UBS Investment Bank

UBS AG
P.O. Box
CH-8098 Zürich
Tel. +41-44-239 11 11

FX Client Delivery

www.ubs.com

UBS Fx2B Liquidity API
FIX Interface - Project Manual

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Table of Contents

1. Introduction

The Scope of this document is to give both a technical (architectural setup and pre-requisites) and a functional overview (Streaming Price, Request for Quote and Order execution) of the Fx2B Liquidity API.

1.1 Revision

Version	Date	Remarks
1.0	Jun. 2007	Initial Document
1.1	Jun. 22nd 2007	4.3.2 Strategies execution Table, 5.2 FIX required data
2.0	Jan. 9th 2008	Radianz connectivity details, Forward Outright – Request for quote, Forward Streaming availability; Sequence Reset
2.1	Oct. 9th 2008	US connectivity details (Internet and Radianz)
2.2	Jul. 28th 2009	Updated to include Request-for-Quote for FX Spot and FX Swap
2.3	Aug. 28th 2010	Updated to include Multiple Subscriptions. Added note on NDF Subscriptions
2.4	Nov. 4th 2011	Updated to reflect changes in UBS Tokyo
2.5	Jul. 10th 2013	Updated to include strategy descriptions, VWAP and project roadmap
2.6	Jun. 23rd 2015	Updated to include our latest interactive API simulator

1.2 Abbreviations

Abbreviation	Definition
UBS-IB	UBS Investment Bank
Fx2B	Foreign Exchange Front-to-Back (UBS-IB registered trademark)
CP	UBS Connectivity Partner
CDM	Client Delivery Manager
PTE	Test Environment
FSS	UBS FixSpec Simulator
PRD	Production Environment
RFQ	Request For Quote
NDF	Non Deliverable Forward
ROE	Rules of Engagement

1.3 Intended Audience

The document is intended for authorised development personnel of UBS Connectivity Partner (CP)'s or their IT partners involved in the planning, design and implementation of the Fx2B Liquidity API FIX interface between UBS Investment Bank (UBS-IB) and the CP.

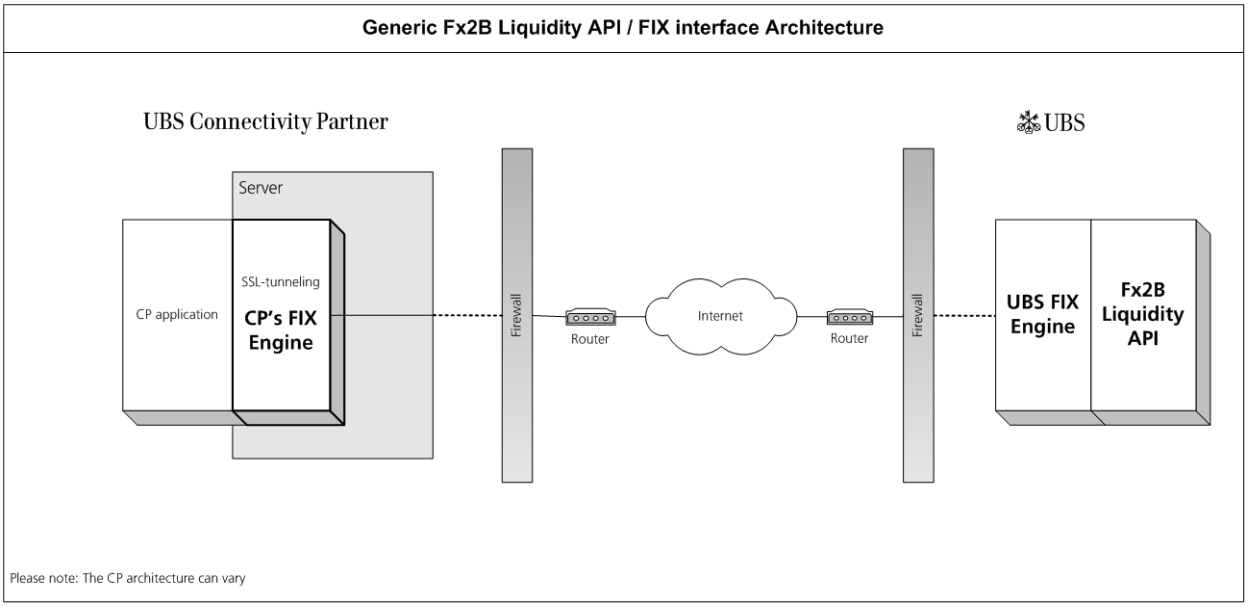
1.4 Related Documents

FIX specifications: **FIX Interface - Rules of Engagement**

2. Product Overview

2.1 Architecture Overview

The following diagram shows the basic architecture.



2.2 Product Overview

UBS Fx2B Liquidity API is based upon the FIX version 4.3 protocol with some minor extensions (details are provided in the document 'FIX Interface - Rules of Engagement'). Our API allows CPs to:

- Subscribe to streaming prices for FX Spot, Forward Outright and NDF instruments
- Request quotes on FX Spot, Forward Outright, Swap and NDF instruments
- Trade on streaming and RFQ prices

UBS Fx2B Liquidity API covers FX Spot for both currencies and Precious Metals (PM), Forward Outright, Swap (RFQ only) and NDF instruments for currencies at the moment.

Note: Some currency pairs require business approval, please contact your UBS Business representative for additional information.

2.3 Functionalities Overview

The Fx2B Liquidity API offers the following functionalities (see section 5 for details):

- Connectivity
- Receive price stream (FX Spot / Forward Outright / NDF instruments)
- Request for Quote (FX Spot / Forward Outright / Swap / NDF instruments)
- Liquidity Management
- Order Execution

3. Project Roadmap

The project is completed in phases which are demarcated by the milestones specified in the diagram below. For each of the milestones, the CP should provide exact (or if not define yet, approximated) dates. The dates may be changed at a later stage, but the establishment of a timeline helps to create an initial framework, to understand the project workflow and to allocate resources accordingly.

During the course of the project, business and technical questions related to the implementation may be directed to the respective Client Delivery Manager (CDM).

