CURRENEX
A State Street Company

Itch Market Data Service

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1 Introduction

1.1 Purpose

The purpose of this document is to present in detail the Itch protocol subset used by the Currenex Executable Streaming Prices (ESP) service.

The Currenex Itch service uses a low latency protocol and is delivered over reliable high-speed physical networks such as LAN cross connects or metro area direct circuits.

Itch is supported on Transmission Control Protocol (TCP) as well as User Datagram Protocol (UDP), with minimal differences between the two (2). As a UDP service, Itch is intended for use on low datagram[1] loss networks. Itch is not supported on Public Internet or low performance connections.

1.2 Itch

- Achieves lower processing and latency times by not compressing messages.
- Enables faster and easier message parsing and memory management through the use of fixed field sizes and the use of integer values where possible.
- Supports fast messaging delivery via UDP and reliable message delivery via TCP.

Customers co-located in the Currenex datacenter can achieve microsecond scale performance on Itch.

[1] The terms “datagram” and “packet” are nearly identical in meaning. In this document “datagram” is used with the unreliable UDP service.

2 Executable Streaming Prices (ESP)

Itch delivers foreign exchange (Forex) executable streaming prices (ESP) from Market Makers (MM) to Market Participants (MP), who can then place orders against the ESP received.

3 Protocol

Itch supports the following network protocols:

- TCP
- UDP

4 Message Data

A message data block consists of one or multiple messages and can be of no more than 1,000 bytes in length.

4.1 Message Data Delimiters

The start and end of a message block are indicated by the one (1) byte ASCII character code decimal equivalents for "SOH" (1) and "ETX" (3):

SOH (1)	indicates message block start
ETX (3)	indicates message block end

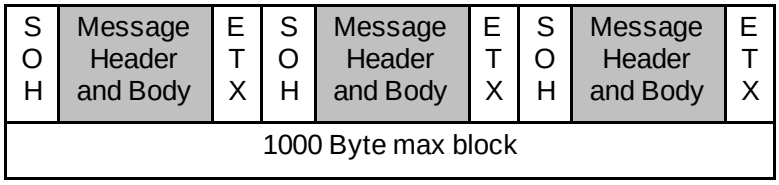

Figure 1: Sample Message Block Layout

4.2 Message Data

4.2.1 Integer, Long, Short

All integer, long and short fields are signed big-endian binary encoded numbers transmitted in network byte order.

4.2.2 Amount

Amount uses Long as a transfer data type, meaning it is an 8 bytes (64-bit) signed number with a minimum value of -9,223,372,036,854,775,808 and a maximum value of 9,223,372,036,854,775,807, inclusive.

Zero (0) is a valid value for some amount related fields; e.g., MinAmt. Amount values less than zero (0) are not valid.

Amounts associated with Itch Forex rates are always in the base or first currency of the streamed currency pair; e.g., a EUR/USD amount is always in terms of EUR.

To account for values to the right of the decimal place, the amount value is a two (2) decimal place scaled value.

A decimal amount of 1,000,000.00 (1M) in base currency would be represented as 0x5F5E100.

4.2.3 Rate

Rate fields are delivered as hexadecimal numbers. They are scaled to five (5) places to the right of the decimal point into integer fields by multiplying 105. E.g., 94.90870 is represented as $0x90D1B6_{hex}$ or 9490870 in decimal format. The maximum rate value allowed is $0x7FFFFFFF_{hex}$ or 2147483647 in decimal, which represents a very high rate of 21474.83647.

For a currency pair CCY1/CCY2, Forex bid and offer prices are quoted as a variable amount of term currency, CCY2, per one (1) unit of the base currency, CCY1.

The base and term currencies can be extracted from the "Instrument Info" message's InstrumentID field.

4.2.4 Date/Time

Dates and times are handled as longs and counted in milliseconds since midnight coordinated universal time (UTC), more commonly known as Greenwich Mean Time (GMT).

