MODUSBOX

Update on Forex for Mojaloop and problems we encountered

Jo Sowden & Rob Reeve

What problem is Forex trying to solve?

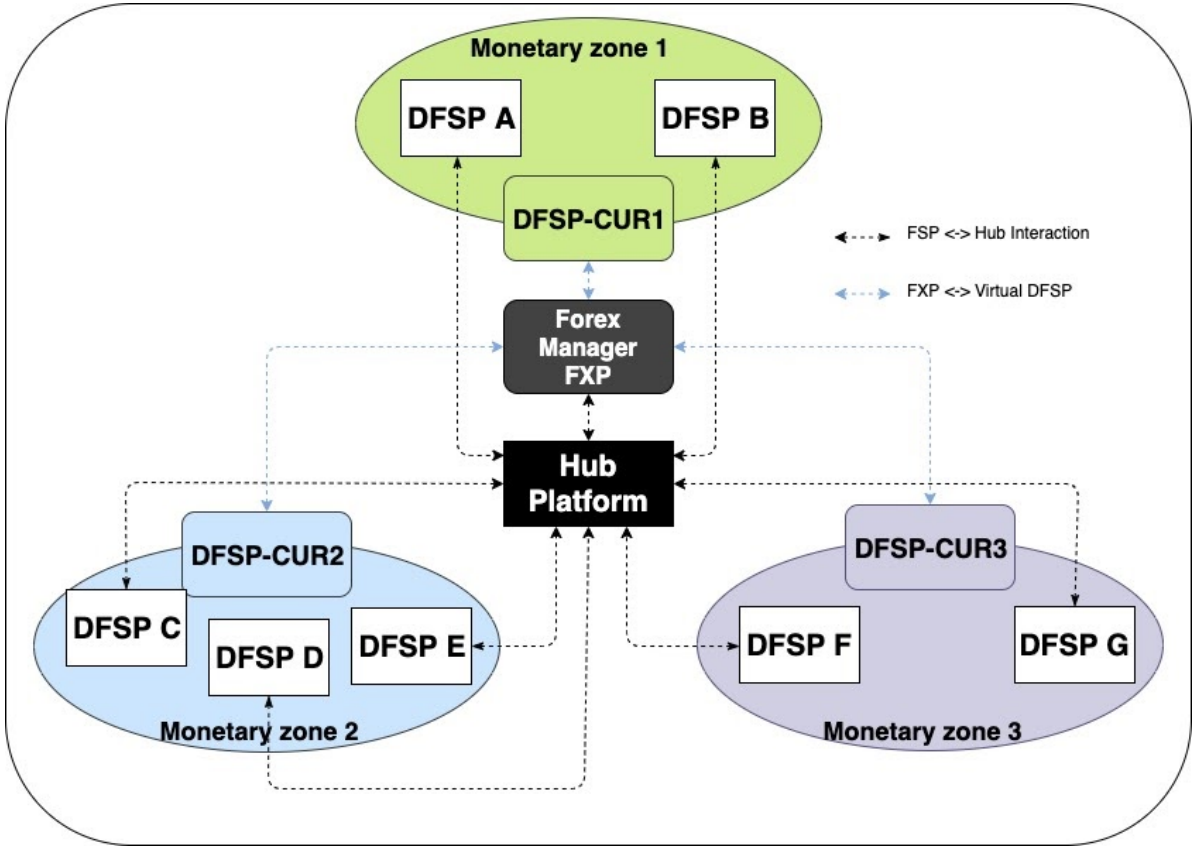
- Mojaloop only allows transactions to be sent where both parties transact in the same currency and within the same network. To make Mojaloop interoperable with the established/existing ecosystem there needs to be the ability to perform cross -network, cross currency transactions.

- We started with the assumption that these transactions should be possible with as little modification to the Mojaloop API and DFSP implementations as possible.

What is FXP?

The Foreign Exchange Provider (FXP) is a service that enables cross-border, cross-currency transactions within a Mojaloop implementation. The service will be responsible for performing the currency conversion calculations based on exchange rates supplied by a Partner Bank.