Project Steps	CDM Actions	CP Actions
Pre-Project	• Email Rules of Engagement and Project Manual document	• Review documentation and prepare questions for kick-off call

1st Milestone **Project Kick-Off**	• CDM to organize kick-off call – points of discussion:
	  ○ Overview of the project tasks
	  ○ Agree on milestones dates
	  ○ Fractional pips, by default UBS will be streaming in fractions, i.e. 1 or more places of decimal in addition to the standard pip-level precision
	  ○ Strategies: FOK, FAK, FBOK, FBAK (incl. limit, previously quoted, etc.)
	  ○ Execution Reports for trades filled across multiple bands
	  ○ IT infrastructure at CP: servers location, fail over plan
	• CDM to email kick-off call minutes	

Development &	• Provide FIX tags and certificate details • Provide UAT test case • Provide signed certificates to access PTE and/or FSS	• Open firewall to access UBS PTE and/or FSS environments • Generate PTE SSL key(s) and CSR file • Connect to PTE and/or FSS • Complete client-side development
2nd Milestone **User**	• Organize conference call for conformance testing	• Complete & pass UAT conformance testing • Sign-off on the UAT
	Note: Following CP's sign-off, no additional changes which were note certified during the conformance testing should be made to CP's API without informing the CDM.	
Production Setup	• Provide PRD IP(s), FIX tags and certificate details • Provide signed certificates to access PRD • Request production support information such as IT Manager, Production Support, Operation, Business Manager	• Confirm firewall is opened to access UBS PRD environment • Generate SSL key and CSR file • Connect to PRD • Subscribe to all enabled currency pairs • Provide production contact details
3rd Milestone	• Organize call for Business Readiness Testing trade • Provide production support details and hand over CP details to UBS production support team FX eHelp	• Execute 1st live trade • Provide final sign-off on project

Notes:

- Production support is provided by UBS FX Ecommerce (FXEcommerce@ubs.com)
- Test support is provided by UBS FX Client Delivery (FX-ClientDelivery@ubs.com)

4. Product setup

4.1 FIX Package

Information on the Financial Information eXchange ("FIX") Protocol can be found on the official website http://fixprotocol.org.

The document **FIX Interface - Rules of Engagement**, which explains the details of how the FIX Protocol is used to establish connectivity and trade FX with UBS will be delivered by the UBS Client Delivery Manager (CDM). CDM is your point of the contact throughout the project.

Once our joint project is live in production, the relationship will be handed over to our production support team UBS FX eHelp.

4.2 Certificate Generation

Use of certificate management tool is required. In order to meet requirement of Stunnel, required features are:

- generate PEM encoded PKCS#1 RSA 1024 bit private key
- generate PEM encoded PKCS#10 Certificate Signing Request

If no certificate management tool is available to CP, OpenSSL can be used, package available on http://www.openssl.org.
See appendix (section 6) for certificates generation procedure.

4.3 Connectivity Requirements

4.3.1 Firewall Setup

- Production environment (PRD):

UBS Client Delivery Manager will provide the IP address details for the production environment.

Overview of the Cross-connect colocation centers and supported leased line providers:

APAC (Japan/Singapore/Australia)	EMEA (United Kingdom)	AM (USA)
Cross Connect Data Centers: @Tokyo (Koto-Ku, Tokyo)* KVH (Koto-Ku, Tokyo) TY2 (Shinagawa-Ku, Tokyo) TY3 (Koto-Ku, Tokyo) TSE (Toshima-Ku, Tokyo) Singapore Exchange (Singapore) ALC (Sydney)	**Cross Connect Data Center:** Equinix LD4 (Slough)*	**Cross Connect Data Centers:** Equinix NY4 (Secaucus, NJ)* Equinix NY7 (North Bergen, NJ) Savvis NJ2 (Weehawken, NJ)
Supported Leased Line Providers: KDDI TNS	**Supported Leased Line Providers:** BT Radianz TNS	**Supported Leased Line: Providers:** BT Radianz TNS

(*) Location of UBS FIX engines (market data feed and order booking)

- Test environment (PTE) – Internet Only:

For clients connecting to London, use: fxfixb2bpte1.ibb.ubstest.com (139.149.11.182) port 2500
For clients connecting to Tokyo, use: fxfixb2bpte7.ibb.ubstest.com (202.1.87.200) port 2500

To confirm the firewall opening, please use the command:
For London*: telnet fxfixb2bpte1.ibb.ubstest.com 2500*
For Tokyo: *telnet fxfixb2bpte7.ibb.ubstest.com 2500*

4.3.2 Connection Setup (Stunnel)

SSL/TLS based solution is required to achieve secured data transfer between FIX client and server side.

In case CP does not have SSL/TLS based solution, Stunnel can be used. Package available on http://www.stunnel.org/

Please use the following configuration for accessing UBS platform using Stunnel:

Stunnel Configuration File for PTE	**Stunnel Configuration File for PRD**
; File Name: stunnel_pte.conf ; Title: UBS FX2B FIX API Stunnel Config. ; Environment: PTE ; Socket parameters tuning socket = l:TCP_NODELAY=1 socket = r:TCP_NODELAY=1 socket = l:SO_KEEPALIVE=1 socket = r:SO_KEEPALIVE=1 ; Security level verify = 2 ; Path to key and certificate files cert = /CP's path/btobxpte**XXXX**.pem key = /CP's path/btobxpte**XXXX**.key CAfile = /CP's path/ca_pte.pem ; Uncomment for troubleshooting purposes ;debug = 7 ; Log file path output = /CP's path/stunnel_pte.log client = yes [UBS_FXFIXB2B_PTE] accept = 2500 connect = 'Host Name for your location':2500	; File Name: stunnel_prd.conf ; Title: UBS FX2B FIX API Stunnel Config. ; Environment: PRD ; Socket parameters tuning socket = l:TCP_NODELAY=1 socket = r:TCP_NODELAY=1 socket = l:SO_KEEPALIVE=1 socket = r:SO_KEEPALIVE=1 ; Security level verify = 2 ; Path to key and certificate files cert = /CP's path/btobxprd**XXXX**.pem key = /CP's path/btobxprd**XXXX**.key CAfile = /CP's path/ca_prd.pem ; Uncomment for troubleshooting purposes ;debug = 7 ; Log file path output = /CP's path/stunnel_prd.log client = yes [UBS_FXFIXB2B_PRD] accept = 2500 connect = To be provided by UBS

