



Nasdaq Calypso

Blended Rate Engine

Version 18

Revision 2.0

April 2024

Approved

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Document History

Revision	Published	Summary of Changes
1.0	February 2024	First revision for version 18.
2.0	April 2024	Updates for version 18 monthly release - Market Analytics Server is replaced by Rate Engine Server.

This document describes the Calypso Blended Rate Engine.

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1. Blended Rate Engine

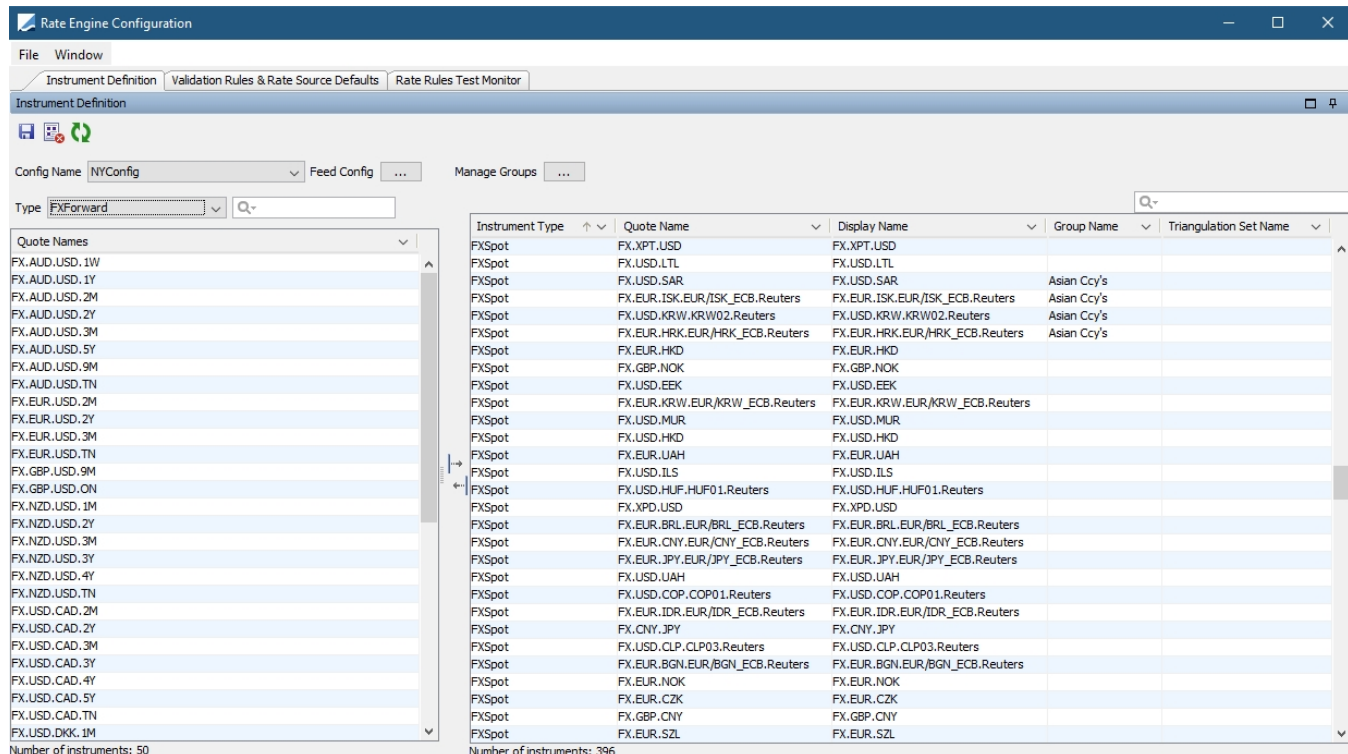
1.1 Introduction

The Calypso Blended Rate Engine brings in market quotes (rates), either from a single or multiple sources, and based on pre-defined rules, cleanses and blends various rates to produce a single output. This single rate, for example, EUR/USD, can then be considered as the "market rate." This configuration is done in the Blended Rate Engine Configuration window (menu action `startup.RateEngineConfigWindow`).

In summary, the Blended Rate Engine provides the following functionality:

- Add, delete and save various rate configurations under a rule name
- Configure various rate sources or feeds as well as select the feed quotes that are to be used
- Select the validation rules that are to be applied to the quotes coming from the selected rate sources
- Configure rate blending rules

The first step in using the Blended Rate Engine is to set up the configuration. This is done in the Rate Engine Configuration Window.



The screenshot shows the 'Rate Engine Configuration' window with the 'Instrument Definition' tab selected. The 'Config Name' is 'NYConfig'. The 'Type' is 'FXForward'. The 'Instrument Definition' table lists various instruments and their configurations.

Instrument Type	Quote Name	Display Name	Group Name	Triangulation Set Name
FXSpot	FX.XPT.USD	FX.XPT.USD		
FXSpot	FX.USD.LTL	FX.USD.LTL		
FXSpot	FX.USD.SAR	FX.USD.SAR	Asian Ccy's	
FXSpot	FX.EUR.ISK.EUR/ISK_ECB.Reuters	FX.EUR.ISK.EUR/ISK_ECB.Reuters	Asian Ccy's	
FXSpot	FX.USD.KRW.KRW02.Reuters	FX.USD.KRW.KRW02.Reuters	Asian Ccy's	
FXSpot	FX.EUR.HRK.EUR/HRK_ECB.Reuters	FX.EUR.HRK.EUR/HRK_ECB.Reuters	Asian Ccy's	
FXSpot	FX.EUR.HKD	FX.EUR.HKD		
FXSpot	FX.GBP.NOK	FX.GBP.NOK		
FXSpot	FX.USD.EEK	FX.USD.EEK		
FXSpot	FX.EUR.KRW.EUR/KRW_ECB.Reuters	FX.EUR.KRW.EUR/KRW_ECB.Reuters		
FXSpot	FX.USD.MUR	FX.USD.MUR		
FXSpot	FX.USD.HKD	FX.USD.HKD		
FXSpot	FX.EUR.UAH	FX.EUR.UAH		
FXSpot	FX.USD.ILS	FX.USD.ILS		
FXSpot	FX.USD.HUF.HUF01.Reuters	FX.USD.HUF.HUF01.Reuters		
FXSpot	FX.XPD.USD	FX.XPD.USD		
FXSpot	FX.EUR.BRL.EUR/BRL_ECB.Reuters	FX.EUR.BRL.EUR/BRL_ECB.Reuters		
FXSpot	FX.EUR.CNY.EUR/CNY_ECB.Reuters	FX.EUR.CNY.EUR/CNY_ECB.Reuters		
FXSpot	FX.EUR.JPY.EUR/JPY_ECB.Reuters	FX.EUR.JPY.EUR/JPY_ECB.Reuters		
FXSpot	FX.USD.UAH	FX.USD.UAH		
FXSpot	FX.USD.COP.COP01.Reuters	FX.USD.COP.COP01.Reuters		
FXSpot	FX.EUR.IDR.EUR/IDR_ECB.Reuters	FX.EUR.IDR.EUR/IDR_ECB.Reuters		
FXSpot	FX.CNY.JPY	FX.CNY.JPY		
FXSpot	FX.USD.CLP.CLP03.Reuters	FX.USD.CLP.CLP03.Reuters		
FXSpot	FX.EUR.BGN.EUR/BGN_ECB.Reuters	FX.EUR.BGN.EUR/BGN_ECB.Reuters		
FXSpot	FX.EUR.NOK	FX.EUR.NOK		
FXSpot	FX.EUR.CZK	FX.EUR.CZK		
FXSpot	FX.GBP.CNY	FX.GBP.CNY		
FXSpot	FX.EUR.SZL	FX.EUR.SZL		

Number of instruments: 50

Number of instruments: 396

1.2 Required Servers

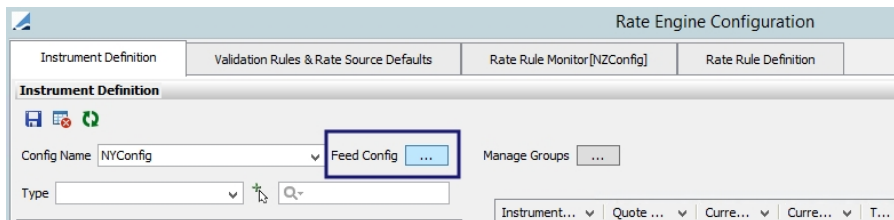
The servers that need to be started to run the Rate Engine are:

1. Auth Server, Discovery Server, Gateway Server, Event Server, Data Server
2. Rate Engine Server

The Rate Engine server is started using `<calypso_home>\deploy-local\<Environment>\rateengineServer.bat\sh` or from the Calypso DevOps Center.

