

Volatility-Quoted Options on Foreign Exchange (FX) Futures

CME Globex Client System Impact

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1. Introduction: Volatility-Quoted FX Options on the CME Globex Platform

This release introduces implied annualized volatility-quoted markets to the CME Globex platform for options on Foreign Exchange (FX) futures. Volatility-quoting allows CME Group customers to trade options volatility with an ‘auto-hedge’ into the corresponding quarterly month of the underlying futures contract. This functionality eliminates the volatility-to-premium conversion and constant price modification previously required to trade options volatility in premium markets. Additionally, the match and post-match efficiencies for client systems implementing volatility-quoting functionality mitigate underlying hedge price risk and, in most cases, ensure futures hedge quantity allocation.

Volatility-quoting will initially be available for European and American-style options on CME Foreign Exchange (FX) futures products as follows:

Volatility-Quoted Options					
Product	Style	Maturity*	Outright Instrument Group Code	Strategy Instrument Group Code	Product Code
Australian Dollar	American	Monthly	3A	4A	V6A
		Weekly			VA1 thru VA5
British Pound	American	Monthly	3B	4B	V6B
		Weekly			VB1 thru VB5
	European	Monthly			VXB
		Weekly			VBA thru VBE
Canadian Dollar	American	Monthly	3C	4C	V6C
		Weekly			VC1 thru VC5
	European	Monthly			VXC
		Weekly			VCA thru VCE
EuroFX	American	Monthly	3E	4E	V6E
		Weekly			VE1 thru VE5
	European	Monthly			VXT
		Weekly			VT A thru VTE
Japanese Yen	American	Monthly	3J	4J	V6J
		Weekly			VJA thru VJ5
	European	Monthly			VXJ
		Weekly			VJA thru VJE
Swiss Franc	American	Monthly	3S	4S	V6S
		Weekly			VS1 thru VS5
	European	Monthly			VXS
		Weekly			VSA thru VSE

* All existing maturities for premium-quoted options will also be available for volatility-quoted: up to 5 Weeklies, 2 Serials and 4 Quarterlies. Listing rules will follow premium-quoted listing conventions.

The volatility-quoted options in the preceding table correspond to the following premium-quoted options products.

Premium-Quoted Options					
Product	Style	Maturity	Outright Instrument Group Code	Strategy Instrument Group Code	Product Code
Australian Dollar	American	Monthly	ZA	0A (zero-A)	6A
		Weekly			6A1 thru 6A5
British Pound	American	Monthly	XB	2B	6B
		Weekly			6B1 thru 6B5
	European	Monthly			XB
		Weekly			XB1 thru XB5
Canadian Dollar	American	Monthly	XD	2C	6C
		Weekly			6C1 thru 6C5
	European	Monthly			XD
		Weekly			XD1 thru XD5
EuroFX	American	Monthly	XT	2E	6E
		Weekly			6E1 thru 6E5
	European	Monthly			XT
		Weekly			XT1 thru XT5
Japanese Yen	American	Monthly	XJ	2J	6J
		Weekly			6J1 thru 6J5
	European	Monthly			XJ
		Weekly			XJ1 thru XJ5
Swiss Franc	American	Monthly	XS	2S	6S
		Weekly			6S1 thru 6S5
	European	Monthly			XS
		Weekly			XS1 thru XS5

CME Globex will use the Black options pricing model for European-style options and the Whaley options pricing model for American-style options as described in Appendix A.

Available Strategy Types

Initially the following strategy types will be available for trading in volatility terms using a single volatility bid or ask input, for monthly maturities only:

Strategy	Strategy Type Code
Vertical	VT
Straddle	ST
Strangle	SG

The above strategy types will not be listed for Weekly maturities on Day 1. Also, please note that in the future, CME Group may make additional exchange-defined strategy types available for these markets. Furthermore, UDS functionality will be available and provide enhanced spreading capability for all volatility-quoted instruments as described below.

