a specific time at the end of an Intraday Time Window, as derived from eligible pairs on the Principal Market using the calculation described in this document
Eligible Exchanges	The exchanges from which pricing data is sourced when valuing the asset; eligible exchanges are determined based on an asset's price tier
Eligible Trades	The trades that remain after trade-level outlier filtering and are considered during price calculation
Intraday Time Window	The 15-second period directly before the DAR Intraday Price is calculated
Price Tier	A tier rating for the price based on DAR's Exchange Vetting process; see <a href="#">Price Tiers</a>



Principal Market	The exchange where the highest trading volume occurred during the Intraday Time Window
Quote Currency	The digital or fiat currency in which the asset is being valued. Digital asset quote currencies include BTC and ETH; stablecoin quote currencies include USDC and USDT; and fiat quote currencies include USD, GBP, EUR, and JPY.
Vetted Exchanges	Digital Asset Exchanges that have passed all of DAR's quantitative and qualitative criteria. These are the most trustworthy exchanges that are not known to report inflated volumes and have robust policies and practices in place to prevent manipulative behavior by customers. See the <a href="#">DAR Exchange Vetting Methodology</a> for additional details.
Watchlist Exchanges	Digital Asset Exchanges that have passed only DAR's preliminary vetting, which includes data science testing and some qualitative diligence. These exchanges are not known to report inflated volumes or have manipulated transactions but may not have institutional policies and practices in place in order to prevent future manipulation and pass full vetting. See the <a href="#">DAR Exchange Vetting Methodology</a> for additional details.
$i$	The $i$ -th trade, where $i$ is a variable that represents any trade in the sequence of trades being considered in the calculation, i.e. the 4th trade or the 5th trade
$V_i$	Volume of the $i$ -th trade
$P_i$	Price of the $i$ -th trade
$VWAP$	Volume-Weighted Average Price, calculated as follows: $VWAP = \frac{\sum_i V_i \times P_i}{\sum_i V_i}$

### 3. Price Tiers

A price's tier level is determined by the number of Vetted Exchanges and Watchlist Exchanges on which it is present and other price correlation factors.



Tier	Requirements
Tier 1	<ul style="list-style-type: none"><li>• Asset must be present on a minimum of 2 Vetted Exchanges</li><li>• The asset's price correlation between Vetted Exchanges and Watchlist Exchanges must be greater than 0.5</li></ul>
Tier 2	<ul style="list-style-type: none"><li>• Asset must be present on a combination of at least 2 Vetted Exchanges and Watchlist Exchanges</li></ul>
Tier 3	<ul style="list-style-type: none"><li>• Asset is present on 1 or fewer Vetted Exchanges and Watchlist Exchanges<ul style="list-style-type: none"><li>◦ Prices calculated for Tier 3 assets include trades from exchanges that are not Vetted Exchanges or Watchlist Exchanges</li></ul></li></ul>

## 4. Conversion to USD

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As an initial step in DAR Intraday Price calculation, all trades with non-USD quote currencies are converted to USD.

### 4.1 Fiat Conversion

If the Quote Currency for a trade is EUR, GBP, or JPY, then FX rates from Alpha Vantage or Polygon.io are used for the conversion.

FX rates are updated each minute and trades are converted to USD using the most recent conversion rate that is prior to the time of the trade.

### 4.2 Stablecoin Conversion

If the Quote Currency for a trade is USDC or USDT, then the trade is converted as follows:

- The previous 10 minutes of trades for each USD-stablecoin pair are collected.
- A VWAP for the stablecoin is calculated for each Eligible Exchange on which the stablecoin trades; this is referred to as the Local Conversion Rate.
- A VWAP for the stablecoin is calculated for all Eligible Exchanges on which the stablecoin trades; this is referred to as the Global Conversion Rate.
- A USD price is calculated for each trade with a stablecoin Quote Currency.
  - If the exchange on which the trade was made has a Local Conversion Rate, then this rate is used in the calculation.
  - If the exchange on which the trade was made does not have a Local Conversion Rate, then the Global Conversion Rate is used in the calculation.