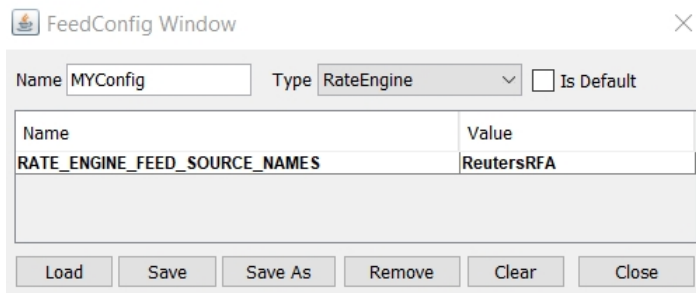
1.3 Instrument Definition

Step 1 - You may have multiple rate engine feed configurations. To load an existing feed configuration or to designate a new one, select Feed Config.



The screenshot shows the 'Rate Engine Configuration' window with the 'Instrument Definition' tab selected. The 'Config Name' is set to 'NYConfig'. The 'Feed Config' button, which has three dots next to it, is highlighted with a red rectangular box. Other buttons like 'Manage Groups' and 'Type' are also visible.

Step 2 - When creating a new rule, you must configure the rate feed source. *RateEngine* must be selected as the Type.



The screenshot shows the 'FeedConfig Window'. At the top, there's a 'Name' field with 'MYConfig', a 'Type' dropdown set to 'RateEngine', and an 'Is Default' checkbox which is unchecked. Below this is a table with two columns: 'Name' and 'Value'. The table contains one row with 'RATE_ENGINE_FEED_SOURCE_NAMES' in the 'Name' column and 'ReutersRFA' in the 'Value' column. At the bottom, there are buttons for 'Load', 'Save', 'Save As', 'Remove', 'Clear', and 'Close'.

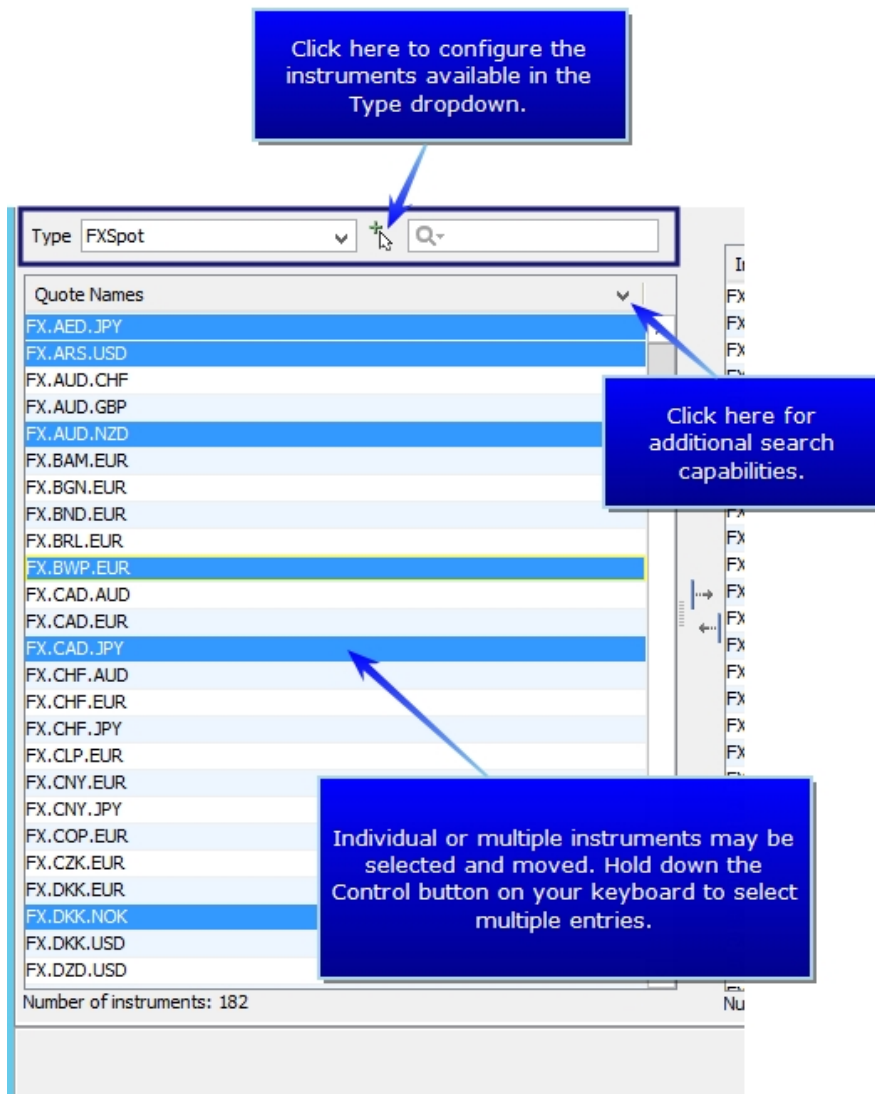
Name	Value
RATE_ENGINE_FEED_SOURCE_NAMES	ReutersRFA

The fields to configure in this window are:

RATE_ENGINE_FEED_SOURCE_NAMES - Specify the rate feed source or sources

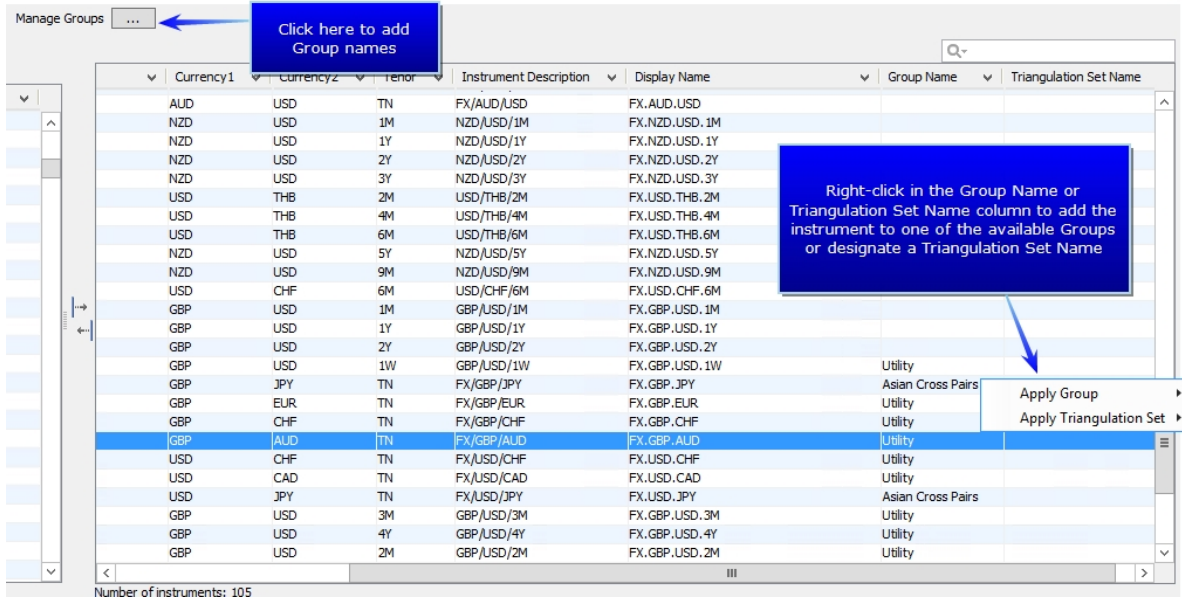
Step 3 - Instrument definition allows for the selection of instruments that are to be used as part of the configuration rule. In this example, the rule name is NYConfig. The instruments (products) that are selected are the instruments for which rates will be observed.

It is possible to select various instrument types from the Type drop-down list or to search for an instrument. The instrument types come from those configured in Calypso.



Then click the middle arrow  to add the instruments.

Step 4 - Once the instruments have been added, you may wish to group them in order to apply rules to certain groups. For example, you could create a group of all G10 currencies or government bonds. You may enter and edit group names under Manage Groups. In the Instrument Definition window, you can then select all the instrument quotes that you wish to group, then in the Group Name column, right-click and select the group to which you would like to assign the selected instrument quotes.