Three (3) types of date and or timestamp formats appear in messages:

- The message header `Timestamp` shows the number of milliseconds past midnight GMT on the current day.
- The `InstrumentInfo` message's `SettlementDate` is the settlement date measured as the number of milliseconds in Epoch time.
- The `TradeTicker` message's `TransactTime` shows the done trade's transaction time as the number of milliseconds past midnight GMT of the current day.

4.2.5 Reason

The `Reason` field's length depends on the message in which it appears, Logon, SubscriptionReply or Reject. It contains alphanumeric characters and is left justified and can be padded with spaces on the right to fill the length.

4.2.6 Padding

Most fields are left justified with a space (20_{hex}) used to pad it to the fill length as shown in the below.

Field Name	Length	Description	Hexadecimal	Character
Password	20	User password	313233707377642020202020202020202020202020	123pswd

5 Invalid Message Handling

Currenex responds with a Reject message to incorrectly formatted messages; messages with invalid headers are ignored.

6 Message Sequence Numbers

The initial sequence number count for a new session must start at one (1) and be incremented by one (1) on each message sent to Currenex afterwards for both UDP and TCP connections.

6.1 UDP Message Sequence Number

To minimize the impact of lost messages, the UDP ITCH implementation overloads the “Sequence Number” definition with two (2) separate counts: 1) message header count and 2) instrument specific message count.

The message header sequence number count is used on all messages except Price, Price Cancel, and Trade Ticker messages. A separate instrument specific sequence count is maintained for each currency pair for Price and Price Cancel messages.

On trade ticker messages, Currenex does not set the sequence count and it should be ignored.

6.2 TCP Message Sequence Number

TCP connections should always preserve the sequence number order with no gaps. If a sequence number gap is detected, the session should be closed and restarted.

7 Datagram

For UDP, there will be only one (1) message in or out per datagram with the only exception being the price and price cancel messages. For enhanced performance, a single packet can contain multiple price and price cancel messages for multiple instruments not sorted.

ITCH UDP message will never be split across multiple datagrams.

Datagrams do not apply to ITCH TCP connections. Here it is possible to see fragmented messages; i.e., a message sent across multiple packets. Where necessary, a user must join messages from across packet using the '01' and '03' delimiters to determine the message beginning and end.

8 Session

8.1 Open Session

A MP initiates a session by submitting a Logon message to Currenex. The session is established when the MP receives a Logon message in response from Currenex.

8.2 Terminate Session

Currenex or a MP can terminate a session by sending a Logout message. The recipient of a Logout message should respond with its own Logout message.