(**XXXX** = 4 digits provided by CDM)

4.4 FIX Required Parameters

FIX tags that are provided by UBS, for FIX details refer to **FIX Interface - Rules of Engagement**

FIX Tag	Field Name	Value	Comments
49	SenderCompID	Provided by CDM	UBS provides 2 FIX sessions by default. One for Market Data Feed and Order Management
56	TargetCompID	UBSFX2B_PTE UBSFX2B_PRD	Test environment Production environment
108	HeartBtInt	30	UBS recommended value
553	Username	btobxpte**XXXX** btobxprd**XXXX**	**XXXX** = 4 digits provided by CDM
554	Password	Provided by CDM	
448	PartyID	Provided by CDM	Not required for indicative market data feed

4.5 Counterparty ID

FIX tag 448 (PartyID) is used to specify the account ID, and will be assigned by CDM. This ID needs to be set in the trade request. Please note that Counterparty ID is not required for indicative market data feed. We do not use FIX tag 1 (Account) to specify the account ID in our current environment.

4.6 Sequence Reset

As per FIX Session Protocol recommendations, Sequence Number Reset should be performed at least once every 24 hours. UBS support the following two modes of operation:

- Client-Initiated sequence number reset, i.e. CP is responsible for triggering the reset of FIX sequence number for each FIX session
- Scheduled Sequence Number Reset, i.e. at the time agreed between CP and CDM, UBS will reset the sequence number of each of the CP's FIX session

Please see Message Sequence Number Reset section of **FIX Interface - Rules of Engagement** for details.

4.7 UBS FixSpec Simulator

UBS-IB partners with FixSpec to offer an interactive API simulator for you to use for development and testing, and to allow you to prepare and take the certification.

UBS FixSpec Simulator provides (un-canned) responses to FIX messages received, and gives visibility into your traffic and certification readiness in real time.

It also allows you to "play the role" of UBS-IB, for example by exposing tools to generate unsolicited messages, or adjusting the rate of market data refresh to simulate fast-moving markets.

Please refer to Appendix C for further details.

5. Product Functionalities

5.1 Price Stream (FX Spot, Forward Outright and NDF instruments)

5.1.1 Request-For-Stream

All Fx2B Liquidity API price streams are based on subscriptions, by amount or by band, initiated by the CP. This means the CP can subscribe to a price stream per set currency pair and start receiving price updates for the subscribed pair. It is also possible to subscribe to multiple amounts for a given currency pair concurrently. In such cases, the CP should use unique MDReqIDs (FIX tag 262) in the MarketDataRequest messages to differentiate the streams. The CP can also un-subscribe from active price streams.

The allowed set of currency pairs is variable depending on business agreement in place with UBS, as well as the maximum allowed number of concurrent subscriptions for each CP.

5.1.2 Update Frequency

Depending on the volatility of the market, price updates frequency can vary. The default behaviour of Fx2B Liquidity API is to send updates directly when they occur.

The CP can also receive throttled updates, a so-called conflated stream, upon request through the API. However, throttled updates are only recommended for CP using indicative stream. It is worth pointing out that receiving the real-time price is relevant for deal accept/reject decisions on the UBS side and thus by subscribing to a throttled stream, the CP runs a higher risk of experiencing slippage and trade rejects. In order to receive the real-time price from UBS, we strongly recommend the use of dedicated lines and/or co-location (Cross-Connect for instance) between CP and UBS; and that is to guarantee low latency on our market data feed.

5.1.3 Indicative Streams

UBS manages the setup of dealable versus indicative CP's Streams. A CP set up for indicative streams cannot request to receive dealable streams from the API.

In addition, all dealable streams can be temporarily set to "indicative" by UBS in some very specific conditions, i.e. FIX tag 276 = I (QuoteCondition). All subsequent deal requests (while and as long as indicative flag is enabled) from the CP are then rejected.

5.2 Request For Quote (Spot, Forward Outright, Swap and NDF)

The Fx2B Liquidity API currently supports Request For Quote for Spot, Forward, outright, Swap, and NDF instruments. RFQ provides a single two-way dealable quote valid for a limited time period after which it expires.

Note: Although UBS does not provide a dedicated FIX message for Request For Stream (RFS), this can be simulated at the CP by subscribing and unsubscribing to a market data feed for the required duration of the RFS.

5.2.1 Quote Request

The CP submits a request with required parameters.

5.2.2 Quote Reply

The CP receives a two way quote reply in return to the quote request.

5.2.3 Deal Request

The CP initiates a deal request with "fill-or-kill" execution strategy with the quote (price and the quote reference) received in the Quote Reply and the desired amount.

5.2.4 Deal Confirmation

The CP receives an ExcutionReport if the deal request is accepted and processed by UBS.

5.3 Liquidity Management

5.3.1 Liquidity Layers

UBS-IB has an advanced pricing mechanism that differentiates applicable prices by amount depth, commonly known as price stack. In the Fx2B Liquidity API price stream, multiple layers of liquidity are published for bid and ask sides. Depending on the ticket size and chosen strategy, the deal execution can involve one or more layers.

Note: The structure of the liquidity banding does not vary very often, but can change at any time without notice, depending on time zone and market situation. The CP application should be capable of dealing with these band changes. For each layer there is:

- Bid price or ask price respectively
- Available liquidity which is nominated in the base currency only, i.e. CCY1, however, it is possible to specify in which currency to execute an order.
- Indicative or Dealable status (in case of an Indicative quote CP's application should prevent from sending deal requests)
- Quote reference

The CP can choose to deal on any amount from zero to the cumulated liquidity of all available layers, the amount being capped by the highest dealable amount.

The Fx2B Liquidity API solution offers the following options to the CP for controlling the 'banding' received in a given currency pair:

1. For receiving a multi-layer structure, the CP can set either of the following parameters:

- Maximum number of liquidity layers published (depending on UBS displayed layers, variable per CCY pairs and market conditions)
- Cut-off amount: The Fx2B Liquidity API will then publish a single band of the CP liquidity bands, up to this cut-off amount.

