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CREDIT RISK
MANAGEMENT SOLUTION

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1. Introduction

The purpose of this document is to outline the implementation of credit monitoring within the Fenics FX framework and describe how a Fenics FX client (operator) can monitor credit exposure and set credit limits via the Fenics FX user interface (UI). Any questions regarding this document should be addressed directly to fenicsfx@lucera.com.

2. Credit Risk Management Specifications

2.1 Entity

The operator defines **entities** for which credit can be assigned. Credit monitoring will be based on a **per entity** configuration. The operator can assign one or several trading connections to each entity. A trading connection is a **FIX taking or providing session** or a specified **account value on a FIX taker connection**.

Creating new entities and allocating FIX session and/or account tags to an entity will not be available in the first implementation through the UI. In a future release, the operator will be able to create new entities and assign FIX sessions/accounts to an entity via the UI.

Adding a new FIX session/account to an entity will be possible in a day as long as there has been no trading activity on this FIX session/account for that trading day. Removing or changing the entity for a FIX session/account with trading activity for a given day will only be possible during the EOD roll window (5pm EST cut off time).

2.2 NOP and Gross Exposure

Fenics FX will calculate the **NOP (Net Open Position) and Gross Risk** exposure for each entity. These risk exposures are monitored based **on USD normalized values** (see Section 2.3 for details on the USD conversion). The UI will show exposure for each individual currency and each settlement date, but the risk limits and alerts are only on the aggregated value (aggregated across currencies and settlement dates).

In a future release, the operator will be able to set against individual currencies as well.

The **Gross risk exposure** is the entire long amount (normalized to USD) **plus the entire short amount** (normalized to USD) divided by 2 for that entity, without any netting.

For example, if an entity buys 1M EUR vs USD at a rate of 1.1, then the operator has a 1M EUR (1.1USD equivalent) short and a 1.1M USD long position against that entity. The gross exposure would be (1.1M + 1.1M)/2 = 1.1M USD.

The **NOP risk exposure** takes into account the side of a trade and nets out positions in the same currency for the same settlement day. For each settlement day, a SD-NOP (Settlement Day Net Open Position) is calculated. This is the average of all netted and normalized long and short positions for that settlement day. The overall NOP is the sum of all outstanding SD-NOPs.

At the end of this document, a calculation example is provided describing how the SD-NOP, overall NOP and Gross exposure is calculated and monitored.

2.3 Floating and Pre-Trade Conversion Rates

For each traded currency two conversion rates, a **floating conversion rate** and a **pre-trade conversion rate**, will be tracked.

The floating conversion rate is the mid-point rate of the currency versus USD (CCY/USD) from an aggregated book of a pre-selected set of benchmark liquidity providers. The operator can choose which benchmark liquidity providers should be used to determine the floating rate. The floating rate will be updated on a 1-minute pulsed feed.

The pre-trade conversion rate will be set equal to the floating conversion rate

at the beginning of the day (17:30 EST). The pre-trade rate stays constant unless it deviates too much from the floating rate. We suggest a 1% difference between the floating and pre-trade rate as acceptable, but this threshold can be reduced or increased by the operator. Once the pre-trade rate breaks out of the acceptable band, it will be updated to the floating rate at the time of the breakout.

It will then stay constant, unless the rate breaks through the allowed band again.

The pre-trade conversion rate is used for the pre-trade credit check on incoming and outgoing orders, as well as for calculating the current exposure that is displayed in the UI. Furthermore, the pre-trade conversion rate is displayed in the UI.

2.4 Settlement Date Accounting

The credit exposure will be monitored with respect to the **spot settlement date** for each **currency pair**. Once the settlement rolls at 5pm EST, credit that is settled will be freed up for that entity again.

2.5 Open Orders

Orders that are open (in active matching process) do account towards the credit exposure. **Once an order is canceled/rejected due to last-look rejection by LP,** the credit is freed again.

Resting orders **do not** account towards the credit exposure and will only be checked for available credit, once a match has been identified, or if the resting order is posted to an outside venue.

If a credit limit is breached, then **any open orders for this entity will be canceled on a best effort basis**. For instance, Fenics FX will send out cancel requests for all open orders immediately following a breach of the limit, however, IOC and FOK orders in general cannot be canceled and might still lead to additional exposure.