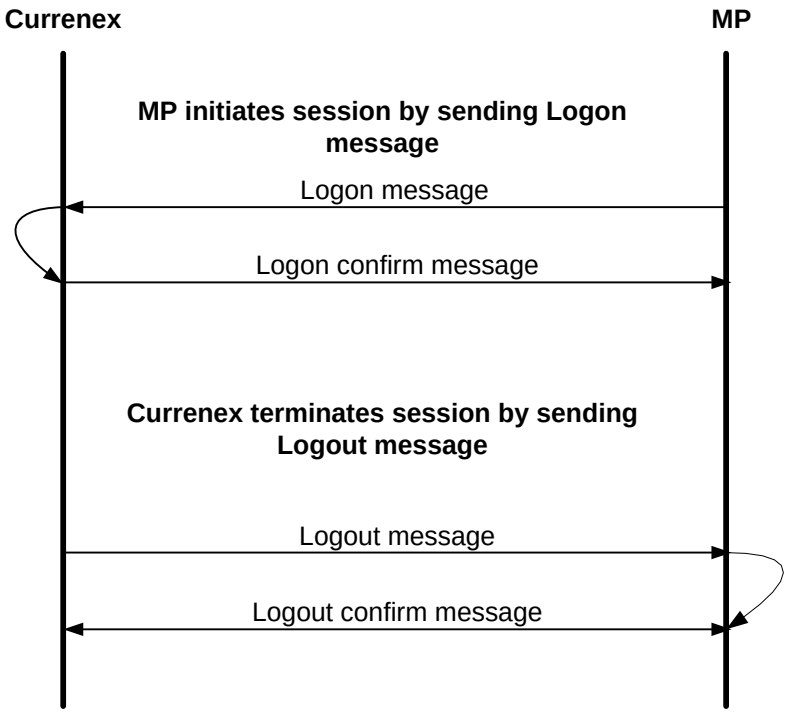

Figure 2: Session Initiation and Termination

9 Heartbeat Message

To ensure ITCH session integrity, Currenex sends a Heartbeat (HB) messages every fifteen (15) seconds. Upon receipt, a user must respond with its own HB message. Currenex will wait fifteen (15) seconds for the HB response. If none is received, Currenex will send another HB, again waiting fifteen (15) seconds. If still no HB response is received, the session will be treated as inactive and explicitly closed by Currenex.

In effect, if two (2) consecutive HB messages from a client are missed, Currenex will treat the connection as inactive and close it.

An ITCH user should send HB messages only in response to a HB received from Currenex. HB messages received in any other context are ignored by Currenex.

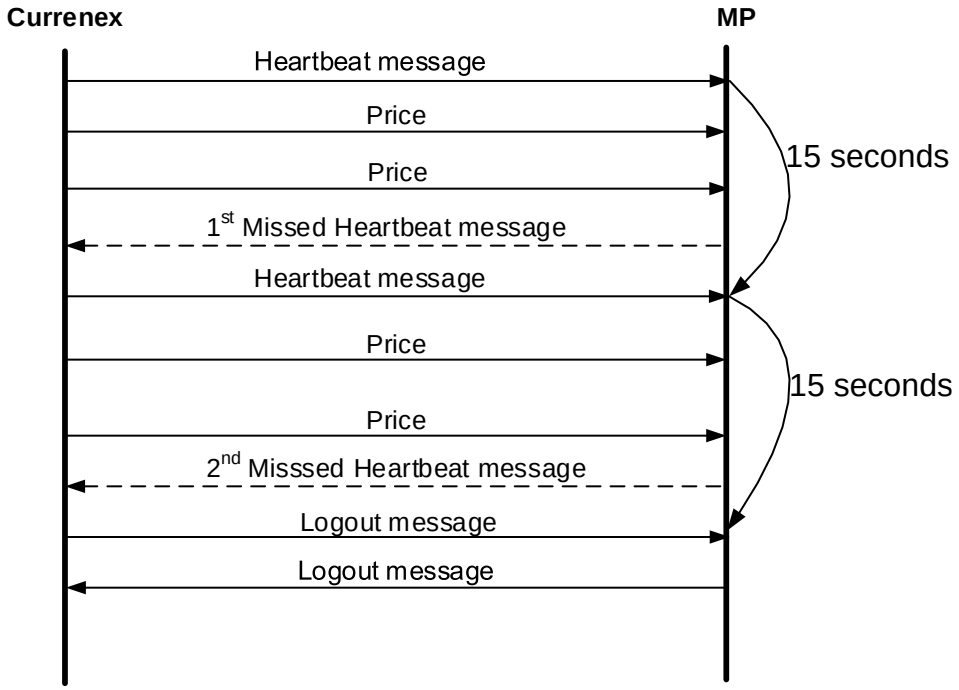

Figure 3: Missed Heartbeat Messages

10 InstrumentInfo Message

Upon successful logon, Currenex will send InstrumentInfo messages automatically, i.e. clients do not need to send an `InstrumentInfoRequest` message.

A MP should respond to each received InstrumentInfo message with an InstrumentInfoAck message. If no acknowledgment is received within a set time period, Currenex will resend an InstrumentInfo message, but only once.

Included in the InstrumentInfo message is the `InstrumentType`, a free form instrument definition, and the `InstrumentIndex` used to request quotes and manage price updates.

In response to specific data changes, Currenex will resend the InstrumentInfo message; e.g., due to the settlement date in a currency pair rolling over.