Manage Groups ... Click here to add Group names

Right-click in the Group Name or Triangulation Set Name column to add the instrument to one of the available Groups or designate a Triangulation Set Name

Apply Group
Apply Triangulation Set

Number of instruments: 105

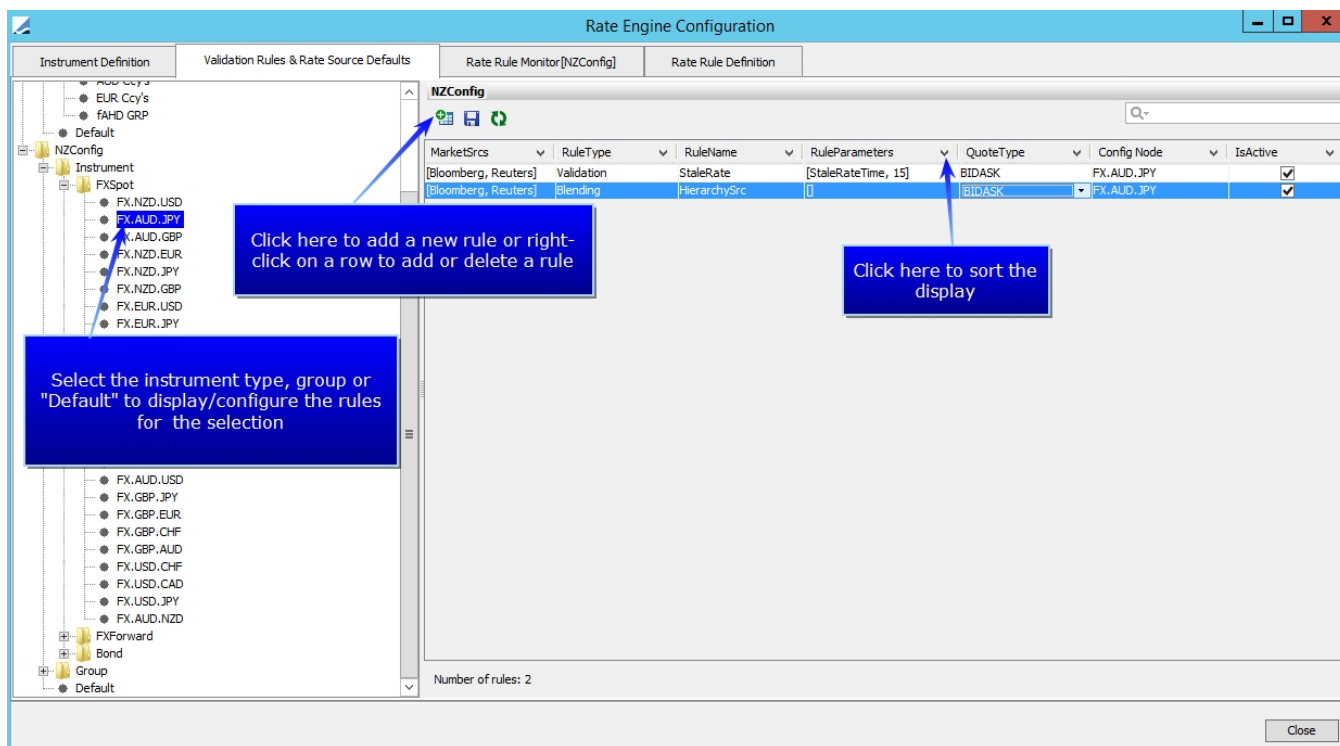
Do not forget to save your configuration.

1.4 Validation Rules & Rate Source Defaults

The subscribed instrument quotes pass through a series of validation rules. Based on these defined rules, the Rate Engine will blend the multiple quotes to come up with a publishable blended rate.

It is possible to apply validation and blending rules at the following levels:

- Instrument Type - for example, FX Spot, FX Forward, Equity, Future, etc...
- Group - user defined groups of instruments and associated quotes
- Default - applies to all instruments and quotes within a Config Name



[NOTE: During Rate Engine's configuration, there must be a blending rule for your feeds for all instruments. The rule will be SingleSrc if you only have one rate source]

The Validation Rules & Rate Source columns are:

Column	Description
MarketSrcs	Select from the configured rate sources
Rule Type	Available rule types are None (no rule applied, takes rates as is), Blending and Validation
Rule Name	Different options are available based on the Rule Type selected. Rule Types are described below.
Rule Parameters	Rule Parameters are based on the Rule Type and the selected Rule Name
Quote Type	Select the quote type for the rule
Config Node	The level at which the blending or validation rules are being applied, such as Default or Group, etc....
Is Active	The selection of this check box indicates that the rule is active

1.4.1 Validation Rules

Below is a description of the Rule Name choices when Validation is selected as the Rule Type.

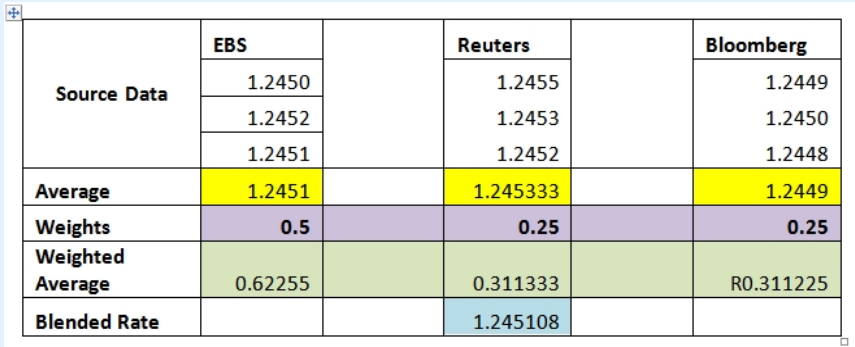
Rule	Description
BidAskCheck	Ensures that the bid amount is always lower than the ask amount, passes if bid < ask
NegativeRateValidation	Ensures that negative rates are eliminated
PercentDeviation	<p>Bid and Ask percentage deviations are calculated as shown:</p> $Bid \% deviation = \frac{ Bid from QuoteValue - Previously saved BidQuote }{Previously saved BidQuote} \times 100$ $Ask \% deviation = \frac{ Ask from QuoteValue - Previously saved AskQuote }{Previously saved AskQuote} \times 100$ <p>If the deviation percent is greater than the max deviation percent configured in the Rule Parameters, the quote is invalid.</p>
PointsDeviation	<p>Points deviation is calculated as shown</p> $Bid difference = Bid from QuoteValue - Previously saved BidQuote $ $Ask difference = Ask from QuoteValue - Previously saved AskQuote $ <p>If the Bid or Ask difference is greater than the maximum points deviation specified in the Rules Parameters, the quote is invalid.</p>
Repeated Rate	Determines the number of times the same quote can be repeated from the feed source for bid, ask or bid/ask within a specified time frame. If the quote repeats itself more than the specified number of times, the quote is deemed to be invalid.
StaleRate	This rule throws out a rate as being stale based on the configured value, expressed in seconds.
VolMovingAvgPercentDeviation	<p>The Volatility Moving Average Percentage Deviations are calculated as shown:</p> $Bid \% deviation = \frac{\sum_{i=1}^n \frac{ Bid from QuoteValue - Previous Bid_i }{Previous Bid_i}}{n} \times 100$ $Ask \% deviation = \frac{\sum_{i=1}^n \frac{ Ask from QuoteValue - Previous Ask_i }{Previous Ask_i}}{n} \times 100$ <p>Where n is the Number of Quotes in Average as specified in the Rule Parameters.</p> <p>If the Bid % deviation or the Ask % deviation is > than the Max Pct Dev specified in the Trade Parameters, the quote is invalid.</p>
VolMovingAvgPointsDeviation	The Volatility Moving Average Points Deviations are calculated as shown:


Rule	Description
	$Bid \% deviation = \frac{\sum_{i=1}^n \frac{ Bid\ from\ QuoteValue - Previous\ Bid_i }{Previous\ Bid_i}}{n}$ $Ask \% deviation = \frac{\sum_{i=1}^n \frac{ Ask\ from\ QuoteValue - Previous\ Ask_i }{Previous\ Ask_i}}{n}$ <p>Where n is the Number of Quotes in Average as specified in the Rule Parameters. If the Bid % deviation or the Ask % deviation is > than the Max Pts Deviation (pips) as specified in the Rule Parameters, the quote is invalid.</p>
VolPercentDeviation	<p>Volatility Percent Deviation is calculated as shown:</p> $Bid \% deviation_{i=1,...,n} = \sum_{i=1}^n \frac{ Bid\ from\ QuoteValue - Previous\ Bid_i }{Previous\ Bid_i}$ $Ask \% deviation_{i=1,...,n} = \sum_{i=1}^n \frac{ Ask\ from\ QuoteValue - Previous\ Ask_i }{Previous\ Ask_i}$ <p>If the Bid % deviation_i or Ask deviation_i is > than the Max Deviation Percent specified in the Rule Parameters, the quote is not valid.</p>
VolPointsDeviation	<p>Volatility Points Deviation is calculated as shown:</p> $Bid \% Diff_{i=1,...,n} = \sum_{i=1}^n Bid\ from\ QuoteValue - Previous\ Bid_i $ $Ask \% Diff_{i=1,...,n} = \sum_{i=1}^n Ask\ from\ QuoteValue - Previous\ Ask_i $ <p>If the Bid % Diff_i or the Ask % Diff_i is > than the Max Points Deviation (pips) specified in the Rule Parameters, the quote is invalid.</p>

1.4.2 Blending Rules

Below is a description of the Rule Name choices when Blending is selected as a Rule Type.