1.1 User-Defined Spread (UDS) Functionality

UDS: Combos functionality will be available on volatility-quoted options at launch as described in the *User-Defined Spreads* section of the [Options](#) volume of the iLink SDK with the following exceptions:

- the UDS instrument cannot combine volatility-quoted and premium options
- the volatility-quoted instruments must deliver into the same futures product
- UDS: Covered functionality is not allowed for volatility-quoted options

1.2 Key Customer Events and Dates

Milestone	Date
Volatility-quoted options instruments available in New Release	11/30/07
Certification	TBD
Production	February 2008

More detailed information on the launch schedule will be announced in the CME Globex Notices; please see www.cme.com/globexnotices/.

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1.3 FIX/FAST Migration Advisory

Please be advised that CME Group will phase out the RLC market data format in 2008; CME Group strongly recommends that customers plan to migrate to the FIX/FAST market data format. This functionality is currently available in the New Release environment.

Information on the New Release and Certification environments is available at:

<http://www.cme.com/cert/>.

FIX/FAST customer documentation including channel definitions is available at:

<http://www.cme.com/fixfast/>.

For more information please contact CME Globex Account Management or CME Group Market Data Operations.

FIX/FAST Format

For customers implementing the FIX/FAST Format, FIX/FAST market data messaging information is included throughout this document following the corresponding RLC market data section.

1.4 Client System Impact Summary

The following tables contain the field-level client system messaging impacts from the launch of volatility-quoted options on CME Globex. Please see the applicable sections within this document for a detailed description of the system impacts listed below.

1.4.1 iLink

→→ indicates nested repeating group

Message	FIX Tag	Description
New Order (tag 35-MessageType=D) Cancel/Replace Request (tag 35-MessageType=G)	44-Price	Volatility-quoted value for the option. Matching occurs with this value. <ul style="list-style-type: none"> A zero (0) or negative price will be rejected. Prices outside price-banding values will be rejected. Off-tick prices will be rejected.
Mass Quote (tag 35-MessageType=i)	132-Bid Px 133-Offer Px	Each of these fields is extended to 20 bytes.
Order Cancel Reject (tag 35-MessageType=9)	102-CxlRejReason	New value: 7=Price exceeds current price band (formerly '7107')
Execution Report - Fill or Partial Fill (tag 35-MessageType=8, tag 150-ExecType= 1 or 2)	31-LastPx	Will contain the calculated premium for a leg fill.
	75-TradeDate	Chicago date
	150-ExecType	The option fill indicates: 1 – partial fill 2 – fill This tag is not sent for the futures fill.
	810-UnderlyingPx	Price for the future used in calculating the conversion of vol to premium for the option.
	811-OptionDelta	Calculated delta, expressed as a decimal between -1 and 1.
	1188-Volatility	Annualized implied volatility for option model calculations.
	1189- ExpirationTimeValue	This value is expressed as a decimal portion of a year. It is typically the days to expiration divided by the days in a year.
	1190-RiskFreeRate	Risk-free rate (100 - front month Eurodollar)
	103 OrdRejReason	New value: 16=Price exceeds current price band (formerly '7107')
Mass Quote (tag 35-MessageType=i)	→→ 132-BidPx	This value must be expressed in volatility terms.
	→→ OfferPx	This value must be expressed in volatility terms.
Quote Acknowledgment (tag 35-MessageType=b)	368- QuoteEntryRejectReason	New value: 10=Price exceeds current price band (formerly '97')

1.4.2 Market Data Platform

The launch of volatility-quoted options on CME Globex will impact the RLC Instrument Creation (MO), Security Definition (MU), and FIX/FAST Security Definition (tag 35-MsgType=d) messages as described in the following sections.

Note: With the introduction of Vol-quoted FX Options, the CME Globex platform will support book depth of up to 5-deep. CME Globex options markets currently support top-of-book or 1-deep markets. This represents a change to the existing functionality.