Note: The `InstrumentIndex` returned in the `InstrumentInfo` message is static for the scope of the session, only. The same value is not guaranteed to be used for a currency pair from session to session or across OUCH and ITCH services.

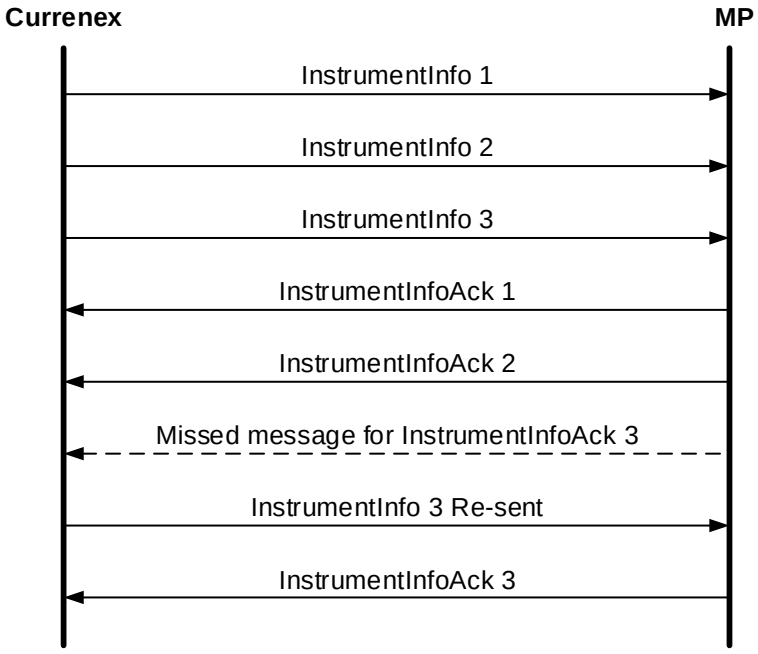

Figure 4: InstrumentInfo Messages

10.1 Value Date Change

An InstrumentInfo message will be sent when the value date in a Currency pair changes.
Value dates changes are applied as follows:

7 a.m. New Zealand Standard Time (NZST)/New Zealand Daylight Time (NZDT) for all NZD prices.

5 p.m. Eastern Standard Time (EST)/Eastern Daylight TIME (EDT) for all non NZD prices.

11 Subscription Request

11.1 Requesting Market Data

Currenex will stream ESP messages to a MP once it receives a SubscriptionRequest message for the pair. Currenex responds to a SubscriptionRequest with a SubscriptionReply message. One SubscriptionRequest message must be sent per currency pair.

A MP can cancel an instrument subscription by sending a SubscriptionRequest message with the SubscriptionType field set to Unsubscribe. A SubscriptionReply message is not sent in response to an Unsubscribe SubscriptionRequest. The rates for the associated InstrumentIndex will just cease being sent.

ESP prices will be streamed for client enabled FOREX instruments, only. The Currenex Customer Support desk must be contacted to make any modifications.

Note: Market data is full book non-aggregated.

11.2 Trade Ticker Updates

A MP can subscribe to TradeTicker messages by setting `SubscribeToTicker`=0 in the SubscriptionRequest message. Once requested, Currenex will send a TradeTicker messages whenever a trade done against the MP's entitled liquidity.