2.6 Credit Limits

For each entity the operator can **set two USD credit limits**, one on the NOP

and one on the gross exposure. These limits are set only for the **USD normalized and aggregated exposure** (not per currency) and can be adjusted in the UI at any time.

In a future release, limits can be set on a per currency basis.

2.7 Pre-trade Credit Check

For every new matched order, the Fenics FX Smart Order Router (SOR) will check if this order would exceed one of the two credit limits for its assigned entity, assuming the LP will fill the order. This check is based on **the pre-trade conversion rate for the entire requested amount.**

If a limit is exceeded, then the deal will immediately be rejected (i.e., not routed out) with reject message "Not enough credit available." In addition, an alert is sent to the Fenics FX operator. See Section 2.8 for more details on alerting.

If the NOP limit is reached, then orders that allow reduction of the NOP exposure are still allowed, as long as the Gross limit is not breached. Any outstanding orders that would additionally increase the NOP exposure will be canceled on a best effort basis. In a first implementation, quotes on both sides of the book will still be shown but only orders on one side will be accepted (orders on the other side will be rejected with reject message "Not enough credit available."). In a future release, only one-sided books that allow reduction of the NOP exposure will be published to a client in the case of a NOP limit breach.

If the gross limit is reached, then any FIX sessions that are assigned to this entity will be paused automatically and any outstanding orders will be canceled on a best effort basis. The FIX session will only resume at EOD when enough credit frees up, or when the operator manually resumes the FIX session. In this case it is strongly advised to increase the credit limit to avoid another automated pausing of the session.

2.8 Credit Alerts

The Fenics FX operator will be notified by email alert if a credit limit is reached. In addition, system alerts will be sent out on **a breach of configurable pre-set % levels** of allowed credit (for example, at 70%, 90% and 95%). Alerts are generated on a per entity basis. The pre-set % levels, however, are fixed across all entities.

Alerting will only be reset if the exposure decreases by at least 5%. For example, if the alert for 70% were triggered, then another 70% would only be sent out if the exposure drops to below 65% and then again breaches the 70% limit. 2.9

2.9 Risk Server Failure and Recovery Scenario

In the case of a failure of the risk server, **all FIX connections will automatically be paused by the system** and an alert is sent out to the Fenics FX operator.

Trade data is saved in at least three different locations and this data will then be used to restore the risk server. Different recovery times are expected depending on the data source from which the recovery is performed. In the fastest method, we expect the risk server to be back up and functional within minutes. In rare cases, recovery of the risk server might require more time. Once the risk server is fully restored, the Fenics FX team will notify the operator and the operator can resume trading at their discretion.

2.10 Best Effort Paradigm

All credit checks will be performed on a best effort basis. Fenics FX is not liable for any credit exposure that the Fenics FX client might have due to trades executed on the Fenics FX platform.

3. User Interface

There will be an additional tab "Credit" in the Fenics FX user interface (UI). At the **top of this tab**, the non-entity specific credit monitoring configurations can be set by the operator:

· Pre-set % alert levels. The operator can set how many levels are needed and at what % these alerts get triggered.

· Email list. All credit alerts will be sent to this email list. (Additional email addresses can be configured on a per entity basis.)

Below this top section, entity specific configurations can be set and the UI will roughly look as follows:

	CURRENT EXPOSURE	CREDIT LIMITS
	NOP ($)	NOP ($)
Entity A	3M	10M
Entity B	43M	100M
Entity C	50M	50M

Current exposures are shown. If pre-set alert level is reached then the corresponding field will be highlighted in orange. If a credit limit is reached then the corresponding field will be highlighted in red.

Fenics FX operator can set and change these credit limits intra-day.

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The operator can choose to display the credit exposure in a more detailed breakdown:

· By currency (this will also show the conversion rate)

· By FIX session/account

· By settlement date

If all of the above are selected, then the full credit risk matrix will look as follows (dots would be the actually exposure, omitted here for display purposes):

Entity	FIX/Acct	CCY	Rate		CURRENT EXPOSURE Net T	T+1	T+2		Gross T	T+1	T+2	CREDIT LIMITS Net	Gross
Entity A		CCY 1	1.000	...	...	...	...	...	...	...	...	10M	50M
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 1	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 2	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 3	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
Entity B		CCY 1	1.000	...	...	...	...	...	...	...	...	100M	1,000M
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 1	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
Entity A		CCY 1	1.000	...	...	...	...	...	...	...	...	50M	100M
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 1	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		
	FIX/ Acct 2	CCY 1	1.000	...	...	...	...	...	...	...	...		
		CCY 2	0.945	...	...	...	...	...	...	...	...		
		CCY 3	1.245	...	...	...	...	...	...	...	...		