2. Subscribe to a single-band price stream for a given target ticket size. The CP will then receive a single price band containing the weighted average price of the requested liquidity across the net available price bands. The CP can also subscribe to multiple amounts for the same currency pair.

The CP can dynamically request price streams on any band configuration up to the amount capped at UBS.

5.4 Trade Execution

To execute RFQ, the CP must use "fill-or-kill" execution strategy and include the quote reference which was returned in quote reply.

Also, when multiple subscriptions have been requested for the same currency pair, new order requests should contain the MDReqID of the respective stream for which the order is being submitted.

Important note: In the case of an order sent and subsequently no order confirmation being received from UBS, UBS Production Support (i.e. FX eHelp) needs to be contacted immediately. As order might have been already fully confirmed on UBS side but not yet received by CP.

5.4.1 Date Switch Convention

At 5:00 PM EST (Eastern Standard Time) the trade and value dates will switch independent of the actual date in another time zone for all FX products except NZD. For NZD trade and value dates switch is based on 7:00 AM Wellington Time.

Note: EST and Wellington Time are subject to daylight saving time.

5.4.2 Execution Strategies

The following execution strategies are available on Price Stream (FX Spot, Forward, Outright and NDF instruments):

- **FILL_OR_KILL:** the whole order must be executed immediately, otherwise the order is cancelled.
- **FILL_AND_KILL:** the order must be executed immediately in whole or in part; any unexecuted part is automatically cancelled.
- **FILL_AT_BEST_OR_KILL:** the whole order must be executed immediately at best price, otherwise the order is cancelled.
- **FILL_AT_BEST_AND_KILL:** the order must be executed immediately in whole or part at best price; any unexecuted part is automatically cancelled.

FILL_OR_KILL is the only strategy supported on the For Request For Quote (All instruments) service.

To properly set the above strategy, please refer to below table and to the section Order Types & Execution Strategies in the **FIX Interface - Rules of Engagement**

Note: all orders are "kill" orders (no orders will remain on UBS order book). RFQ is supported for FOK only.

Execution Behavior		Strategy	Required FIX Tag			
Possible execution on multiple bands	Filled Qty		OrdType (40)	TimeInForce (59)	Price (44)	QuoteID (117)
No	All or nothing	FOK Quoted	D	4	Price	QuoteId
Yes	All or nothing	FOK Limit Rate	2	4	Limit Price	Not to be Set
No	All or partially	FAK Quoted	D	3	Price	QuoteId
Yes	All or partially	FAK Limit Rate	2	3	Limit Price	Not to be Set
Yes	All or nothing	FBOK	1	4	Not to be Set	Not to be Set
Yes	All or partially	FBAK	1	3	Not to be Set	Not to be Set

5.4.3 Strategy Descriptions

Fill Or Kill (FOK)
Fill Or Kill Orders allow the trader to specify a target deal amount which may be either filled in full or rejected. This order type may be an optimal choice for strategies where complete execution of the requested amount is required. Such order types do not support partial fills. Fill Or Kill orders may be submitted either as Limit or PreviouslyQuoted. In case of Limit, the order will be executed if the entire requested amount can be fulfilled at the specified limit rate. Please note that the order is executed immediately is not submitted to an order book for later matching. With PreviouslyQuoted, the order will get filled in full exactly at the quoted rate. However, both Limit and PreviouslyQuoted Orders are subject to standard trade validations such as for market movements, etc. and may get rejected. The trader must await the final trade confirmation (ExecutionReport) to determine the final state of the order.
Fill And Kill (FAK)
Also known as Immediate or Cancel (IoC), Fill And Kill Orders allow the trader to specify a target deal amount which may be filled in full or in part up to the requested amount. This strategy supports partial fills. Fill And Kill orders may be submitted either as Limit or PreviouslyQuoted. In case of Limit, only the portion of the requested amount that can be fulfilled at the specified rate will get executed and hence may result in partial fills when the entire amount is not available within the specified limit price. Please note that the order is executed immediately is not submitted to an order book for later matching. With PreviouslyQuoted, the order will be filled exactly at the quoted rate and in cases where only a part of the requested liquidity is available at the given rate, the order will be partially filled. However, both Limit and PreviouslyQuoted Orders are subject to standard trade validations such as for market movements, etc and may get rejected. The trader must await the final trade confirmation (ExecutionReport) to determine the final state of the order.
Fill at Best Or Kill (FBOK)
Fill at Best Or Kill is a type of Market Order that may be filled at the prevailing market rate if the entire liquidity requested is available for execution at the time of the order. Such order types do not support partial fills. As these are Market Orders, they do not offer any protection on slippage and the execution price might not be similar to a reference price that the trader may have received prior to submitting the order. Issues such as line latency may cause slippage. For price-sensitive trades, the client should consider using limit orders (FOK or FAK) with slippage added on top of the limit rate as an alternative.
Fill at Best And Kill (FBAK)
Fill at Best And Kill is a type of Market Order that may be filled in full or in part at the prevailing market rate upto the liquidity available at the time of the order. With such orders, the trader may get partial fills if only a part of the requested amount is available for execution at the time of the order. As these are Market Orders, they do not offer any protection on slippage and the execution price might not be similar to a reference price that the trader may have received prior to submitting the order. Issues such as line latency may cause slippage. For price-sensitive trades, the client should consider using limit orders (FOK or FAK) with slippage added on top of the limit rate as an alternative.