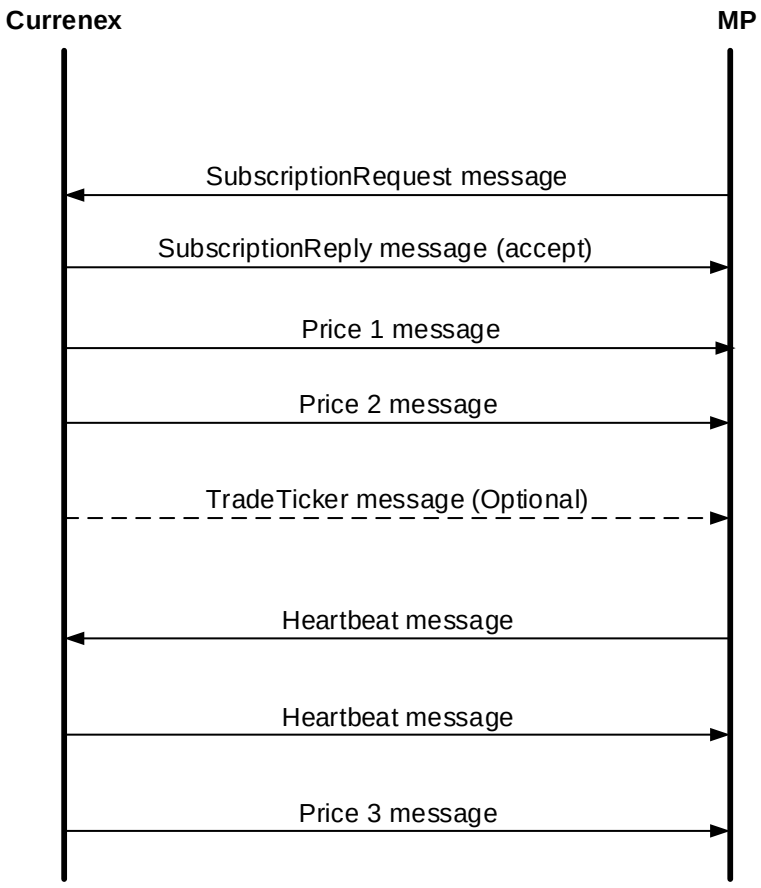

Figure 5: ESP Subscription and Streaming

12 Processing Streamed Prices

Once an MP's subscription request has been received and acknowledged, Currenex will stream prices via UDP messages containing a list of Price and PriceCancel messages.

Prices are sent in data sizes optimized to 1,000 bytes in which there can be more than one (1) Price message for more than one (1) currency pair. A Price message requires forty-three (43) bytes. A PriceCancel message requires seventeen (17) bytes. A single packet containing no PriceCancel messages can contain up to twenty-three (23) prices, 1000/43 = 23.

For example, Currenex might send the following data:

```
010000163502d022234800240000005b310000000005f5e100000000000000000000022981322020202003 0
10000163602d02223480024000000023200000000 05f5e10000000000000000000002298c322020202003
```

Though sent as one group of data, it contains two (2) separate price messages, distinguished by the 01 and 03 message start and end indicators. They are separated here:

```
010000163502d022234800240000005b310000000005f5e100000000000000000000022981322020202003

010000163602d022234800240000000232000000000 5f5e100000000000000000000002298c322020202003
```

This works out, assuming a EUR/USD index, to be a EUR/USD bid and offer price pair:

EUR/USD-SP BID 1.41697 1000000

EUR/USD-SP OFFER 1.41708 1000000

A new Price replaces in the book any outstanding price with the same `PriceId`.

A PriceCancel message cancels from the book any outstanding price with the same `PriceId`.

A single packet may include multiple Price messages for the same InstrumendIndex, but each price will have a unique value of `PriceId`. Therefore a PriceCancel message will always refer to a unique PriceID.

13 Message Recovery

Message losses or order inconsistencies can be indentified by tracking the sequence number in the header of the message. Any gaps in the sequnce count would indicate dropped packets.

13.1 TCP Message Recovery

The TCP protocol by design guarantees message delivery and order. No additional action is required on the part of the ITCH service user. In the event of message inconsistencies, the session should be closed.

13.2 UDP Message Recovery

The UDP protocol by design does not guarantee message delivery or order. In the event of dropped or out of order datagram, the ITCH UDP user has two (2) choice for ensure data integrity: Natural Rebuild and Re-Subscription.

13.2.1 Rebuild

In this method, if a dropped datagram is detected, the MP drops its internal book representation for the currency pair in which the sequence gap occurred; i.e., all cached prices for the associated currency pair are discarded. The MP then waits as new prices are received. Any price cancel messages received for a PriceID not in the cache is ignored as the price was discarded with the book.