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EXAMPLE:
The following is an example of new incoming orders (1, 2, 3, …) and the exposure to each currency, as well as overall exposure changes.

Counterparty DEALS

	Settlement Day	CounterParty Side	Dealt ccy	Counter ccy	Dealt Rate	Dealt amount	Counter amount
1	T+1	BUY	EUR	USD	1.1137	1,000	1,114
2	T+1	SELL	EUR	USD	1.1211	10,000	11,211
3	T+1	SELL	EUR	GBP	0.7205	1,000	721
4	T+1	BUY	GBP	USD	1.5451	5,000	7,726
5	T+2	BUY	EUR	GBP	0.7221	7,000	5,055
6	T+2	BUY	EUR	USD	1.1254	3,000	3,376
7	T+2	SELL	EUR	USD	1.1267	6,000	6,760
8	T+2	SELL	EUR	USD	1.1245	-	-
9	T+2	SELL	EUR	GBP	0.7222	-	-
10	T+3	SELL	GBP	USD	1.5321	11,000	16,853
11	T+3	BUY	GBP	USD	1.5323	-	-

TOTAL EXPOSURE:

	NOP ($)	GROSS ($)		
T+1	11,210	21,170		
T+2	7,812	17,935	T+2	BUY
T+3	16,850	16,850	T+2	BUY
TOTAL	**35,872**	**55,955**		
			T+3	BUY
NOP LIMIT	**40,000**			
NOP LEFT	4,128			

Net	Gross	Rate	Net	Gross	Rate	Net($)	Gross($)	Net	Gross	Rate	Net($)	Gross($)
1,114	1,114	1	-1,000	1,000	1.1139	-1114	1114	0	0	1.5411	0	0
-10,097	12,325	1	9,000	11,000	1.1210	10089	12331	0	0	1.5411	0	0
-10,097	12,325	1	10,000	12,000	1.1210	11210	13452	-721	721	1.5451	-1113	1113
-2,372	20,050	1	10,000	12,000	1.1210	11210	13452	-5,721	5,721	1.5451	-8839	8839
0	0	1	-7,000	7,000	1.1245	-7872	7872	5,055	5,055	1.5410	7789	7789
3,376	3,376	1	-10,000	10,000	1.1245	-11245	11245	5,055	5,055	1.5410	7789	7789
-3,384	10,136	1	-4,000	16,000	1.1245	-4498	17992	5,055	5,055	1.5315	7741	7741
-3,384	10,136	1	-4,000	16,000	1.1245	-4498	17992	5,055	5,055	1.5315	7741	7741
-3,384	10,136	1	-4,000	16,000	1.1245	-4498	17992	5,055	5,055	1.5315	7741	7741
-16,853	16,853	1	0	0	1.1245	0	0	11,000	11,000	1.5315	16847	16847
-16,853	16,853	1	0	0	1.1245	0	0	11,000	11,000	1.5315	16847	16847

Dealt ccy	counter ccy	conv rate	NOP BUY ($)	NOP BUY		Dealt ccy	counter ccy	conv rate	NOP SELL ($)	NOP SELL
EUR	USD	1.1245	7,512	6,681	SELL	EUR	USD	1.1245	8,626	7,671
EUR	GBP	1.1245	4,128	3,671	SELL	EUR	GBP	1.1245	11,870	10,555
GBP	USD	1.5315	20,981	13,700	SELL	GBP	USD	1.5315	4,128	2,696

- Gross exposure is the sum of all long and short positions (single counted) **without** netting.

- NOP exposure:

  - For each currency and each settlement day, the net exposure is calculated. For example, if an entity has a 2M long EUR and a 1M short EUR for the same settlement date, then the net position is 1M long EUR for that settlement date.

  - For each netted currency, the USD equivalent is calculated based on the pre-trade conversion rate.

  - For a single settlement day, the NOP is the sum of all netted long exposures plus the sum of all netted short exposures (single counted).

  - The overall NOP exposure is the sum of all individual settlement day NOP exposures.

- The NOP buy and sell limits are based on each currency pair's settlement day and available overall NO.