How does FXP work



Problems we encountered

Exchange Rates
Quotes & Transfers
Settlement

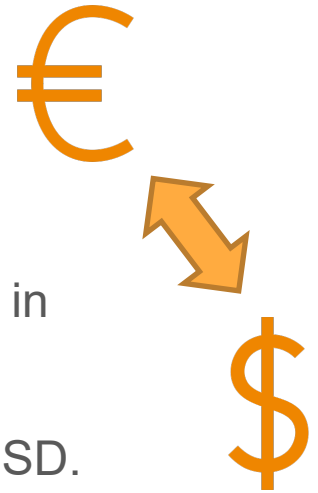
Problems we encountered

Exchange Rates

Exchange Rates - Dealing with Real Money in a transfer

EURUSD Rate = 1.1090

This means for 1 EUR I will receive 1.1090 USD



Sarah wants to send 57.50EUR to Sanjay who has an account in USD

The amount to be received will be 57.50 * 1.1090 = 63.7675 USD.

How to round? 63.76 or 63.77

Whichever way means there will be a discrepancy when we come to settlement of multiple transfers

Exchange Rates – A solution for rounding on a quote

The solution - ensure that the least amount extra is quoted !

That changes dependng on the type of Quote

- SEND – FX rate on the Request for Quote (rounding down)
- RECEIVE FX rate on the Quote (rounding up)

Exchange Rates– Rounding Solution in practice

***SEND* 1 EUR**

Exchange Rate = 10.415

1 x 10.415 is rounded down to 10.41

General Rounding would apply as 10.42

OK - Sort of make sense

***RECEIVE* 10.41 MAD**

10.41 / 10.415 is rounded up to 1.00

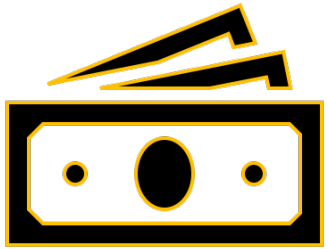
General Rounding would also apply as 1.00

but there are some edge cases
10.32 /10.415 is rounded up to 1

Exchange Rates– We risk confusing the customer

How to Store the Currency Pair

Major Currency First? *EURAUD*
Alphabetic First ? *AUDEUR*
.



Exchange rates for a Currency pair are stored for one direction based on the Base Currency - this is the industry standard

Exchange Rates– Another chance to confuse your customer

Currency Pair is **EURMAD**. In this case EUR is the Base Rate. But they are given as Bid and Offers

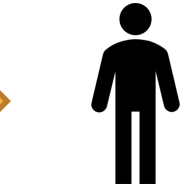
10.412 Spot Bid rate	**10.435 Spot Offer Rate.**
This is the rate that the FX Provider sells the Base Rate.	This is the rate that the FX Provider buys the base rate. i.e. 1 EUR will cost 10.435 MAD
For 1 EUR sent 10.412 MAD will be received	For 1 MAD sent 0.09583 EUR will be received (1 / Offer Rate)

Exchange Rates– Another chance to confuse your customer ctd

SEND **100 EUR**

Exchange Rate = 10.412 (Bid)

OK - Sort of make sense



Receive 1041.20 MAD

SEND **1000 MAD**

Exchange Rate = 10.435 (Offer)

VERY DIFFICULT FOR END USER TO UNDERSTAND RATE USED IF MONEY MOVING MAD -> EUR

Receive 95.83 EUR (1000 / Offer Rate)

Exchange Rates– A solution for both

The solution - convert the rate into unidirectional pairs !