1.4.2.1 RLC Instrument Message Impacts

Message	Position	Description
Instrument Creation (MO)	94 Trade Unit	This field contains the notional value for each instrument. The notional value is equivalent to the corresponding premium-quoted contract.
	113 Partial Leg ISIN	<p>For volatility-quoted outright instruments:</p> <ul style="list-style-type: none"> First 6 bytes contain the premium equivalent CME Globex ID from position 6-11 of the CME Globex ID from the MO message Second 6 bytes contain the futures hedge CME Globex ID from position 6-11 of the CME Globex ID from the MO message Set to '000000' if not present. <p>For volatility-quoted spreads:</p> <ul style="list-style-type: none"> Contains 6 bytes representing position 6-11 of the CME Globex ID from the MO message for each volatility-quoted outright instrument. May be up to 40 occurrences of 6 bytes each in length. Set to '000000' if not present <p>MO messages for volatility-quoted spreads will contain the vol-outright components only (no futures data).</p>
	353 Spread Ratio	<p>In the MO message sent for vol-quoted options instruments:</p> <ul style="list-style-type: none"> For vol-outright, the first 6 bytes of the spread ratio will contain +01+01 or +01-01 depending on whether the futures hedge is bought or sold when the option is bought. The first 3 bytes (+01) will indicate an equivalence of 1 for the premium contract. Of the next 3 bytes, only the sign is significant, since the quantity of futures is determined by the calculated delta of the option pricing model. For vol-spreads, the ratio will contain the standard configuration. The remainder of the field following the defined values will be postpended with 0s (zeroes).
	473 Derivative Product Price Display Format	Volatility-quoted values are displayed in standard "price" decimal format.
	548 Derivative Product Tick Increment Value Amount	Notional value of one tick. Will contain space + 18 zeros.

Message	Position	Description
	572 Tick Display Format Type	Volatility -quoted values are decimal and should be displayed as such. Minimum vol-tick increments are currently specified as .025.
	587 Settlement Price	Volatility-quoted outrights receive updated settlements in the same manner as other outright instruments. Volatility-quoted option settlement prices are always represented in volatility terms.
	606 High Limit	High limit volatility value.
	625 Low Limit	Low limit volatility value.
	799 Vol Quoted Option Flag	'1' = volatility-quoted instrument. '0' = premium
	806 Future or Option Spread Indicator	F=futures spread O=options spread M=mixed (UDS containing options + futures) < >=outright
	807 Options Pricing Model Indicator	Indicates which options pricing model is used to convert from volatility quote to premium and corresponding delta. Non volatility-quoted options instruments will have this space set to blank.
	840 Minimum Price Fluctuation	This is the minimum tick size. For volatility-quoted instruments, it represents the minimum change of volatility that represents one tick.
	859 Minimum Monetary Value Fluctuation	Do not use for volatility-quoted options. This field will contain a single space followed by 18 zeroes.
Security Definition (MU)	246 VolQuotedOptionFlag	'1' = volatility-quoted option '0' = Premium options or future

1.4.2.2 FIX/FAST Market Data Impacts

Please see Section 5 for the FIX/FAST market data impact summary.

2. Volatility-Quoted Markets

Volatility-quoted markets will be separate from premium markets and designated as such in the appropriate market data messages (see Sections 4 and 5). Products in volatility-quoted markets will be bid or offered in terms of annualized implied volatility to three decimal places and trade in increments of .025 of a vol (i.e., one percentage point of annualized implied volatility). The order book for any given strike price will be represented by quantity and volatility as shown below.