Rule	Description
HierarchySrc	Set the Rule Parameters for the Hierarchy

Rule	Description
MultipleSrcAverage	An average of the rates from the selected sources
MultipleSrcBestBidOffer	Takes the best bid and offer rates from the rate sources being used
Multiple SrcWeightedAvg	<p>Adds a weighting to the rate sources being used. For example, each rate source can be weighted differently based on which source is considered most accurate.</p> <p>The weighting is applied to each source to be used for blending. The Weighted Average is equal to the average rate times the weighting. The Blended Rate is equal to the total of the weighted average for each rate source.</p> <p>The weighting is specified in the Rule Parameters column.</p> <p>See the figure below for an example on how this calculation works.</p> 
SingleSrc	Specifies a single rate source
MultipleSrcNthBidOffer	Takes the Nth bid and offer rates from the rate sources being used, where N is a user defined number
Grouping	Allows for the creation of a Group of sources to which rules can be applied
MultipleSrcMedianBidOffer	Takes the middle Bid or Offer when more than one source is available. For example, if there are three sources available, it takes the two best. If there are 4 sources available, rounds up and takes the second best

 [NOTE: A flag is added to highlight if a quote is either calculated (e.g. *MultipleSrcAverage*) and therefore not tradeable or non-calculated (e.g. *MultipleSrcBestBidOffer*) and therefore tradeable]

1.5 Triangulation

In the Instrument Definition window, right-click in the Group Name column to apply a Triangulation Rule Set to the selected cross instrument quotes. Note, the assumption is that you do not have a rate feed for the cross rate and therefore it will be triangulated.

The following applications and services are used for triangulation:

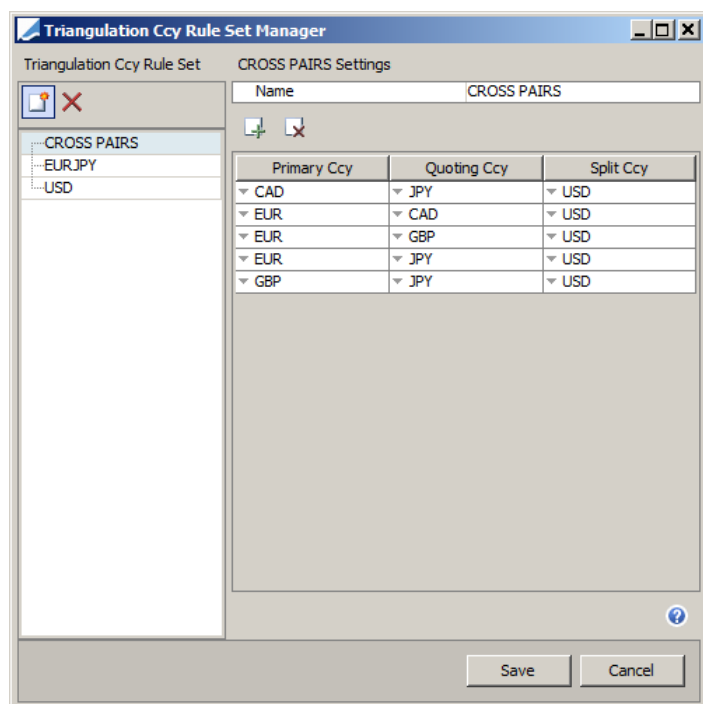
- [Triangulation Currency Rule Set Manager](#)
- [Rate Engine](#) - The Rate Engine Test Monitor window shows the defined Triangulated Cross Pair. Only blended and validated rates are picked up from the Rate Engine for triangulation.

1.5.1 Triangulation Currency Rule Set Manager

The Triangulation Currency Rule Set Manager is Calypso functionality that is used to determine which cross currency pairs should be triangulated.

A rule is created and the Primary Currency and the Quoting Currency of the cross currency pair is specified in the rule. For each cross currency pair to be triangulated, the Split Currency must be specified. The Split Currency is the currency that drives the triangulation.

For example, a cross currency pair of EUR/JPY split through USD will then use EUR/USD and USD/JPY to create EUR/JPY.



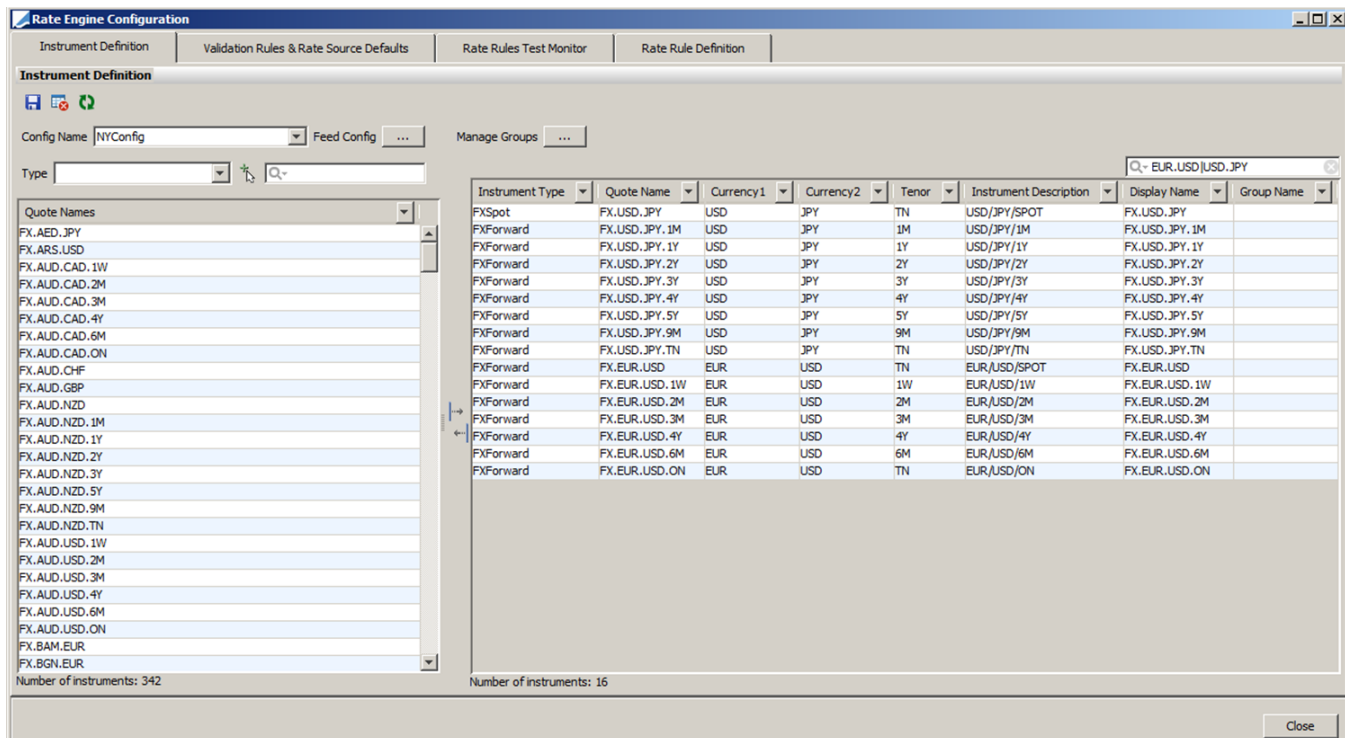
1.5.2 Rate Engine

For any cross instrument quote where a triangulation currency rule set name has been assigned, the Rate Engine takes the relevant configured straight pairs and triangulate them to create the cross pair quote.

- » For triangulated cross rates, such as EUR/JPY, the required straight pairs (e.g. EUR/USD and USD/JPY) must be configured and available as source rates within the Rate Engine.

- » The cross rate EUR/JPY must also be configured within the Rate Engine and the relevant triangulation currency rule set specified.
- » Blending and validation rules are only applied on the straight pair (e.g. EUR/USD and USD/JPY).
- » Only if all blending and validation rules are applied successfully to the straight pairs (EUR/USD and USD/JPY) will these rates be published and used for triangulation and deriving the cross rate (EUR/JPY).
- » The Rate Engine will either publish a direct sourced rate of EUR/JPY or a triangulated EUR/JPY. It will not switch between a direct source and a triangulated rate for publishing.

[NOTE: If a cross pair is configured as a quote and the triangulation rule set is not specified, then the expectation is that the cross pair will be sourced directly from the configured rate feed, such as Bloomberg or Reuters]



Rate Engine Configuration

Instrument Definition | Validation Rules & Rate Source Defaults | Rate Rules Test Monitor | Rate Rule Definition

Instrument Definition

Config Name: NYConfig | Feed Config: ... | Manage Groups: ...