The advantage to this method is that no additional network traffic is generated. Its disadvantage is the time needed to rebuild and synchronize the book, though low, is indeterminate.

13.2.2 Re-Subscription

In the re-subscribe method, if a dropped datagram is detected, the MP drops the internal book representation, all cached prices and all cached PriceIds should be dropped. It then submits a subscribition request message with the SubscriptionType set to two (2) for resubscribe. In repsonse, Currenex will unsubscribe from and resubscribe to the associated currency pair. The sequence number count will be reset to one (1). The book for the pair will then rebuild with a book snap shot and price updates.

This method has as an advantage the immediate reconstruction of the MP's book. Its disadvantage is that a lot of messages will be generated at a time when the network might be prone to drop datagrams, potentially aggravating the datagram loss. See below caveat.

Currenex will respond with SubscriptionReject message to failed subscription requests.

A MP should analyze the number of missed sequence numbers, i.e., lost datagrams, experienced each day. If the number of missed sequence numbers is excessive, the MP should escalate the issue to its network providers and Currenex network engineering.

14 Message Header

Field Name	Offset	Length	Type	Description	Example
Sequence number	0	4	Integer	Directional session based sequence number.	00000001_{hex} (1_{dec})
Timestamp	4	4	Integer	Time in milliseconds since midnight GMT.	$03010b37_{hex}$ (50400055_{dec}ms = 14:00:00,055)
Message Type	8	1	Alpha	Message type	41_{hex} (A_{char})

15 Messages

15.1 Logon

Message Type A (41_{hex}) – Logon					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
UserID	9	20	Alpha	User session login id	$41626355736572202020202020202020202020_{hex}$ ($AbcUser_{char}$)
Password	29	20	Alpha	User password	$31323370737764202020202020202020202020_{hex}$ ($123pswd_{char}$)
SessionID	49	4	Integer	Unique session ID provided by Currenex. NOTE: This field is only used by Currenex in response to Logon requests.	$4300015f_{hex}$ (1124073823_{dec})

15.2 Logout

Message Type B (42_{hex}) - Logout					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
UserID	9	20	Alpha	User session login id	$41626355736572202020202020202020202020_{hex}$ ($AbcUser_{char}$)
SessionID	29	4	Integer	Unique session ID provided by Currenex	$4300015f_{hex}$ (1124073823_{dec})
Reason	33	3	Alpha	Optional text. See Appendix, Logout Message Reason Codes, for more information.	004131_{hex} ($A1_{char}$)

15.3 Heartbeat

Message Type C (43_{hex}) - Heart Beat					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})

15.4 InstrumentInfo

Message Type D (44_{hex}) - Instrument Info					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})
InstrumentIndex	13	2	Short	Numeric identifier for currency pair identified by the InstrumentID ; unique for the session scope, only. Not guaranteed to be the same from session to session or across Ouch and Itch services.	0055_{hex} (85_{dec})
InstrumentType	15	1	Alpha	Instrument Type: 31_{hex} (1_{char}) - Foreign Exchange 32_{hex} (2_{char}) - Cash Metals	31_{hex} (1_{char})
InstrumentID	16	20	Alpha	Free form instrument definition string.	4555522f5553442d53502020202020202020202020$_{hex}$ (EUR/USD-SP$_{char}$) 5553442f4a50592d31572020202020202020202020$_{hex}$ (USD/JPY-1W$_{char}$)
SettlementDate	36	8	Long	Settlement date in milliseconds since midnight 01 January 1900 GMT	$000001390b416a00_{hex}$ (20120809-12:00:00,000_{dec})

15.5 InstrumentInfoAck

Message Type E (45_{hex}) - Instrument Info Ack					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})
InstrumentIndex	13	2	Short	Numeric identifier for currency pair identified by the InstrumentID ; unique for the session scope, only. Not guaranteed to be the same from session to session or across Ouch and Itch services.	0055_{hex} (85_{dec})