900 Call / Currency Option			
		Bid	Ask
Quantity	Volatility	Volatility	Quantity
90	8.150	8.175	100
50	8.125	8.200	50
20	8.100	8.225	20

2.1 Hedge Assignment

Following the volatility-quoted options match, CME Globex performs pricing and hedge quantity assignment as follows:

1. Determine the hedge quantity for the volatility match.
2. Determine the option premium price using the following variables applied in the appropriate options pricing model:
 - matched implied volatility
 - underlying futures price*
 - time to expiration
 - option strike
 - interest rate**
 - call/put
 - option style (European or American)

*The most liquid front month future will be used to calculate all underlying futures prices used for hedging. This calculation will be direct for options delivering into this front month futures contract. For all options delivering into back month futures, CME Globex will use the mid-market price of the front month contract and add or subtract the appropriate spread to produce a synthetic value for the back month underlying futures contract. The spread used in this computation will be the closing value for this particular spread as of the prior trading day. Also, during expiration week of the front month future, CME Globex will compare the Bid/Ask spread of the front month future against the next quarterly and use the instrument with the tightest Bid/Ask spread as the basis for calculating the underlying futures price.

**This value is 100 minus the previous day's settlement price of the front month Eurodollar future until LTD. It then rolls to the next front month contract.

Note: When performing the volatility to premium conversion, CME Globex uses an additional decimal place to allow for greater rounding precision. Please see Appendix B for detailed examples.

3. Determine the future hedge quantity by multiplying the matched volatility option quantity by the associated delta value for the option.

Note: Only one futures product is supported for the futures hedge.

4. Determine futures price. Price is based on the midpoint of the most recent Bid and Ask spread of the future.
 - If the midpoint is not on-tick, CME Globex will round to the side with the smallest quantity.
 - If no resting Bid/Ask spread is available, CME Globex will use the last traded price.
 - If no traded price is available, the previous day's settle will be used.
-

Note: It is possible for a volatility match to occur without a futures hedge if the total calculated futures hedge ratio per buy/sell match is between + 0.50 and - 0.50. In either instance, the futures hedge rounds to zero.

Example

The matched quantity is a 10-lot and its corresponding delta is 0.04. The product of these two multiplied factors equates to a futures hedge ratio of 0.40 (10-lot * 0.04 delta). The hedge ratio equals zero futures since the hedge ratio is rounded toward zero.

CME Globex does not send an Execution Report for a futures hedge when the quantity rounds to zero. The delta for the futures hedge is sent in the Execution Report (tag 35-MsgType=8) Fill message for the option premium outright instrument(s) in tag 811-OptionDelta.

2.1.1 Hedge Assignment with Multiple Counterparties

If a single volatility match has multiple counterparties, then the incoming futures hedge ratio will be determined for the entire incoming order. The futures hedge ratio for each counterparty will be determined individually for each resting order.

The following example is for a European-style option:

1. Assume the Ask side order enters the market and sweeps the Bid side quantity.

1.7000 Call / Currency Option			
BID		ASK	
QTY	Volatility	Volatility	QTY
40	1220	1220	100 (incoming order)
30	1220		
20	1220		
10	1220		

2. Black's model outputs a computed delta of 0.51.

3. The breakdown for hedge ratios is as follows:

Bid QTY	Delta	Assigned Hedge Ratio	Ask QTY	Delta	Assigned Hedge Ratio
40	0.51	21	100	.51	51
30	0.51	15			
20	0.51	10			
10	0.51	5			
		51			

Explanation:

The resting 40 lot had a total delta of 20.4

The resting 30 lot had a total delta of 15.3

The resting 20 lot had a total delta of 10.2

The resting 10 lot had a total delta of 5.1

INOF/RNOF methodology dictates that INOF must = RNOF

To have INOF=RNOF, CME Globex distributes the leftover futures from INOF to the least allocated RNOF, 1 lot at a time. Therefore, the resting 40 lot will receive the leftover 1 lot since it was the least allocated RNOF.

This rule ensures that an incoming order is never uncovered by more than 0.50 futures. Also, the resting orders are never uncovered/over covered by more than 0.99 futures.

2.1.2 Position Management

Volatility trades will not create separate volatility positions in CME Clearing but will be added to the position aggregate for the premium instrument.

3. Order Entry

Order entry on iLink for volatility-quoted markets is identical to that for premium markets with the exception that client systems will submit order, quote, and cancel messages with a volatility rather than price value. CME Globex will send confirmation messages in volatility terms with an additional tag to identify the premium assigned by CME Globex. Also in this launch are new values for reject messages.