Type: [Q-] | Search: EUR.USD.JPY

Instrument Type	Quote Name	Currency1	Currency2	Tenor	Instrument Description	Display Name	Group Name
FXSpot	FX.USD.JPY	USD	JPY	TN	USD/JPY/SPOT	FX.USD.JPY	
FXForward	FX.USD.JPY.1M	USD	JPY	1M	USD/JPY/1M	FX.USD.JPY.1M	
FXForward	FX.USD.JPY.1Y	USD	JPY	1Y	USD/JPY/1Y	FX.USD.JPY.1Y	
FXForward	FX.USD.JPY.2Y	USD	JPY	2Y	USD/JPY/2Y	FX.USD.JPY.2Y	
FXForward	FX.USD.JPY.3Y	USD	JPY	3Y	USD/JPY/3Y	FX.USD.JPY.3Y	
FXForward	FX.USD.JPY.4Y	USD	JPY	4Y	USD/JPY/4Y	FX.USD.JPY.4Y	
FXForward	FX.USD.JPY.5Y	USD	JPY	5Y	USD/JPY/5Y	FX.USD.JPY.5Y	
FXForward	FX.USD.JPY.9M	USD	JPY	9M	USD/JPY/9M	FX.USD.JPY.9M	
FXForward	FX.USD.JPY.TN	USD	JPY	TN	USD/JPY/TN	FX.USD.JPY.TN	
FXForward	FX.EUR.USD	EUR	USD	TN	EUR/USD/SPOT	FX.EUR.USD	
FXForward	FX.EUR.USD.1W	EUR	USD	1W	EUR/USD/1W	FX.EUR.USD.1W	
FXForward	FX.EUR.USD.2M	EUR	USD	2M	EUR/USD/2M	FX.EUR.USD.2M	
FXForward	FX.EUR.USD.3M	EUR	USD	3M	EUR/USD/3M	FX.EUR.USD.3M	
FXForward	FX.EUR.USD.4Y	EUR	USD	4Y	EUR/USD/4Y	FX.EUR.USD.4Y	
FXForward	FX.EUR.USD.6M	EUR	USD	6M	EUR/USD/6M	FX.EUR.USD.6M	
FXForward	FX.EUR.USD.ON	EUR	USD	TN	EUR/USD/ON	FX.EUR.USD.ON	

Number of instruments: 342 | Number of instruments: 16

Close

In the Rate Rule Test Monitor tab, it is possible to see the configured source rates for EUR/USD, USD/JPY and the triangulated cross rate of EUR/JPY.

Rate Engine Configuration

Instrument Definition

Validation Rules & Rate Source Defaults

Rate Rule Monitor[NYConfig]

Rate Rule Definition

Rate Rule Monitor[NYConfig]

Config Name

NYConfig

STARTED

Stop

Q- EUR.USD|EUR.JPY|USD.JPY

Rule Names	Source	Feed Quote	Date Time	Bid	Ask	Last	Config Node	Status	Instr. Type	Details
SingleSrc	Random	FX.EUR.JPY	3/7/16 2:29:34.789 P...	147.5197095	147.5849196	136.0600000	Default	Pass	FXSpot	0
SingleSrc	Random	FX.EUR.JPY.1M	3/7/16 2:29:34.789 P...	-9.1051135	-8.1219828	-8.2000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.1W	3/7/16 2:29:34.789 P...	0.0302293	0.0314806	0.0110000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.1Y	3/7/16 2:29:34.790 P...	26.4279050	36.9023170	30.6000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.2M	3/7/16 2:29:34.790 P...	-46.3244113	-41.2000000	-41.2000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.3M	3/7/16 2:29:34.791 P...	0.0514231	0.0543225	0.0510000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.6M					Default			0
SingleSrc	Random	FX.EUR.JPY.ON	3/7/16 2:29:34.791 P...	0.0009554	0.0019761	0.0012000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.TN	3/7/16 2:29:34.791 P...	0.0364836	0.0424470	0.0120000	Default	Pass		0
SingleSrc,StaleRate	Random	FX.EUR.USD	3/7/16 2:29:34.792 P...	1.1218980	1.1232890	1.1405000	Default	Pass	FXSpot	0
SingleSrc	Random	FX.EUR.USD.1M	3/7/16 2:29:34.792 P...	0.8189960	0.8555924	0.8500000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.1W	3/7/16 2:29:34.792 P...	0.2528270	0.2768150	0.2800000	Default	Pass	FXForward	0
SingleSrc	Random	FX.EUR.USD.1Y	3/7/16 2:29:34.793 P...	35.7985377	37.0628592	30.6000000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.2M	3/7/16 2:29:34.793 P...	0.8806300	1.0508370	1.0200000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.3M	3/7/16 2:29:34.793 P...	4.7608640	5.3196330	4.4000000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.4Y					Default		FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.6M	3/7/16 2:29:34.794 P...	12.0971570	12.9748370	12.4500000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.ON	3/7/16 2:29:34.794 P...	0.0924800	0.2036450	0.0040000	Default	Pass	FXForward	0
SingleSrc	Random	FX.EUR.USD.TN	3/7/16 2:29:34.794 P...	0.0321360	0.0410121	0.0010000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.USD.JPY	3/7/16 2:29:34.824 P...	116.8620000	116.8980000	118.8020000	Default	Pass	FXSpot	0
SingleSrc,StaleRate	Random	FX.USD.JPY.1M	3/7/16 2:29:34.822 P...	-13.1438000	-12.3450000	-12.3000000	Default	Pass	FXForward	0
SingleSrc	Random	FX.USD.JPY.1W	3/7/16 2:29:34.822 P...	-2.4718782	-2.2035405	-2.0000000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.USD.JPY.1Y	3/7/16 2:29:34.822 P...	-43.1069000	-41.4158000	-45.5000000	Default	Pass	FXForward	0
SingleSrc		FX.USD.JPY.2M					Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.2Y					Default		FXForward	0
SingleSrc	Random	FX.USD.JPY.3M	3/7/16 2:29:34.823 P...	-5.1043178	-4.8463612	-5.9900000	Default	Pass	FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.3Y					Default		FXForward	0

Number of instruments: 33

Close

1.6 Rate Rules Test Monitor

The Rate Rules Test Monitor allows you to view the configured quotes and rules that are being applied.

Rate Engine Configuration

Instrument Definition

Validation Rules & Rate Source Defaults

Rate Rule Monitor[NZConfig]

Rate Rule Definition

Rate Rule Monitor[NZConfig]

Config Name NZConfig

Stop

STARTED

Select a Configuration Name here (Monitor must be stopped)

Q


Rule Names	Source	Feed Quote				Config Node	Status	Instr. Type	Details
SingleSrc,PercentDevia...	Random	FX.NZD.USD	9/22/16 1:51:25.439 ...	0.7640400	0.7651900	0.7648000 Utility	Pass	FXSpot	0
SingleSrc,StaleRate		FX.AUD.JPY				Default		FXSpot	0
SingleSrc,StaleRate		FX.AUD.GBP				Default		FXSpot	0
SingleSrc,StaleRate		FX.NZD.EUR				Default		FXSpot	0
SingleSrc,StaleRate		FX.NZD.JPY				Default		FXSpot	0
SingleSrc,StaleRate		FX.NZD.GBP				Default		FXSpot	0
SingleSrc,StaleRate	Random	FX.EUR.USD	9/22/16 1:51:25.427 ...	1.1211720	1.1235720	1.1405000 Default	Pass	FXSpot	10
SingleSrc,StaleRate	Random	FX.EUR.JPY	9/22/16 1:51:25.426 ...	147.5400000	147.6800000	136.0600000 Default	Pass	FXSpot	10
SingleSrc,StaleRate	Random	FX.GBP.USD	9/22/16 1:51:25.441 ...	1.4678020	1.4685470	1.5180000 Default	Pass	FXSpot	10
SingleSrc,StaleRate		FX.NZD.USD.TN				Default		FXForward	0
SingleSrc,StaleRate		FX.USD.THB.9M				Default		FXForward	0
SingleSrc,StaleRate	Random	FX.USD.THB.1M	9/22/16 1:51:25.477 ...	5.8145400	6.7917600	6.9800000 Default	Pass	FXForward	10
SingleSrc,StaleRate	Random	FX.USD.THB.3M	9/22/16 1:51:25.480 ...	17.0475900	18.7610700	17.0000000 Default	Pass	FXForward	10
SingleSrc,StaleRate		Bond. US TREASURY .0...				Default			0
SingleSrc,StaleRate		Bond. US TREASURY .0...				Default			0
SingleSrc,StaleRate	Random	Bond. US TREASURY .0...	9/22/16 1:51:25.488 ...	1.7512261	1.7716202	0.0000000 Default	Pass		10
SingleSrc,StaleRate	Random	Bond. US TREASURY .0...	9/22/16 1:51:25.489 ...	2.3246350	2.3289788	0.0000000 Default	Pass		10
SingleSrc,StaleRate		Bond. US TREASURY .0...				Default			0
SingleSrc,StaleRate		Bond.BNTNB .05-15-20...				Default			0
SingleSrc,StaleRate	Random	FX.USD.INR	9/22/16 1:51:25.464 ...	61.6800000	61.7500000	59.4900000 Default	Pass	FXSpot	10
SingleSrc,StaleRate	Random	FX.USD.JPY.1M	9/22/16 1:51:25.482 ...	-13.2168000	-12.4186000	-12.3000000 Default	Pass	FXForward	10
SingleSrc,StaleRate	Random	FX.USD.JPY.1Y	9/22/16 1:51:25.484 ...	-43.5024000	-41.4082000	-45.5000000 Default	Pass	FXForward	10
SingleSrc,StaleRate		FX.USD.JPY.2Y				Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.3Y				Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.4Y				Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.5Y				Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.7M				Default		FXForward	0