5.4.4 Execution Report

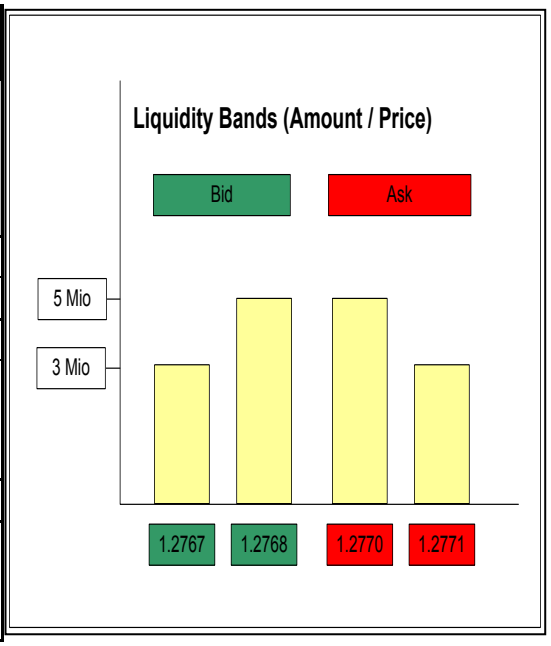
When a deal execution involves more than one liquidity band in order to cover each price level, the CP will receive one execution report with a weighted average price. This is the default behaviour.

Please inform your CDM if your application does not support fractional pips.

5.4.5 Client Control Over Slippage

The Fx2B Liquidity API allows the CP to specify a limit rate on a deal request without having to specify a UBS Quote reference. The CP has the choice to include a slippage on his limit rate. Typically, CP's limit rate would be UBS reference price +/- a slippage (depending on the side of CP's order request). This gives the CP control over slippage versus fill rate and reduces the risk of deal rejects since his order will still get filled if there is UBS liquidity up to the limit rate specified. CP should be notified that Limit Orders are subjected to price improvement when this is possible.

Strategy		Case (as per Liq Bands next)		
		Order amt within a single band (i.e 5M)	Order amt across multiple bands (i.e. 7M)	Order amt over available total liquidity (i.e. 10M)
FOK	Normal	Filled	Rejected	Rejected
	Limit Rate	Filled	Filled	Rejected
FAK	Normal	Filled	Rejected	Rejected
	Limit Rate	Filled	Filled	Partially filled remaining is cancelled
FBOK	Normal	Filled	Filled	Rejected
FBAK	Normal	Filled	Filled	Partially filled remaining is cancelled



5.4.6 Conditions for UBS Rejects

If an order fails trade validation checks, it may be rejected. A few reject scenarios are provided below. The list is not exhaustive, but reflects sample cases that may lead an order to get rejected:

- Attempt to deal on a stream with "indicative" status.
- The dealt amount is higher than the liquidity pushed out, e.g. trying to deal 20 units when quote is only good for 10 units.
- As the CP is using up the provided liquidity, the Fx2B liquidity accordingly reduces the dealable amount resulting in an amount update being streamed out to the CP. In the case the CP hits UBS again before processing the next stream update; it can happen that UBS deny the deal because of it breaking the liquidity limits.
- When any application or network latency accompanied with a price change exceeds a set tolerance threshold: grace period, UBS reserves the right to deny these late deal requests.

- UBS checks the market move between the time when the UBS price was streamed out and the time when the deal request is received. UBS reserves the right to reject the deal if this move exceeds a certain threshold.
- UBS will reject deal requests if credit check fails.

5.4.7 Multiple Deal Requests (FOK and FAK only)

CP can choose to deal multiple times on the same quote as long as the maximum dealable amount for the quote is not breached and total liquidity is available.

5.4.8 Acknowledgement to Deal Confirmation

The CP application has to acknowledge receipt of the UBS deal confirmation. In the case of un-acknowledged deal confirmations UBS will set the price stream to indicative. In such case CP is to contact UBS support promptly.

6. Appendix A

6.1 Certificate Generation

This section describes the certificates generation and implementation process.

6.1.1 Process Overview

- Generate Private Key
- Generate the Certificate Signing Request (see 6.1.4 for details)
- Send Certificate Signing Request to CDM
- Receive UBS Signed Certificates and UBS Certificate Authority (CA) from CDM
- Use in Stunnel Configuration file

6.1.2 Required Data

Before the CP starts generating Certificate Signing Request certain data should be prepared:

Data	Description	Provided by
Common Name (CN)	Common Name: CP user ID, btobxpteXXXX or btobxprdXXXX **Please do not enter anything other than your B2B ID for the value of the CN field as given above**	UBS
EMAILADDRESS	CP's **group e-mail address** (i.e.fx-support@fxcompany.com) **Please do not use personal email address**	CP
Country Name	CP's Country code (i.e. CH)	CP
State or Province Name	CP's State (i.e. Zurich)	CP
Locality Name	CP's Location (city) (i.e. Zurich)	CP
Organization Name	CP's Organization (i.e. FXCOMPANY)	CP
Organizational Unit Name	CP's Organisation Unit (i.e. FX)	CP

Note: EMAILADDRESS must be a valid group email address at CP. UBS will send certificate renewal notifications to that email address. **If the email address is not valid** and therefore the certificate renewal notification is not received at the CP, **there would be a risk for CP to lose production and/or test connections**.

6.1.3 Tool Used

Make sure your "openssl" command is available in PATH or simply move to directory where openssl binary is located.

6.1.4 Private Key Generation:

Use the following command to generate private key:

```
openssl genrsa –out btobxOOOXXXX.key 1024
```

NOTE: Make sure you keep your private key properly protected on your file system

6.1.5 Certificate Signing Request Generation

Prepare all required data as per the table in section 6.1.2.

Step 1: Generate the certificate.

```
openssl req -new -key btobxOOOXXXX.key -out btobxOOOXXXX.csr
```

NOTE: Just type Enter (Carriage Return) when asked for "A challenge password" and "An optional company name"

Step2:
Please send the Generated file btobxOOOXXXX.csr to the CDM at UBS

Step3:
Use the UBS signed certificate and CA certificate to setup your Stunnel client