3.1 New Order (tag 35-MessageType=D)

For order entry purposes, the New Order message handles the volatility value in the same manner as a standard price. Conversion from a volatility to premium value occurs at match. The premium value is sent in the corresponding Execution Report (tag 35-MessageType=8) messages.

Tag 44-Price is populated in volatility terms and must comply with tick rules for the volatility value(s) expressed.

Tag	FIX Name	Req	Format	Length	Description
44	Price	Y	Price	20	Required. This is the volatility-quoted value for the option. Matching occurs with this value. <ul style="list-style-type: none"> A zero (0) or negative price will be rejected. Prices outside price-banding values will be rejected. Off-tick prices will be rejected.

Y = FIX required

3.2 Order Cancel Replace Request (tag 35-MessageType=G)

Tag	FIX Name	Req	Format	Length	Description
44	Price	N	Price	20	This is the volatility-quoted value for the option. Matching occurs with this value. <ul style="list-style-type: none"> A zero (0) or negative price will be rejected. Prices outside price-banding values will be rejected. Off-tick prices will be rejected.

Y = FIX required

3.3 Order Cancel Reject (tag 35-MessageType=9)

Tag	FIX Name	Req	Format	Length	Description
102	CxlRejReason	Y*	Int	6	New value: 7=Price exceeds current price band (formerly '7107')

Y* = CME required

3.4 Fill and Partial Fill (tag 35-MsgType=8, tag 150-ExecType=1 or 2)

When CME Globex sends Execution Reports for volatility-quoted trades, the first Execution Report will contain the volatility value in tag 31-LastPx. The subsequent Execution Report(s) associated with that trade will contain the calculated premium price in tag 31-LastPx.

Tag	FIX Name	Vol Fill	Premium Fill	Format	Length	Description
31	LastPx	Y*	Y*	price	20	Will contain the calculated premium for a leg fill.
75	TradeDate	Y*	Y	string	8	Chicago date
150	ExecType	Y*	N	char		The option fill indicates: 1 – partial fill 2 – fill This tag is not sent for the futures fill.
810	UnderlyingPx	N	Y	price	20	Price for the future used in calculating the conversion of vol to premium for the option.
811	OptionDelta	N	Y	float		Calculated delta, expressed as a decimal between -1 and 1.
1188	Volatility	N	Y	string	20	Annualized volatility for option model calculations.
1189	ExpirationTimeValue	N	Y	float		This value is expressed as a decimal portion of a year, typically the days to expiration divided by the days in a year. Currently the year assumption is 365.
1190	RiskFreeRate	N	Y	price	20	Risk-free rate (100 - front month Eurodollar)

Y = FIX required Y* = CME Globex required N = Not required

3.5 Execution Report Trade Cancellation (tag 35-MsgType=8, tag 150-ExecType=4)

Trade Cancellation (Bust) can be performed for any executed trade. Busted volatility-quoted option trades receive an Execution Report bust for the premium options instruments as well as for the futures hedge instrument. Execution Reports for busted trades include all of the data from the original trades including the risk-free rate used for the premium calculation. The following new tags support this functionality.

Tag	FIX Name	Premium Bust	Future Bust	Type	Description
810	UnderlyingPX	Y*	N	Price(20)	Price for the future used in calculating the conversion of vol to premium for the option.
811	OptionDelta	Y*	N	Float	Calculated delta, expressed as a decimal between -1 and 1.
1188	Volatility	Y		Float	Annualized volatility for option model calculations.
1189	ExpirationTimeValue	Y	N	Float	This value is expressed as a decimal portion of a year, typically the days to expiration divided by the days in a year. Currently the year assumption is 365.
1190	RiskFreeRate	Y*	N	Float	Risk free rate used to calculate the value of this option.