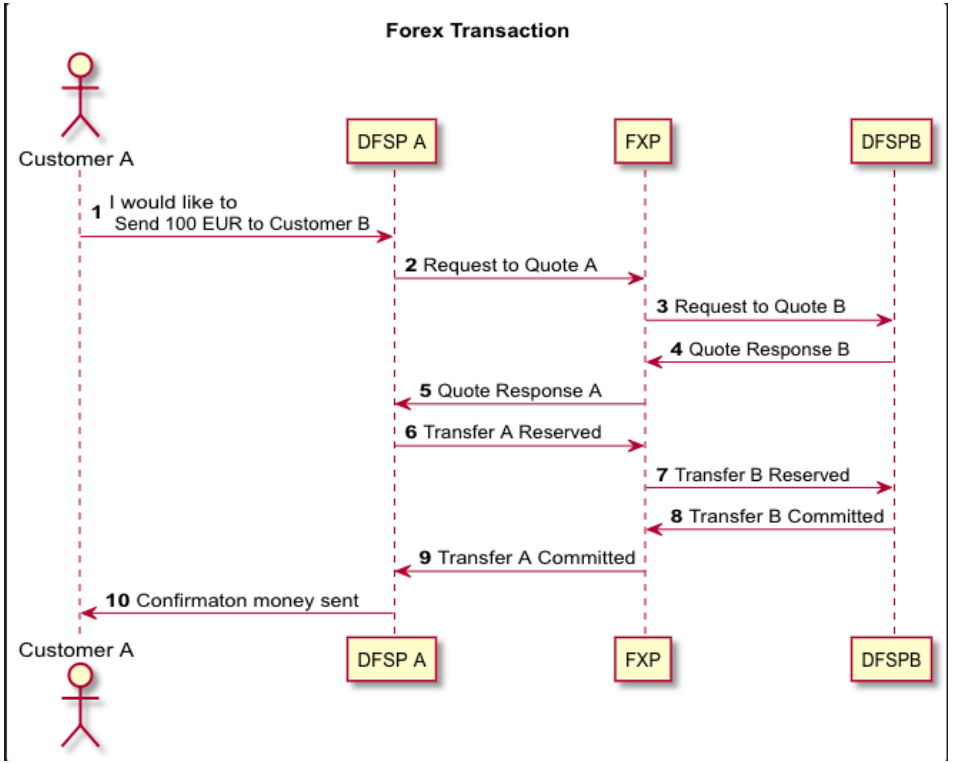
Exchange rate stored twice for each Currency Pair
Once with base currency as EUR and once with MAD as the base currency.
They will just have buy rates to show the customer
EURMAD Rate = Bid rate (10.412)
MADEUR Rate = 1/Offer Rate (1/10.435) = 0.9583133

ROUNDING ISSUE FOR CALCULATION MAY CAUSE CONFUSION i.e. showing 0.9583 for MADEUR

Problems we encountered

Quotes and Transfers

Transaction – 2 Separate quotes and transfers



[A] and [B] Represent 2 separate quotes
& transaction– One for each Currency

Need to be linked together : parenttransferID stored in Extension list

Transaction – Edge Cases

Timeouts and other Edge Cases

Telescopic timeouts - Need to ensure that the timeout for the second leg is less than the timeout for the first leg

If there are failures on Leg B , we need to replicate the failure for Leg A as either both transactions should complete or neither

Where to Commit?