Number of instruments: 106

Close

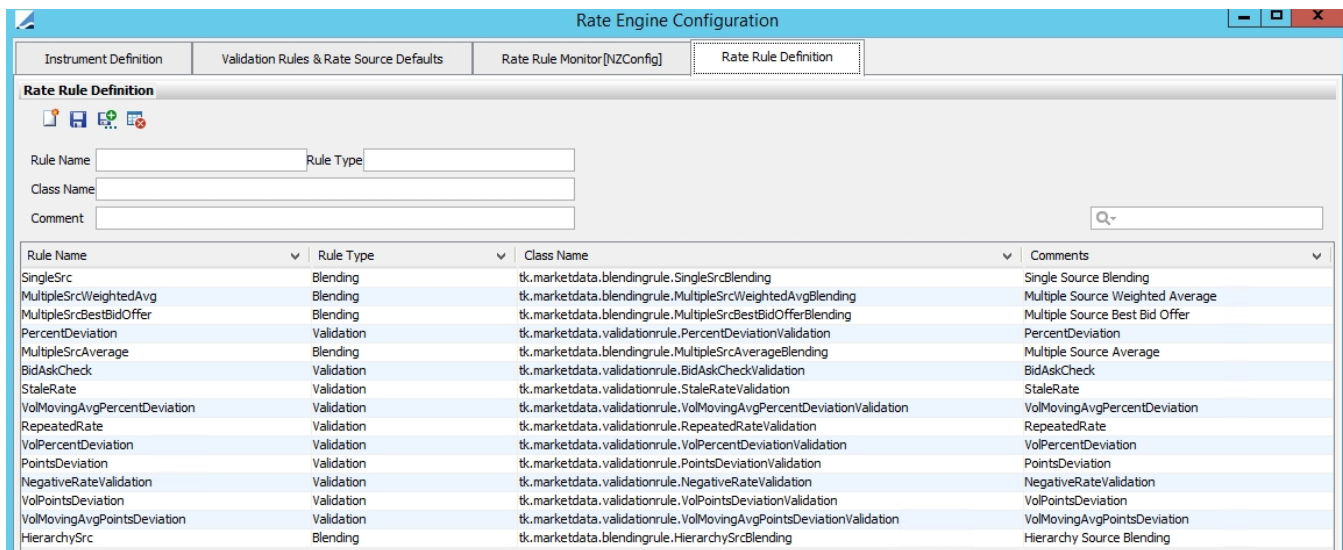
The columns of this monitor are described below.

Column	Description
Rule Name	The configured rule to which each quote and associated blending and validation rule is applied
Source	Rate source for each quote/instrument
Feed Quote	Feed quote name as configured in the Feed Quotes
Date Time	The date time of each update
Bid	Bid rate from the quote
Ask	Ask rate from the quote
Last	Last rate from the quote
Config Node	The level at which the blending or validation rules are being applied, such as Default or Group
Status	Indicates if the quote passed or failed the validation and blending rules being applied
Instr. Type	Type of instrument/quotes to which the rate rule applies

Column	Description
Details	Indicates the number of times the quote/instrument has failed with the rule being applied. Click the displayed number to display details of the validation or blending rule failure.
	 [NOTE: Only the last 10 failures are displayed. Click to see the reason for the failure]

1.7 Rate Rules Definition

The Rate Rules Definition window shows the rules available for use within the Rate Engine.



The screenshot shows the 'Rate Rule Definition' window in the Nasdaq Calypso Rate Engine. The window has a tabbed interface with 'Rate Rule Definition' selected. It contains a form for defining a new rule with fields for Rule Name, Rule Type, Class Name, and Comment. Below the form is a table listing existing rules.

Rule Name	Rule Type	Class Name	Comments
SingleSrc	Blending	tk.marketdata.blendingrule.SingleSrcBlending	Single Source Blending
MultipleSrcWeightedAvg	Blending	tk.marketdata.blendingrule.MultipleSrcWeightedAvgBlending	Multiple Source Weighted Average
MultipleSrcBestBidOffer	Blending	tk.marketdata.blendingrule.MultipleSrcBestBidOfferBlending	Multiple Source Best Bid Offer
PercentDeviation	Validation	tk.marketdata.validationrule.PercentDeviationValidation	PercentDeviation
MultipleSrcAverage	Blending	tk.marketdata.blendingrule.MultipleSrcAverageBlending	Multiple Source Average
BidAskCheck	Validation	tk.marketdata.validationrule.BidAskCheckValidation	BidAskCheck
StaleRate	Validation	tk.marketdata.validationrule.StaleRateValidation	StaleRate
VolMovingAvgPercentDeviation	Validation	tk.marketdata.validationrule.VolMovingAvgPercentDeviationValidation	VolMovingAvgPercentDeviation
RepeatedRate	Validation	tk.marketdata.validationrule.RepeatedRateValidation	RepeatedRate
VolPercentDeviation	Validation	tk.marketdata.validationrule.VolPercentDeviationValidation	VolPercentDeviation
PointsDeviation	Validation	tk.marketdata.validationrule.PointsDeviationValidation	PointsDeviation
NegativeRateValidation	Validation	tk.marketdata.validationrule.NegativeRateValidation	NegativeRateValidation
VolPointsDeviation	Validation	tk.marketdata.validationrule.VolPointsDeviationValidation	VolPointsDeviation
VolMovingAvgPointsDeviation	Validation	tk.marketdata.validationrule.VolMovingAvgPointsDeviationValidation	VolMovingAvgPointsDeviation
HierarchySrc	Blending	tk.marketdata.blendingrule.HierarchySrcBlending	Hierarchy Source Blending

1.8 Cross Currency Calculations

1.8.1 Calculating Cross Currency Rates from USD Exchange Rates

Non-USD based exchange rates can be calculated from USD based exchange rates. All cross currency calculations must be done at the spot and forward point market feed level to minimize calculation adjustments. In any exchange rate calculation, you are buying one currency and selling another currency. If you are trying to determine the exchange rate for two non-USD currencies, you can determine the exchange rate to buy one of the non-USD currencies against USD and compare it. For example,

EUR/USD Exchange Rate = 1.0900 = USD 1.0900 for every 1 EUR or EUR .917431193 for every 1 USD

GBP/USD Exchange Rate = 1.5200 = USD 1.5200 for every 1 GBP or GBP .657894737 for every 1 USD

EUR/GBP Exchange Rate = GBP .657894737 ÷ EUR .917431193 = .717105263

1.8.2 Spot Cross Currency Calculation

$$\text{C1C2 Bid Exchange Rate} = \text{C2\$SM(Offer)} \div \text{C1\$SM(Bid)}$$

$$\text{C1C2 Offer Exchange Rate} = \text{C2\$SM(Bid)} \div \text{C1\$SM(Offer)}$$

Where,

C1 = currency 1

C2 = currency 2

C2\$SM = is the European (USD Terms) market feed spot foreign exchange rate for C2 (B=Bid Price, O = Offer Price)

Example:

$$\text{EUR/USD} = \text{C1\$SM(Bid)} = .917431193$$

$$\text{GBP/USD} = \text{C2\$SM(Offer)} = .657894737$$

$$\text{C1C2 Bid Exchange Rate} = .717105263$$

1.8.3 Forward Point Cross Currency Calculation

$$\text{C1C2 Bid Forward Points} = ((\text{C2\$SM(Offer)} + \text{C2\$FPM(Offer)}) / (\text{C1\$SM(Bid)} + \text{C2\$FPM(Bid)}) - (\text{C2\$SM(Offer)} / \text{C1\$SM(Bid)}))$$

$$\text{C1C2 Offer Forward Points} = ((\text{C2\$SM(Bid)} + \text{C2\$FPM(Bid)}) / (\text{C1\$SM(Offer)} + \text{C2\$FPM(Offer)}) - (\text{C2\$SM(Bid)} / \text{C1\$SM(Offer)}))$$

Where,

C1 = currency 1

C2 = currency 2

C2\$SM = Is the European (USD Terms) market feed spot foreign exchange rate for C2 (B = Bid Price, O= Offer Price)

C2\$FPM = Is the European (USD Terms) market feed forward points for C2 (B = Bid Price, O= Offer Price)

C1\$SM = Is the European (USD Terms) market feed spot foreign exchange rate for C1 (B = Bid Price, O= Offer Price)

C1\$FPM = Is the European (USD Terms) market feed forward points for C1 (B = Bid Price, O= Offer Price)

Example:

$$\text{EURUSD} = \text{C1\$SM(Bid)} = .917431193$$

$$\text{GBPUSD} = \text{C2\$SM(Offer)} = .657894737$$

$$\text{EURUSD FP} = \text{C1\$FPM} = -.0002$$

$$\text{GBPUSD FP} = \text{C2\$FPM} = .0007$$

C1C2 Forward Exchange Rate = .718024793

C1C2 Spot Exchange Rate = .717105263
C1C2 Forward Points = .718024793 - .717105263 = .00091953

1.8.4 Spot Rate Adjustment

Adjustment of the spot rate is required for one of the split currency pairs when the spot days of one pair of the triangle is not the same as the spot days of the other pairs.