6.1.6 Step-by-Step Process of Generating a CSR Using a Sample B2B ID

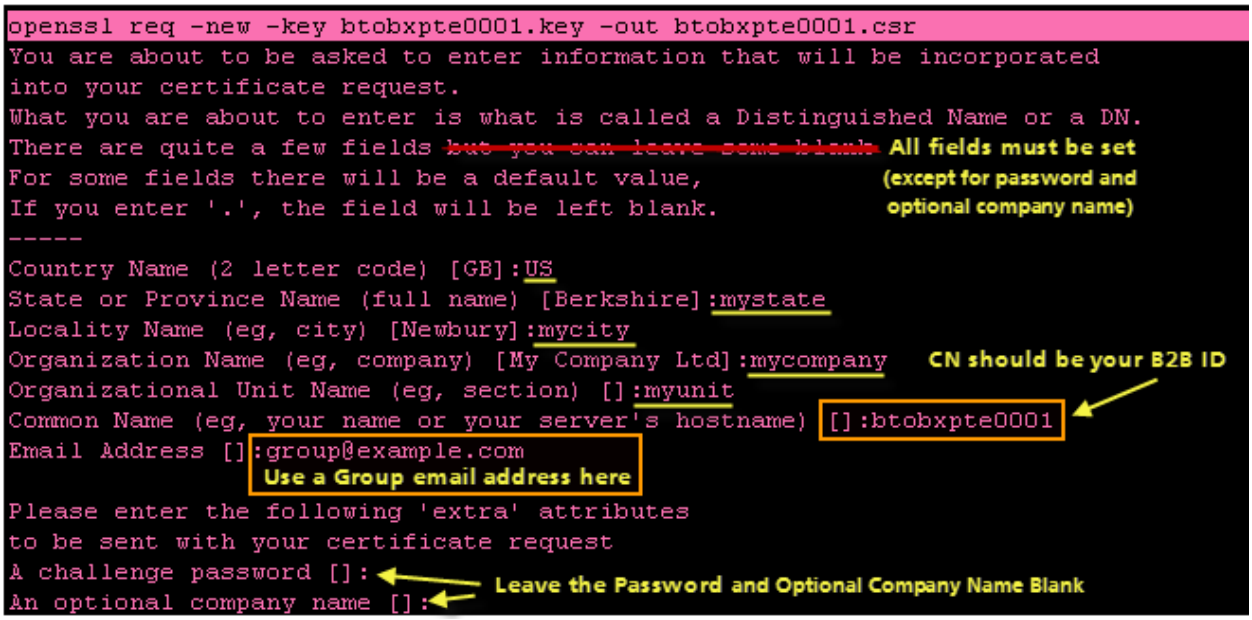
A sample B2B ID (btobxpte0001) for PTE is used to demonstrate the process of generating the CSR key. The CP should replace this with the appropriate CP-specific ID when generating the CSR key

a) Generating the .key file - btobxpte0001.key

b) Generating the .csr file - btobxpte0001.csr

There are a few mandatory rules for generating the CSR key that must be followed in order to ensure that the CSR key will be properly validated by UBS

- All the fields, except Password is **required**
- Password should be left blank
  Common Name **MUST** be the **value of your B2B ID** as shown in the example below
- Email Address **MUST** be a group or distribution list address



6.1.7 Certificate Renewal

Certificate is valid for a year. Prior to certificate expiry, UBS will provide CP with new certificate.

For certificate renewal repeat step 3 of section 6.1.5.

6.2 FIX Required Data

Information Provided by CDM	Used in	UBS Given Value
Common Name	- Certificates - Stunnel configuration file - FIX Message: Tag 553	
SenderCompID	- FIX Message: Tag 49	
TargetCompID	- FIX Message: Tag 56	
Password	- FIX Message: Tag 554	
PartyID	- FIX Message: Tag 448	

6.3 Connection Troubleshooting

This section describes the possible cause of connection failure and the workaround.

- Firewall not setup (see section 4.3.1 for details)
- Stunnel: uncomment debug

7. Appendix B

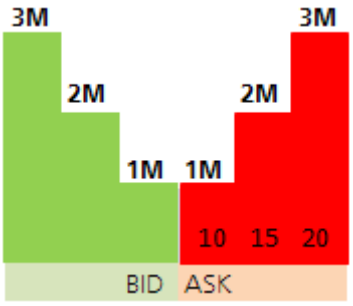
7.1 Trading Across Multiple Bands

Subscription by Band and Subscription by Amount are the 2 commonly used subscription methods over standard FX FIX API platforms. In both cases, the end user receives a single price feed that may or may not have multiple layers (bands/tiers) of pricing and liquidity. Both of these subscriptions can accommodate a maximum of 1 subscription per currency pair. However, in certain situations it may be necessary to have more than 1 subscription for the same currency pair.

As long as trades are executed over a single band, it is possible to determine the effective execution rate[1] directly from the quoted price. However, if a trade is requested with an amount greater than the individual liquidity of any of any single band, some additional computation is required to determine the effective execution rate. A scenario will help to understand the concept in more detail.

7.2 Multiple Band Trading Using Subscription by Band

Consider a price stream as shown below. For simplicity, we will look at the using prices from only the Ask Side of the quote.



EURUSD

Band Level	Liquidity	Ask Price (UBS)
1	1M	10
2	2M	15
3	3M	20

The bands are of "discrete" amounts. Hence the band of 2M has a net liquidity of 0-2M and so on.

As spreads widen progressively with increasing levels, it's more profitable to trade on the target liquidity beginning with the lowest band of pricing. Hence an order for 2M should be executed as follows –

1M on Band 1 @ 10
1M on Band 2 @ 15

2M @ 25/2 – giving a net effective rate of 12.5

In order to accommodate this, the client system should be able to **split a large order into smaller "sub"-orders depending on the available liquidity of each individual band.** Further, the client system should be able to determine the actual execution price (and hence select the venue) taking into account the effective rate of 12.5 (rather than using the absolute prices of any individual band as reference)

[1] Effective Execution Rate: The rate at which the order will get executed. For Limit Orders this may be the limit price specified by the counterparty in the OrderSingle message.

The above method of splitting a large order into smaller constituents is applicable only if the client is using the Quoted Order Type (i.e., the client specifies the Quote Reference ID in the order request).

A second alternative to this method is using Limit Prices. In such cases the client has 2 options –

a) Submit Order with an Absolute Limit Price; or
b) Submit Order with a Weighted Average Limit Price

Using Option (a), the client will have to submit an order with the Limit Price being equal to the **highest price corresponding to the bands across which the execution will get distributed.** Taking the above example, the client would have to submit a Limit Order using the Limit Price of Band 2 = 15. The actual execution(s) will however occur at the individual bands' price levels, i.e., the entire order of 2 M will **not** get filled @ 15. Rather, the client will receive a fill of 1M @ 10 and another fill of 1M @ 15, again giving a net effective execution price of 2M @ 12.5.