15.6 SubscriptionRequest

Message Type F (46_{hex}) - Subscription Request					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})
SubscriptionType	13	1	Alpha	Subscription Type: 30_{hex} (0_{char}) - Subscribe 31_{hex} (1_{char}) – Unsubscribe 32_{hex} (2_{char})- Resubscribe	30_{hex} (0_{char})
InstrumentIndex	14	2	Short	Numeric identifier for currency pair identified by the InstrumentID ; unique for the session scope, only. Not guaranteed to be the same from session to session or across Ouch and Itch services.	0055_{hex} (85_{dec})
SubscribeToTicker	16	1	Alpha	Subscribe to Trade Ticker message. Only relevant for SubscriptionType=0. Type: 30_{hex} (0_{char})- Subscribe 31_{hex} (1_{char})- Do not subscribe	30_{hex} (0_{char})

15.7 SubscriptionReply

Note: A SubscriptionReply message is not sent in response to an Unsubscribe SubscriptionRequest. The rates for the associated InstrumentIndex will just cease being sent.

Message Type G (47_{hex}) - Subscription Reply					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})
InstrumentIndex	13	2	Short	Instrument Index	0055_{hex} (85_{dec})
Type	15	1	Alpha	Instrument Type: 31_{hex} (1_{char}) - Accepted 32_{hex} (2_{char}) - Rejected	31_{hex} (1_{char})
Reason	16	50	Alpha	Free form reject reason text, specified if AckType is set to 2 - Rejected	

15.8 Price

Message Type H (48_{hex}) - Price					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
InstrumentIndex	9	2	Short	Numeric identifier for currency pair identified by the InstrumentID ; unique for the session scope, only. Not guaranteed to be the same from session to session or across Ouch and Itch services.	0055_{hex} (85_{dec})
PriceID	11	4	Integer	Id, unique across all currency pairs for the scope of the session, assigned to the price	00003218_{hex} (12824_{dec})
Side	15	1	Alpha	Price Side: 31_{hex} (49_{dec}) – Bid 32_{hex} (50_{dec}) - Offer	31_{hex} (49_{dec})
MaxAmount	16	8	Amount	The maximum amount being offered at this Price.	$0000000005f5e100_{hex}$ (1000000.00_{dec})
MinAmount	24	8	Amount	The minimum amount that can be filled at this Price	$00000000003d0900_{hex}$ (40000.00_{dec})
Price	32	4	Rate	Price rate All in Rate for Forwards Swap points for Swaps	$0001e666_{hex}$ (1.24518dec)
Attributed	36	1	Alpha	Is attributed price: 31_{hex} (49_{dec}) -attributed 32_{hex} (50_{dec}) - not attributed	31_{hex} (49_{dec})
PriceProvider	37	4	Alpha	Market Maker id.	00004353_{hex} (CS_{char})

15.9 PriceCancel

Message Type I (49_{hex}) - Price Cancel					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
InstrumentIndex	9	2	Short	Instrument Index	0055_{hex} (85_{dec})
PriceID	11	4	Integer	Unique Id of outstanding price to be canceled. NOTE: The ID is unique across all currency pairs for the scope of the session.	00003218_{hex} (12824_{dec})

15.10 TradeTicker

Message Type J ($4A_{hex}$) - Trade Ticker					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
InstrumentIndex	9	2	Short	Numeric identifier for currency pair identified by the InstrumentID ; unique for the session scope, only. Not guaranteed to be the same from session to session or across Ouch and Itch services.	0055_{hex} (85_{dec})
Rate	11	4	Rate	Trade execution rate	$0001e666_{hex}$ (1.24518_{dec})
TickerType	15	1	Alpha	Aggressor flag: 31_{hex} (49_{dec}) - given 32_{hex} (50_{dec}) - paid	31_{hex} (49_{dec})
TransactTime	16	8	Long	Trade transaction time in epoch time GMT.	$0000015ea9ada052_{hex}$ (13:01:21,874)