Given a EUR/CAD spot date (Jan 15th), the EUR/USD spot date (Jan 15th) and USD/CAD spot date (Jan 14th). Cross rates need to be on the same date (it does not make sense to use the rate from the 15th to cross with rate from 14th), it is necessary to do the calculation on Jan 15th.

Therefore, the following triangulation is needed:

EUR/CAD spot = EUR/USD spot * (USD/CAD spot + 1 Day adjusted points)

In the calculation above, USD/CAD spot + 1 Day adjusted points = rate on 15th, which can be used to cross. The table below explains the adjustment & triangulation calculation.

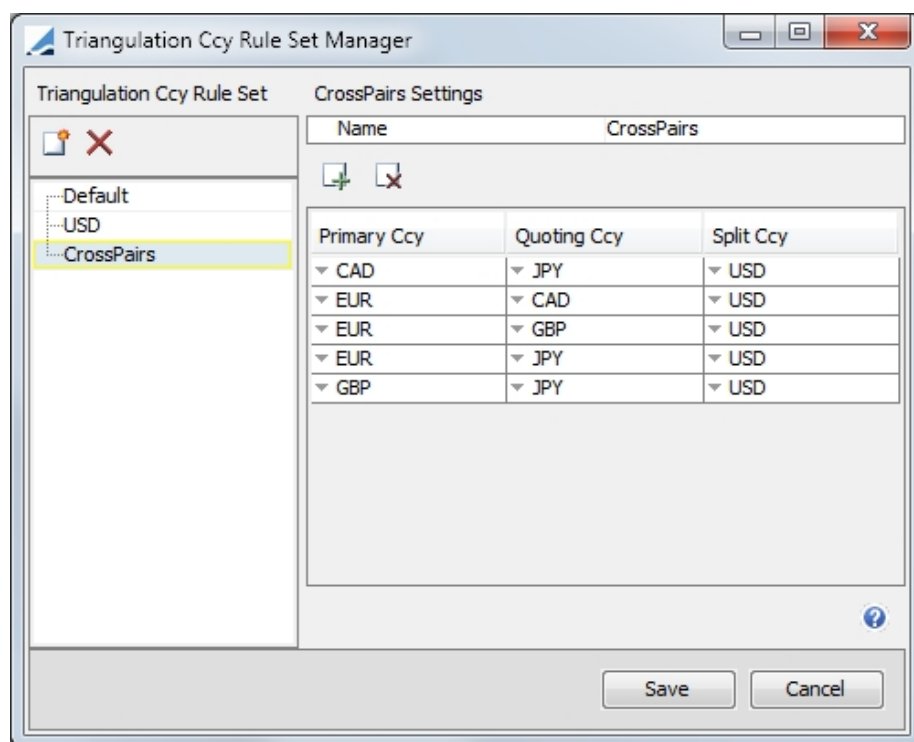
Spot Rate Adjustment Example				
	EUR/CAD	EUR/USD	USD/CAD	
Point Factor	10000	10000	10000	
Spot Date [MM/DD/YYYY]	1/15/2016	1/15/2016	1/14/2016	
Spot Rate	Not Known	1.09	1.4381	
1 Day Point Adjustment	0	0	0	Step 1: Find if any 1D adjustment is required
Adjusted Spot Rate	1.56759985	1.09	1.438165	
Forward Points (if Value Date is not Spot)	10.70859374	4.85	3.6737	
All In Rate	1.568670709	1.090485	1.43850737	
	Step 3: Compute All-In Rate for Cross Pair	Step 4: Find Forward Points for Cross Pair		

2. Rate Triangulation

Customers may wish to receive quotations for cross rate transactions. Some banks may have an underlying cross rate feed. These requests can be supported using underlying split currency based quote feeds to compute the cross rate at the time of the request.

Core Calypso supports the triangulation of cross rates and the eDealing web portal uses the triangulation rules defined in core Calypso so that rate triangulation can be performed for crosses or less liquid currency pairs.

- » The Triangulation Currency Rule Set Manager in Calypso is used by eDealing determine which cross currency pairs are to be triangulated.
- » For each cross currency pair to be triangulated, the split currency must be specified. The split currency is the currency that drives the triangulation. For example, a cross currency pair of EURJPY split through USD will then use EURUSD and USDJPY to create EURJPY.



- » The Rate Engine shows the defined Triangulated Cross Pair. Only blended and validated rates are picked from the Rate Engine for triangulation.

2.0.0.1 Point Calculation for Standard Tenors less than Spot Date

For standard tenors less than spot date:

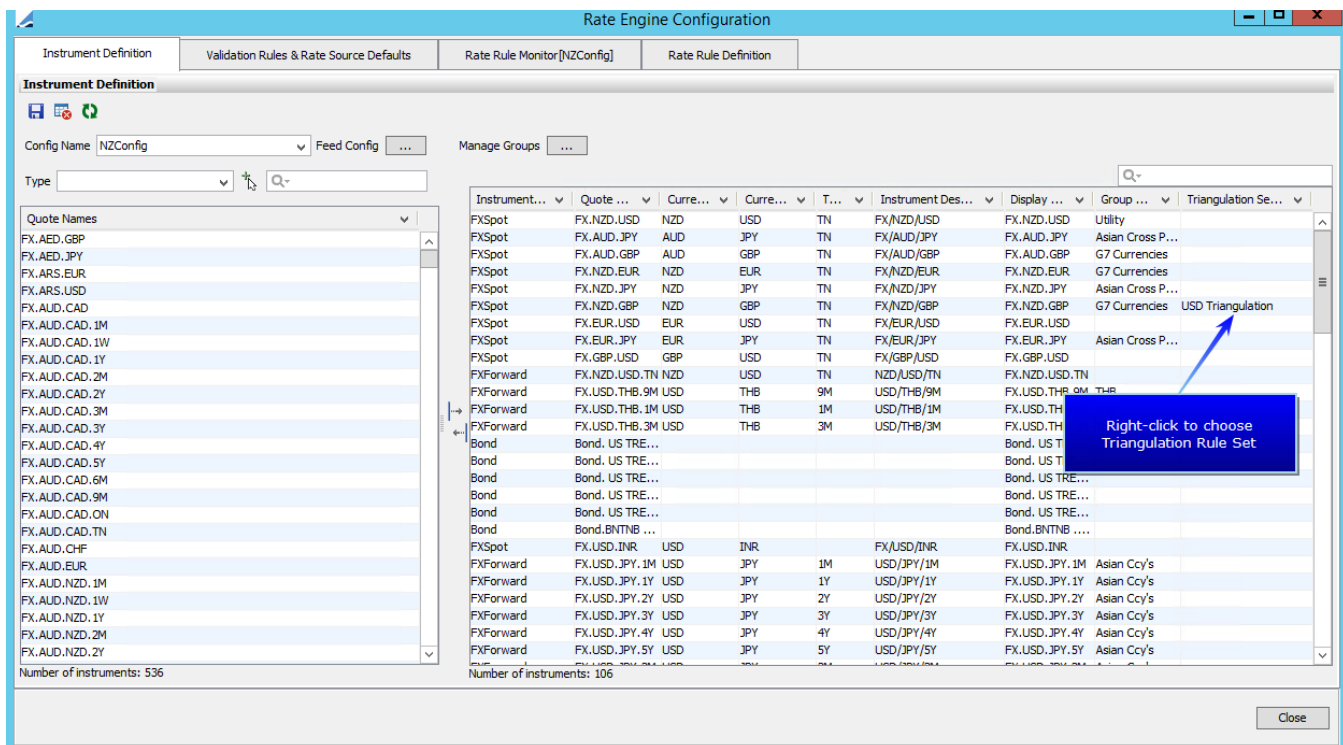
- Once FX market quotes are received from the Rate Engine, the sign and side of the quote received is flipped from the Rate Engine

- If the Tenor Date = Today, then the Tenor Points for the tenor are equal to the sum of quotes (after the flip in the step above) for all standard tenors less than spot date

2.1 Rate Engine's Role in Triangulation

The [Rate Engine](#) takes the configured straight pairs, triangulates them and passes the triangulated rate to the Pricing Engine to be used for pricing. For triangulated cross rates, the required straight pairs must be configured and available as source rates from within the Rate Engine. The cross rate must also be configured within the Rate Engine and the relevant triangulation currency rule set needs to be specified by right-clicking in the Triangulation Set Name column.