## 4.3 Digital Asset Conversion

If the Quote Currency for a trade is BTC or ETH, then the trade is converted as follows:

- The previous 10 minutes of trades for each BTC-fiat and ETH-fiat pair are collected.
- A VWAP for the digital asset Quote Currency is calculated for each Eligible Exchange on which the digital asset trades; this is referred to as the Local Conversion Rate.
- A VWAP for the digital asset Quote Currency is calculated for all Eligible Exchanges on which the digital asset trades; this is referred to as the Global Conversion Rate.
- A USD price is calculated for each trade with a digital asset Quote Currency.
  - If the exchange on which the trade was made has a Local Conversion Rate, then this rate is used in the calculation.
  - If the exchange on which the trade was made does not have a Local Conversion Rate, then the Global Conversion Rate is used in the calculation.

## 5. Trade Outlier Filtration

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After conversion to USD and prior to calculating the DAR Intraday Price, trades are filtered at the exchange level and trade level to identify and remove outliers.

### 5.1 Exchange-Level Outlier Filtering

Trades are initially filtered at the exchange level using the following process:

- All trades for a given asset from within the 15-second Intraday Time Window are collected to form the data set.
- Using the data set, a VWAP for the asset is calculated for each exchange on which the asset trades.
- Using the set of exchange VWAP values for the asset, a mean VWAP value and standard deviation values are calculated.
- Any exchange with a VWAP value for the asset that is not within 1.5 standard deviations of the mean will have its trades excluded from the DAR Intraday Price calculation.

### 5.2 Trade-Level Outlier Filtering

Trades are then filtered at the trade level using the following process:

- All trades for a given asset that from within the most recent 10-minute period are collected to form the data set.



- Using the data set, calculate the mean price and standard deviation values for each asset.
- Any trade that has a price that is not within 2.5 standard deviations of the mean is excluded from the DAR Intraday Price calculation.
- The final data set of remaining trades is known as Eligible Trades.

## 6. DAR Intraday Price Calculation

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The DAR Intraday Price is the price of an Asset as derived from trades within the Intraday Time Window and is calculated as follows:

1. Aggregate all trades for a single Asset on all Eligible Exchanges that were made during the Intraday Time Window.
  - a. If there are no trades during the Intraday Time Window, the Intraday Time Window is iteratively extended back in 15-second increments until a minimum of one trade is collected in a given period.
2. Convert [non-USD Quote Currencies to USD](#).
3. Remove outlier trades using the [Trade Outlier Filtration](#) process to determine Eligible Trades.
4. Derive the DAR Intraday Price by calculating a VWAP of all Eligible Trades (non-outlier trades) within the Intraday Time Window.

## 7. DAR Intraday Principal Market Price Calculation

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The DAR Intraday Principal Market Price is a time-weighted average price (TWAP) of the Asset on the exchange that saw the highest trading volume during the Intraday Time Window and is calculated as follows:

1. Aggregate all trades for a single Asset on all Eligible Exchanges that were made during the Intraday Time Window.
  - a. If there are no trades during the Intraday Time Window, the Intraday Time Window is iteratively extended back in 15-second increments until a minimum of one trade is collected in a given period.
2. Convert [non-USD Quote Currencies to USD](#).
3. Remove outlier trades using the [Trade Outlier Filtration](#) process to determine Eligible Trades.



- Using the Eligible Trades data set, determine which exchange had the highest volume for the Asset during the Intraday Time Window. This exchange is considered the Principal Market Price during the subsequent calculation steps.
- For the Principal Market, derive the DAR Intraday Principal Market Price by calculating a VWAP of all Eligible Trades (non-outlier trades) within the Intraday Time Window.

## Appendix: Changelog

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Substantive changes to the DAR Intraday Price Methodology are tracked below.

Version	Change	Description
1.1	Intraday Principal Market Price added	Details on the calculation of the DAR Intraday Principal Market Price were added to the methodology
1.2	Asset Tier changed to Price Tier	The <i>Asset Tier</i> section was renamed to <i>Price Tier</i> to clarify that tiering occurs at the price level; the <i>Key Definitions</i> section was also updated to reflect this change
1.3	Additional FX rate source added	Polygon.io was added as a source for FX rate data





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