15.11 Reject

Message Type K ($4B_{hex}$) - Reject					
Field Name	**Offset**	**Length**	**Type**	**Description**	**Example**
SessionID	9	4	Integer	Unique session ID provided by Currenex.	$4300015f_{hex}$ (1124073823_{dec})
RejectMsgType	13	1	Alpha	Rejected message type	46_{hex} (F_{char})
Reason	14	50	Alpha	Reason for rejecting message	496e76616c6964206d6573736 1676520666f726d6174202020 2020202020202020202020202020 2020202020202020202020202020 20_{hex} (Invalid message $format_{char}$)

Appendix

Appendix A Logout Message Reason Codes

Logout Message Reason Codes	
Reason Codes	**Description**
A1	Replaced by New Session
A2	Session Timed Out
A3	Invalid Session Id
A4	Internal Session Error
A5	Authentication Failure
A6	User Logout
A7	Failed Message Delivery
A8	Internal Session Closed
A9	Second Missed Heartbeat
A10	Invalid First Sequence Number

Appendix B Message Examples

Logon

Inbound Itch message:

```
01000000010004692A41746573746964202020202020202020202020207465737431323334202020202
02020202020202020202020202003
```

Parsed message:

```
SeqNo:1
Timestamp:00:04:49,066
MessageType:Logon
UserID:testid
Password:test1234
```

InstrumentInfo

Inbound Itch message:

```
01000000020084C0544000000010030314742502F53454B2D535020202020202020202020000001611
DBD4A0003
```

Parsed message:

```
SeqNo:2
Timestamp:00:09:03,749
MessageType:InstrumentInfo
SessionID:1
InstrumentIndex:0030=GBP/SEK-SP
InstrumentType:FOREX
InstrumentID:GBP/SEK-SP
SettleDate:20180122-12:00:00,000
```

Subscription Request

Inbound Itch message:

0100000003042D7D10460000002E3000253003

Parsed message:

SeqNo:3
Timestamp:19:28:10,000
MessageType:SubscriptionRequest
SessionID:46
SubscriptionType:Subscribe
InstrumentIndex:EUR/USD-SP
SubscribeToTicker:Yes

Price

Outbound Itch message:

0100000001042D8ECB480025000000033100000000005F5E10000000000000000000001DDDA322020202003

Parsed message:

SeqNo:1
Timestamp:19:28:14,539
MessageType:NewPrice
Instrument:EUR/ZAR
PriceID:3
Side:ASK
MaxAmount:1,000,000.00
MinAmount:0.00
Rate:1.22330
Attributed:No

Revision History

Revision Number	Revision Date	Page Number	Update
1	24 September 2012	20, 21, 22	Section 15.7 SubscriptionReplay (MsgType = G): Type was changed from 'byte' to 'alpha.' Section 15.8 Price (MsgType = H): Side was changed from 'byte' to 'alpha.' Section 15.10 TradeTicker (MsgType = J): Ticker Type was changed from 'byte' to 'alpha.'
2	01 November 2012	16, 20	Section 13.2.2 and Section 15.6: Resubscription added to SubscriptionRequest.
3	5 November 2014	22	Section 15.8: Support Added for streaming forwards and swaps.
4	10 February 2015	7, 19, 22	Sections 4.2.4, 15.4 and 15.10: Updated timestamp information to reflect that times are in milliseconds since midnight GMT.
5	3 July 2017	22	Section 15.10 TransactTime description updated.
6	15 August 2017	10	Section 7: Price cancel included with price messages.
7	22 September 2017	7,15,17,19,22	Sections 4.2.4, 14, 15.4 and 15.10: Updated Timestamp, SettlementDate and TransactTime descriptions. Section 12: description corrected for block size and to make clear datagram can contain price updates for more than one currency pair. Throughout the documents spaces removed from message names and hyperlinks corrected.
8	19 January 2018	14,20	Section 11.1, 15.7 clarified to indicate SubscriptionReply not sent in response to unsubscribe requests.
9	24 March 2021	15	Section 12: Added info about uniqueness of PriceID