Y = FIX required Y* = CME required N = Not required

3.6 Execution Report – Reject (tag 35-MsgType=8, tag 39-OrdStatus=8)

Tag	FIX Name	Req	Format	Length	Description
103	OrdRejReason	Y*	Int	6	New value: 16=Price exceeds current price band (formerly '7107')

Y* = CME required

3.7 Mass Quote (tag 35-MsgType=i)

Mass quote functionality for volatility-quoted instruments is identical to that described in the [Quoting Functionality](#) volume of the iLink SDK with the following exceptions:

→→ indicates nested repeating group

Tag	FIX Name	Req	Format	Length	Description
→→132	BidPx	N	Int	8	This value must be expressed in volatility terms.
→→133	OfferPx	N	Int	8	This value must be expressed in volatility terms.

3.8 Quote Acknowledgment (tag 35-MsgType=b)

Tag	FIX Name	Req	Format	Length	Description
368	QuoteEntryRejectReason	Y*	Int	2	New value: 10=Price exceeds current price band (formerly '97')

Y* = CME required

4. RLC Market Data Impact

Market data for volatility-quoted options will be broadcast on separate Market Data Platform channels in implied volatility terms (these channel definitions will be made available in a future version of this document). Volatility-quoted instruments will be identified by Instrument Code and a new 'Volatility-Quoted Options' flag in the Instrument Creation (MO) message.



Book depth for these markets will be five deep.*

When the volatility-quoted instrument trades, CME Globex will broadcast a Last Best Price (M0) message for the instrument and will also broadcast a Trade (M6) message for the volatility-quoted instrument and the premium option leg. There will not be a separate Trade (M6) message broadcast for the underlying futures leg.

Note: No market data is generated for the futures hedge leg.

4.1 RLC Instrument Creation (MO) Message

This message has several new and modified fields to support volatility-quoted options.

Note: Since the Instrument Creation (MO) message is created at the beginning of the week, the futures hedge contract is indicated so that the client system can retrieve the settlement price for the instrument in order to verify the final vol-to-premium conversion.

The following table lists all fields in the MO message specifically pertaining to volatility-quoted instruments. Fields added or modified in support of volatility-quoted options appear shaded.

Position	Field Name	Valid Values	Format	Length	Description
94	Trade Unit			19	This field contains the notional value for each instrument. The notional value is equivalent to the corresponding premium-quoted contract.

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Position	Field Name	Valid Values	Format	Length	Description
113	Partial Leg ISIN			240	<p>For volatility-quoted outright instruments:</p> <ul style="list-style-type: none"> First 6 bytes contain the premium equivalent CME Globex ID from position 6-11 of the CME Globex ID from the MO message Second 6 bytes contain the futures hedge CME Globex ID from position 6-11 of the CME Globex ID from the MO message Set to '000000' if not present. <p>For volatility-quoted spreads:</p> <ul style="list-style-type: none"> Contains 6 bytes representing position 6-11 of the CME Globex ID from the MO message for each volatility-quoted outright instrument. May be up to 40 occurrences of 6 bytes each in length. Set to '000000' if not present <p>MO messages for volatility-quoted spreads will contain the vol-outright components only (no futures data).</p>
353	Spread Ratio			120	<p>In the MO message sent for vol-quoted options instruments:</p> <ul style="list-style-type: none"> For vol-outright, the first 6 bytes of the spread ratio will contain +01+01 or +01-01 depending on whether the futures hedge is bought or sold when the option is bought. The first 3 bytes (+01) will indicate an equivalence of 1 for the premium contract. Of the next 3 bytes, only the sign is significant, since the quantity of futures is determined by the calculated delta of the option pricing model. For vol-spreads, the ratio will contain the standard configuration. <p>The remainder of the field following the defined values will be postpended with 0s (zeroes).</p>
473	Derivative Product Price Display Format	1=price 2=percentage		1	Volatility-quoted values are displayed in standard "price" decimal format.
548	Derivative Product Tick Increment Value Amount	0		19	Notional value of one tick. Will contain space + 18 zeros.
572	Tick Display Format Type			2	Volatility -quoted values are decimal and should be displayed as such. Minimum vol-tick increments are currently specified as .025.
587	Settlement Price		P	19	Volatility-quoted outrights receive updated settlements in the same manner as other outright instruments. Volatility-quoted option settlement prices are always represented in volatility terms.
606	High Limit		P	19	High limit volatility value.
625	Low Limit		P	19	Low limit volatility value.
683	Book Depth	5		2	Options book depth; new book depth of '5'.
685	Matching Algorithm Indicator	F		1	'F' (FIFO) is the algorithm applied for volatility-quoted options.