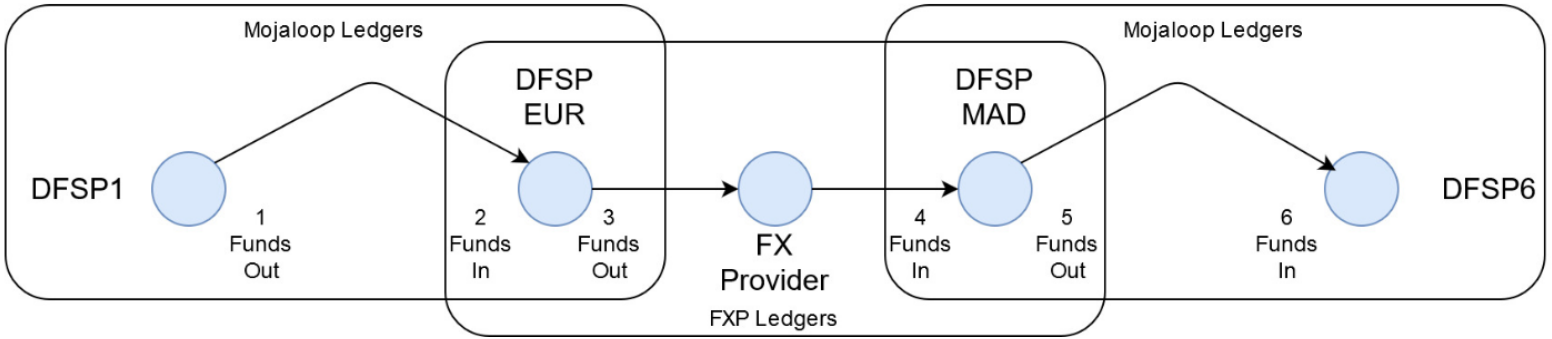
Problems we encountered

Settlement

Settlement – Logical Vs Physical

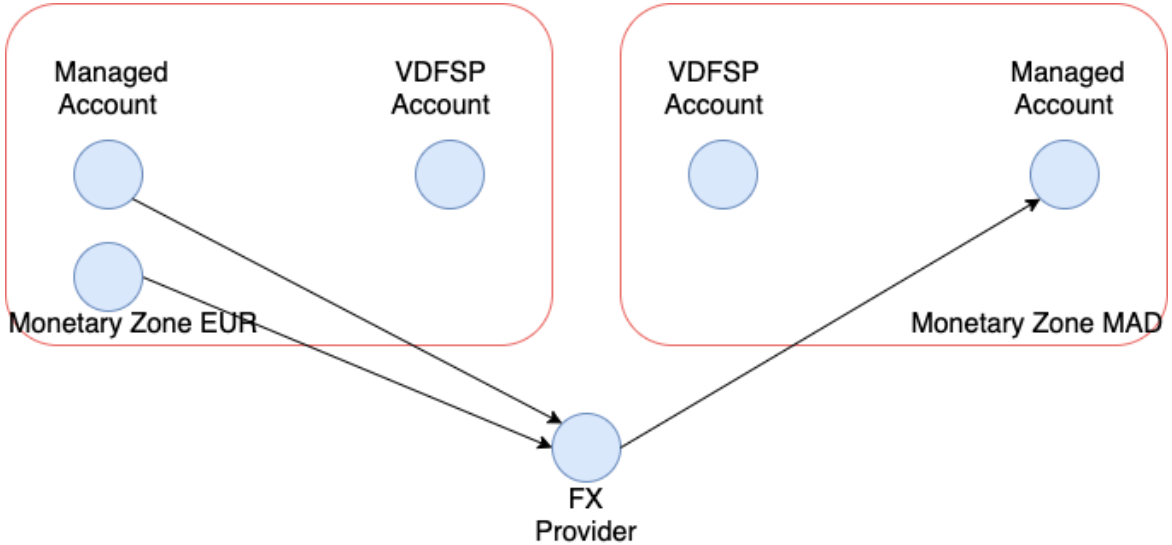
Currently Logical and Physical settlement are tightly coupled within Mojaloop, however they are two separate processes. Logical settlement is recording money movements within the ledgers.