Using Option (b), the client calculates the Weighted Average Price of the order being submitted and requests a fill using this calculated value (instead of using a higher limit price as in the Option a). In this example, in order to get a fill for 2M, the client will calculate the Volume Weighted Average (Limit) Price (VWAP) Price as follows:

Fill 1M @ 10 = 10
Fill 1M @ 15 = 15

This gives a **VWAP** for EURUSD of

$$\frac{NetCost}{NetAmount} = \frac{25}{2} = 12.5$$

Note that in such Order Types, the client should specify the appropriate fields in the Order Request message to indicate that the order is of type VWAP. Please refer to FIX tag 9645 (LimitPxType).If the CP cannot support FIX tag 9645, UBS can enable VWAP type trading on behalf of the CP where FIX tag 9645 is not required.

7.3 Multiple Band Trading Using Subscription by Amount

The above scenarios are applicable for subscription by band where the client receives the full stack of pricing. If due to some limitation, the client is unable to accept a multi-tiered pricing, it becomes necessary to use subscription by amount. In subscription by amount, the requested amount is specified in the Market Data Request message. Hence in the above case, if the client required a net liquidity of say, 3M, a request for 3M would allow the client to receive a single stream with liquidity of 3M EURUSD.

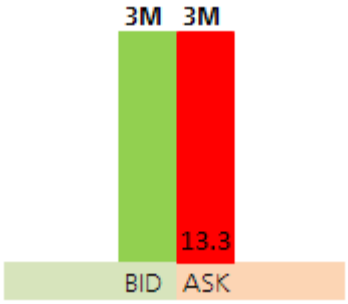
This process however, raises some issues. It is fine as long as the required executions are for amount 3M, but for any execution less than 3M the effective execution price is sub-optimal.

A subscription of 3M EURUSD will have a price calculated as the weighted price of 3M of liquidity. In this case, it will be

1M @ 10
2M @ 15

3M @ 40/3, giving a rate of 13.3.

The feed will look like as follows ---



However, at this price rate, **any amount less than 3M will also get filled @ 13.3**. An order for 2M will get filled @ 13.3 and an order for 1M will also get filled @ 13.3 instead of their true weighted prices (Ideally, an execution for 2M should be @ 12.5 as we have already seen and an execution for 1M should be @ 10 as derived from the 1st level of Pricing).

This limitation is a function of the **method by which the original subscription was requested**. The (UBS B2B) system has provided the most optimal price for 3M, it is not concerned with lower amounts as long as it ensures that the max liquidity can be filled at the best possible rate.

7.4 Multiple Subscriptions

Multiple Subscriptions is a way to circumvent the issue presented by the previous example. The Multiple Subscription feature allows a client to request for multiple streams for the **same currency pair** but with **different amounts.**

Each subscription by amount will reflect the **weighted average pricing (the best price)** available for the max liquidity corresponding to the subscription amount.

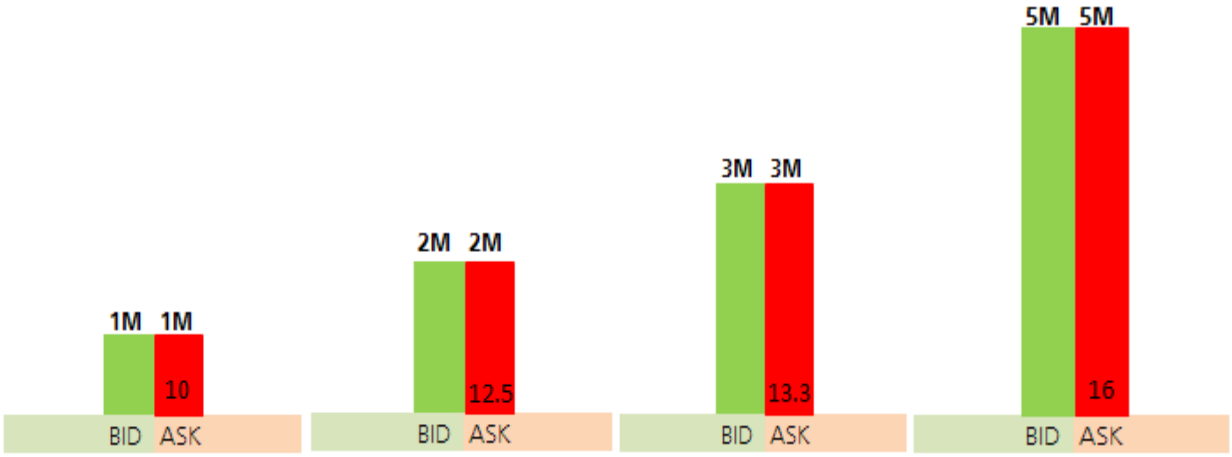
Using the previous price stack, some examples are given below to illustrate the point.

Subscription for 1M Feed
1M @ 10
= EURUSD @ **10**

Subscription for 2M Feed
1M @ 10 + 1M @ 15
= 2M @ VWAP of 2M = 2M @ 25/2 = **12.5**

Subscription for 3M Feed
1M @ 10 + 2M @ 15
= 3M @ VWAP of 3M ={(10) + (15 X 2)}/3 = 40/3 = **13.3**

Subscription for 5M Feed
1M @ 10 + 2M @ 15 + 2M @ 20
= 5M @ VWAP of 5M = {(10) + (15 X 2) + (20 X 2)} / 5 = 80/5 = **16**



This method of subscription ensures that the client has several options available to determine the optimal execution price rather than being restricted to a single feed fixed to a higher amount.

7.5 Common Issue

As shown above, tiered prices are the basic underlying reference that is used to calculate all the weighted average price for the different amounts.

Hence, if an order is submitted, it immediately alters the state of the levels of liquidity in the different bands (due to standard liquidity refill logic).

Consider the following scenario.