- » Blending and Validation rules are only applied on the straight pair.
- » If all blending and validation rules are applied successfully to the straight pairs (e.g. EURUSD and USDJPY) , these rates will be published and used for triangulating and deriving the cross rate (e.g. EURJPY)
- » The Rate Engine either publishes a directly sourced cross rate or a triangulated cross rate. It will not switch between a direct source and a triangulated rate for publishing.



The screenshot shows the 'Rate Engine Configuration' window with the 'Instrument Definition' tab selected. On the left, there is a list of 'Quote Names' including various currency pairs like FX.AED.GBP, FX.AED.JPY, etc. The main area on the right contains a table with columns: Instrument..., Quote..., Curre..., Curre..., T..., Instrument Des..., Display..., Group..., and Triangulation Se... . A blue callout box with an arrow points to the 'Triangulation Set Name' column, containing the text 'Right-click to choose Triangulation Rule Set'.

- » Within the Rate Rule Test Monitor panel in the Rate Engine Configuration window, it is possible to view the configured source straight pair rates as well as the triangulated cross rate.

Rate Engine Configuration

Instrument Definition

Validation Rules & Rate Source Defaults

Rate Rule Monitor[NYConfig]

Rate Rule Definition

Rate Rule Monitor[NYConfig]

Config Name

NYConfig

STARTED

Stop

Q- EUR.USD|EUR.JPY|USD.JPY

Rule Names	Source	Feed Quote	Date Time	Bid	Ask	Last	Config Node	Status	Instr. Type	Details
SingleSrc	Random	FX.EUR.JPY	3/7/16 2:29:34.789 P...	147.5197095	147.5849196	136.0600000	Default	Pass	FXSpot	0
SingleSrc	Random	FX.EUR.JPY.1M	3/7/16 2:29:34.789 P...	-9.1051135	-8.1219828	-8.2000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.1W	3/7/16 2:29:34.789 P...	0.0302293	0.0314806	0.0110000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.1Y	3/7/16 2:29:34.790 P...	26.4279050	36.9023170	30.6000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.2M	3/7/16 2:29:34.790 P...	-46.3244113	-41.2000000	-41.2000000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.3M	3/7/16 2:29:34.791 P...	0.0514231	0.0543225	0.0510000	Default	Pass		0
SingleSrc		FX.EUR.JPY.6M					Default			0
SingleSrc	Random	FX.EUR.JPY.ON	3/7/16 2:29:34.791 P...	0.0009554	0.0019761	0.0012000	Default	Pass		0
SingleSrc	Random	FX.EUR.JPY.TN	3/7/16 2:29:34.791 P...	0.0364836	0.0424470	0.0120000	Default	Pass		0
SingleSrc,StaleRate	Random	FX.EUR.USD	3/7/16 2:29:34.792 P...	1.1218980	1.1232890	1.1405000	Default	Pass	FXSpot	0
SingleSrc	Random	FX.EUR.USD.1M	3/7/16 2:29:34.792 P...	0.8189960	0.8555924	0.8500000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.1W	3/7/16 2:29:34.792 P...	0.2528270	0.2768150	0.2800000	Default	Pass	FXForward	0
SingleSrc	Random	FX.EUR.USD.1Y	3/7/16 2:29:34.793 P...	35.7985377	37.0628592	30.6000000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.2M	3/7/16 2:29:34.793 P...	0.8806300	1.0508370	1.0200000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.3M	3/7/16 2:29:34.793 P...	4.7608640	5.3196330	4.4000000	Default	Pass	FXForward	0
SingleSrc,StaleRate		FX.EUR.USD.4Y					Default		FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.6M	3/7/16 2:29:34.794 P...	12.0971570	12.9748370	12.4500000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.EUR.USD.ON	3/7/16 2:29:34.794 P...	0.0924800	0.2036450	0.0040000	Default	Pass	FXForward	0
SingleSrc	Random	FX.EUR.USD.TN	3/7/16 2:29:34.794 P...	0.0321360	0.0410121	0.0010000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.USD.JPY	3/7/16 2:29:34.824 P...	116.8620000	116.8980000	118.8020000	Default	Pass	FXSpot	0
SingleSrc,StaleRate	Random	FX.USD.JPY.1M	3/7/16 2:29:34.822 P...	-13.1438000	-12.3450000	-12.3000000	Default	Pass	FXForward	0
SingleSrc	Random	FX.USD.JPY.1W	3/7/16 2:29:34.822 P...	-2.4718782	-2.2035405	-2.0000000	Default	Pass	FXForward	0
SingleSrc,StaleRate	Random	FX.USD.JPY.1Y	3/7/16 2:29:34.822 P...	-43.1069000	-41.4158000	-45.5000000	Default	Pass	FXForward	0
SingleSrc		FX.USD.JPY.2M					Default		FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.2Y					Default		FXForward	0
SingleSrc	Random	FX.USD.JPY.3M	3/7/16 2:29:34.823 P...	-5.1043178	-4.8463612	-5.9900000	Default	Pass	FXForward	0
SingleSrc,StaleRate		FX.USD.JPY.3Y					Default		FXForward	0

Number of Instruments: 33

Close

Note: If a cross pair is configured as a quote and the Triangulation Rule Set is not specified, then the cross pair will be sourced directly from the configured rate feed (e.g. Bloomberg).

2.2 Triangulation in the Pricing Engine

Within the [Pricing Engine](#), the required cross rates need to be configured along with the required Tenors, Trade Amount, Trader Bid/Ask Spread, Trader Skew and Max Limit.

The Pricing Engine takes the triangulated cross rate and applies the configured rules. If the required triangulated cross pair is not configured in the Pricing Engine, the cross rate will not be calculated.

Pricing Rule Configuration - Test1 - EURJPY

Trade Region/Time Zone: ACT

InstrumentName	Trade Amount	Trader Bid/Ask Spread (Pips)	Trader Skew(+/-) (Pips)	Maximum Limit	Volatility Trigger(s)
EURCLP					
SPOT				25,000,000	4 Rule(s)...
	100,000	2.00	0.00		
	500,000	4.00	0.00		
	1,000,000	4.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	2.00	0.00		
	15,000,000	4.00	0.00		
	20,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
EURJPY					
SPOT					
	0	4.00	0.00		
	50,000	4.00	0.00		
	100,000	4.00	1.00		
	250,000	4.00	2.00		
	500,000	4.00	0.00		
	1,000,000	2.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	3.00	0.00		
	15,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
	50,000,000	6.00	0.00		
EURUSD					
SPOT				50,000,000	2 Rule(s)...
	0	4.00	0.00		
	50,000	4.00	0.00		
	100,000	4.00	1.00		
	250,000	4.00	2.00		
	500,000	4.00	0.00		
	1,000,000	2.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	3.00	0.00		
	15,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
	50,000,000	6.00	0.00		

Close

2.3 Triangulation in the Customer Engine

Within the [Customer Margin Rule Configuration window](#), the required cross rates need to be configured along with the required Tenors, Max Amounts, Markup Type, Markup, Skew and Quote Side.

The customer engine takes the triangulated cross rate and applies the configured customer engine pricing rules.

It is possible to flag the cross rate as being available as an inverse rate to the web portal user.

If the required triangulated cross pair is not configured in the Customer Engine, the customer cross rate will not be calculated and published.

Pricing Rule Configuration - Test1 - EURJPY

Trade Region/Time Zone: ACT

Trader Spread

InstrumentName	Trade Amount	Trader Bid/Ask Spread (Pips)	Trader Skew(+/-) (Pips)	Maximum Limit	Volatility Trigger(s)
EURCLP					
SPOT				25,000,000	4 Rule(s)...
	100,000	2.00	0.00		
	500,000	4.00	0.00		
	1,000,000	4.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	2.00	0.00		
	15,000,000	4.00	0.00		
	20,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
EURJPY					
SPOT					
	0	4.00	0.00		
	50,000	4.00	0.00		
	100,000	4.00	1.00		
	250,000	4.00	2.00		
	500,000	4.00	0.00		
	1,000,000	2.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	3.00	0.00		
	15,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
	50,000,000	6.00	0.00		
EURUSD					
SPOT				50,000,000	2 Rule(s)...
	0	4.00	0.00		
	50,000	4.00	0.00		
	100,000	4.00	1.00		
	250,000	4.00	2.00		
	500,000	4.00	0.00		
	1,000,000	2.00	0.00		
	5,000,000	2.00	0.00		
	10,000,000	3.00	0.00		
	15,000,000	4.00	0.00		
	25,000,000	4.00	0.00		
	50,000,000	6.00	0.00		

Close