Logical Settlement



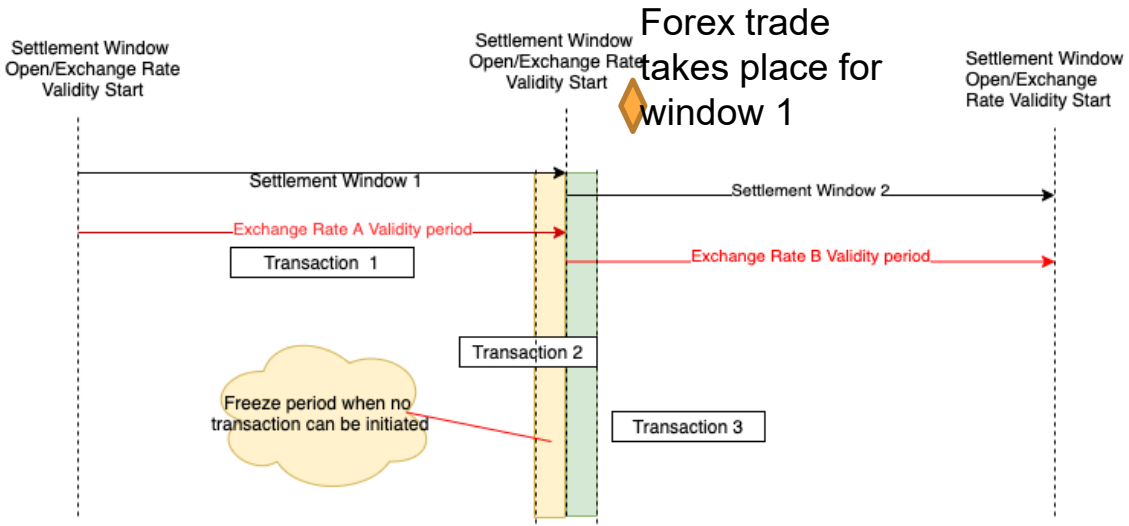
Settlement – Logical Vs Physical

Physical settlement is the actual money movement in the real world



Settlement – Because logical & Physical are linked in Mojaloop

Mojaloop tightly couples settlement window closures with physical settlement. As a consequence Window Closure has to match Exchange Rate Expiry if the window is used to define the amounts traded and settled



Transaction 1 uses Exchange rate A and is included in settlement Window 1

Transaction 3 uses Exchange rate B and is included in settlement Window 2

Transaction 2 uses Exchange rate A But is included in settlement Window 2

Transaction 2 is included in settlement Window 2. Window 2 will be settled at a different exchange Rate

Settlement - How to resolve this short term

Short Term

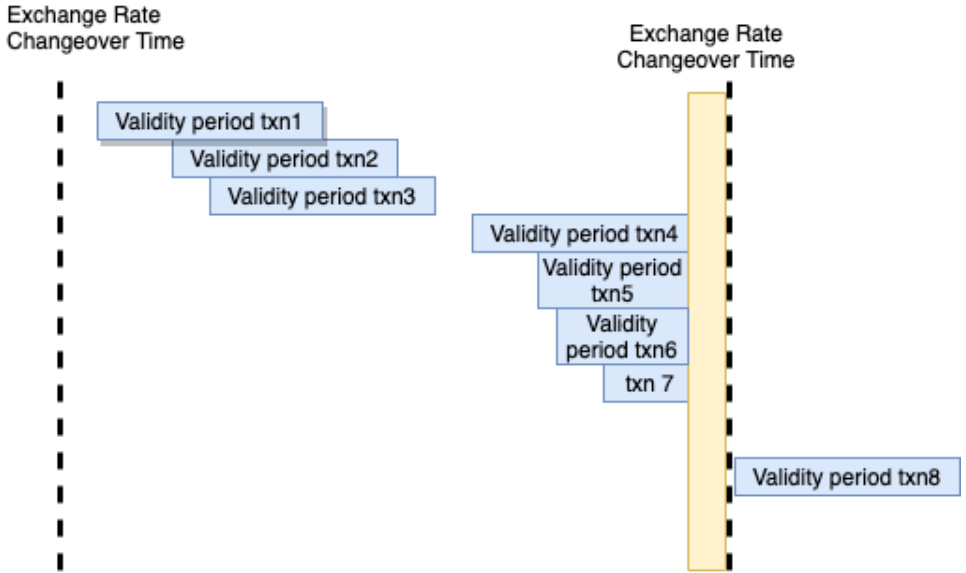
Stop transactions being performed in a ‘freeze period’ so that we can be sure that the transaction starts and finishes in the same settlement window.

This freeze period should equal the validity length of Quote A.

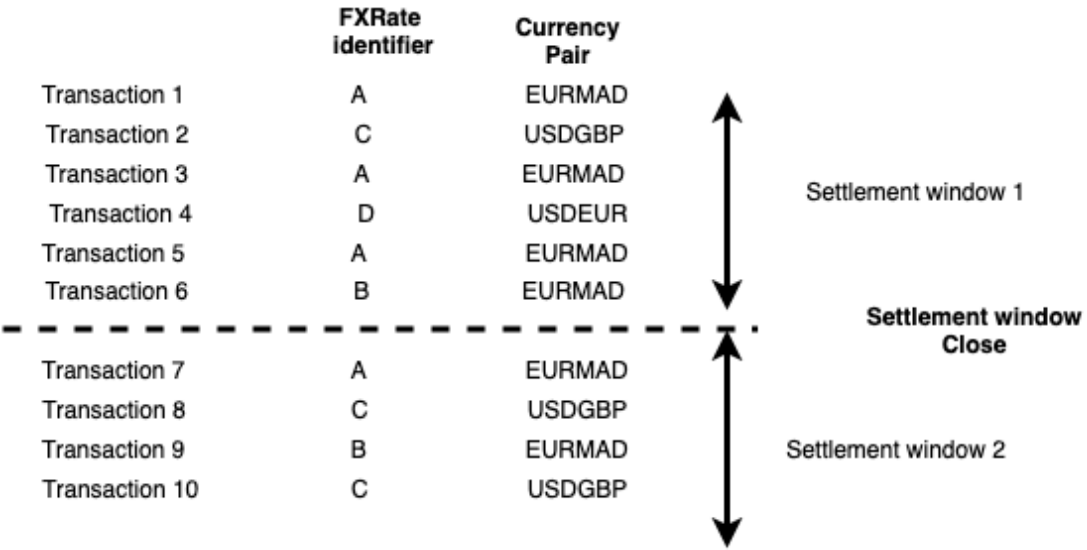
However as the validity period of a quote may be several minutes this isn’t practical as no transactions can be performed for that time.