Client has 3 feeds of 1M, 3M and 5M. The rates are as follows ---

1M Feed = 10
3M Feed = 13.3
5M Feed = 16

An order for 3M is submitted over the 3M Feed. The client gets a fill for 3M @ 13.3. It is important to understand how this affects the underlying band structure from which this price was derived. As noted before, the 3M Feed has the weighted average price calculated using 1M from Band 1 and 2M from Band 2. Hence, a 3M order, in terms of the underlying structure, uses up all liquidity from Band 1 and Band 2. If no price change has occurred in the interim, the new price updates across the 3 feeds will be as follows –

1M Feed = 20
3M Feed = 20
5M Feed = will show only 3M since that is the Max Available Liquidity, Rate → @ 20

In push-pop philosophy, the first 2 levels have been popped from the stack and the 3rd level has been pushed to the bottom of the stack (in other words, the client will see a 1st band of 3M with price = 20 considering no price movement had occurred in between the updates).

The client must wait for a new set of updates on each of the requested subscriptions before placing a new trade to determine the correct prices for each of the liquidity levels. Taking the earlier example, if another order were placed successive to the first order of 3M, the 2nd order

will get rejected as the first execution alters the pricing and liquidity of the underlying bands immediately after submission.

As long as enough time is allowed (generally within a few milliseconds) to receive new updates and subsequent orders are placed on the newer updates, there should be no issues.

8. Appendix C

8.1 Access

Access to UBS FixSpec simulator will be provided upon request. Once registered on the simulator you will receive a welcome email from UBS which will include credentials for https://ubs.fixspec.com.

FIX details and information about how to get started with this service are available on the Simulator's webpage.

8.1.1 Certificate Generation

The certificate generation process is similar to Appendix A except for the required data and certificate's naming convention which are available in the section below.
Do not hesitate to contact your CDM should you require any assistance with the certificate generation process.

8.1.1.1 Required Data

In preparation to the Certificate Signing Request, please use the following information:

Data	Description
Common Name (CN)	This is a unique code for your connection provided by UBS, e.g. btobxfssXXXX
EMAILADDRESS	FX-ClientDelivery@ubs.com
Country Name	CH
State or Province Name	Zurich
Locality Name	Zurich
Organization Name	UBS FixSpec
Organization Unit Name	FX

8.1.2 Connectivity Requirements

8.1.2.1 Firewall Setup

UBS FixSpec environment is available over Internet only by connecting to IP **151.236.219.108** on port 2500.

8.1.2.2 Connection Setup (Stunnel)

SSL/TLS based solution is required to achieve secured data transfer between FIX client and server side.

In case CP does not have SSL/TLS based solution, Stunnel can be used. Package available on http://www.stunnel.org/

It is possible to run UBS PTE and UBS FixSpec environments in a merged or separate configuration, as described below.

	Merged Configuration	Separate Configuration
Pros	• Single stunnel.conf file which allows to switch access between PTE and FSS • Both environments can be accessible simultaneously	• Same FIX sessions details are used regardless of the platform reached
Cons	• 2 different FIX Ports (local) are required: PTE localhost:2500 FSS localhost:2501	• FIX applications cannot connect to both environments simultaneously Requires 2 Stunnel instances, one configured to connect to PTE, the other to FSS

Please use the following configuration for accessing UBS platform using Stunnel in a **merged configuration**:

Stunnel.conf File for Merged Configuration

```
; File Name: stunnel_ubsuat.conf
; Title: UBS FX2B FIX API Stunnel Config.
; Environment: PTE and FSS
; Socket parameters tuning
socket = l:TCP_NODELAY=1
socket = r:TCP_NODELAY=1
socket = l:SO_KEEPALIVE=1
socket = r:SO_KEEPALIVE=1
; Security level
verify = 2
; Uncomment for troubleshooting purposes
;debug = 7
; Log file path
output = /your path to the log file location/stunnel_ubsuat.log
client = yes

[UBS_FXFIXB2B_PTE]
accept = 2500
connect = 139.149.11.182:2500
; Path to key and certificate files
cert = /your path to the certificate location /btobxpteXXXX.pem
key = / your path to the key file location /btobxpteXXXX.key
CAfile = / your path to the CA file location /ca_pte.pem

[UBS_FXFIXB2B_FSS]
accept = 2501
connect = 151.236.219.108:2500
; Path to key and certificate files
cert = /your path to the certificate file location/btobxfssXXXX.pem
key = / your path to the key file location/btobxfssXXXX.key
CAfile = /your path to the CA file location/ca_ubs_fixspec.pem
```

(**XXXX** = 4 digits provided by CDM)

Please use the following configuration for accessing UBS platform using Stunnel in a **separate configuration**:

Stunnel Configuration File for PTE	Stunnel Configuration File for **FSS**
; File Name: stunnel_pte.conf ; Title: UBS FX2B FIX API Stunnel Config. ; Environment: PTE ; Socket parameters tuning socket = l:TCP_NODELAY=1 socket = r:TCP_NODELAY=1 socket = l:SO_KEEPALIVE=1 socket = r:SO_KEEPALIVE=1 ; Security level verify = 2 ; Path to key and certificate files cert = /CP's path/btobxpte**XXXX**.pem key = /CP's path/btobxpte**XXXX**.key CAfile = /CP's path/ca_pte.pem ; Uncomment for troubleshooting purposes ;debug = 7 ; Log file path output = /CP's path/stunnel_pte.log client = yes [UBS_FXFIXB2B_PTE] accept = 2500 connect = 139.149.11.182:2500	; File Name: stunnel_fss.conf ; Title: UBS FixSpec Simulator Stunnel Config. ; Environment: FSS ; Socket parameters tuning socket = l:TCP_NODELAY=1 socket = r:TCP_NODELAY=1 socket = l:SO_KEEPALIVE=1 socket = r:SO_KEEPALIVE=1 ; Security level verify = 2 ; Path to key and certificate files cert = /CP's path/btobxfss**XXXX**.pem key = /CP's path/btobxfss**XXXX**.key CAfile = /CP's path/ca_ubs_fixspec.pem ; Uncomment for troubleshooting purposes ;debug = 7 ; Log file path output = /CP's path/stunnel_fss.log client = yes [UBS_FXFIXB2B_FSS] accept = 2500 connect = 151.236.219.108:2500

(**XXXX** = 4 digits provided by CDM)