Settlement - How to resolve this medium term

We introduce the Diminishing Quote expiry Time. As you get closer to the end of the exchange rate Validity period the Quote expiry length decreases to match



Settlement - How to resolve this long term



Decouple the settlement window from exchange rate validity period

- Logically settle by settlement window
- Physically settle by exchange rate

The Settlement Window Closure is purely for accounting within the ledgers.

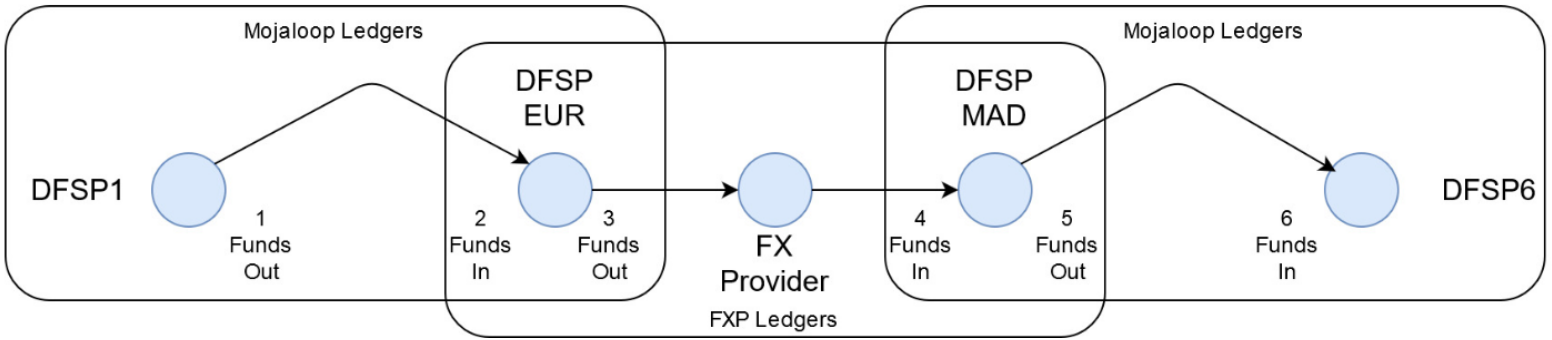
The Physical Settlement will be for a FXRate Identifier/Currency Pair and can happen at any point

Settlement – Reconciliation & Rounding

We need to reconcile that the transactions the FXP is settling matches those at the Hub

To do this we need to be able to maintain ledgers at both the Hub and FXP

Logical Settlement



Settlement – Revenge of the Rounding

The Sum of the parts does not equal the whole!

So the sum of individual transactions will not equal the amount that is requested as part of the Forex trade

Exchange Rate Used = 10.4130

Amount Type	EUR Amount	MAD Amount
SEND	53.00	551.88
SEND	172.00	1791.03
SEND	1430.00	14890.59
Total	1655.00	17233.50

Total to be converted = 1655 EUR
Using the exchange rate this will give : 1655 * 10.4130 = 17233.51

The expected amount is different to what will be received by 1 cent

Thank you

Jo SowdenJo.Sowden@modusbox.com

Rob ReeveRob.Reeve@modusbox.com