Position	Field Name	Valid Values	Format	Length	Description
799	Vol Quoted Option Flag	0, 1		1	'1' = volatility-quoted instrument. '0' = premium
806	Future or Option Spread Indicator	F O M < blank>		1	F=futures spread O=options spread M=mixed (contains options + futures) < >=outright
807	Options Pricing Model Indicator	F=Black W=Whaley < >=none		1	Indicates which options pricing model is used to convert from volatility quote to premium and corresponding delta. Non volatility-quoted options instruments will have this space set to blank.
840	Minimum Price Fluctuation		P	19	This is the minimum tick size. For volatility-quoted instruments, it represents the minimum change of volatility that represents one tick.
859	Minimum Monetary Value Fluctuation			19	Do not use for volatility-quoted options.

4.2 RLC Security Definition (MU) Message

The MU message has one new field to support volatility-quoted options.

Position	Field Name	Valid Values	Length	Description
246	VolQuotedOptionFlag	0=Standard 1=Volatility-quoted	1	'1' = volatility-quoted option '0' = Premium options or future

5. FIX/FAST Market Data Impact

5.1 Security Definition (tag 35-MessageType=d) Message

In FIX/FAST, this message takes the place of both the RLC Instrument Creation (MO) and Security Definition (MU) messages.



Book depth for these markets will be five deep.*

Repeating groups are designated within the message by the (→) symbol.

Tag	FIX Name	Description
→264	MarketDepth	Will contain options book depth.
555	NoLegs	Number of legs (repeating groups)
→600	LegSymbol	Spread instrument security symbol. Only sent for spreads.
→623	LegRatioQty	The ratio of quantity for this individual leg relative to the entire multi-leg instrument.
→624	LegSide	The side of the leg for this repeating group.
→602	LegSecurityID	Unique instrument ID.
→603	LegSecurityIDSource	Identifies source of tag 602-LegSecurityID value. This value is always '8' for CME.
969	MinPriceIncrement	Minimum fluctuation for instrument price.
870	NoInstAttrib	Number of repeating InstrAttribType entries.
→871	InstAttribType	Will contain '24' to indicate eligibility.
→872	InstAttribValue	When the preceding tag 871 = '24', a value of '13' in this tag indicates this instrument is a volatility-quoted option.
870	NoInstAttrib	Number of repeating InstrAttribType entries.
→871	InstAttribType	Will contain '23' to indicate VTT eligibility.
→872	InstAttribValue	When the preceding tag 871 = '23', this tag will contain the VTT code.
1142	MatchAlgorithm	'F' (FIFO) is the algorithm applied for volatility-quoted options.
1147	UnitOfMeasureQty	This field contains the notional value for each instrument. The notional value is equivalent to the corresponding premium-quoted contract.
1148	LowLimitPrice	Low limit volatility value.
1149	HighLimitPrice	High limit volatility value.
1150	TradingReferencePrice	Volatility-quoted outrights receive updated settlements in the same manner as other outright instruments. Volatility-quoted option settlement prices are always represented in volatility terms.
9853	PricingModel	Indicates which options pricing model is used to convert from volatility quote to premium and corresponding delta.

6. Message Sequence

The following two examples illustrate the CME Globex messaging sequence for volatility-quoted instruments from instrument creation through trade execution for volatility-quoted outright and volatility-quoted spread instruments. The third and fourth examples illustrate messaging for a trade bust.

6.1 Volatility-Quoted Outright Trade

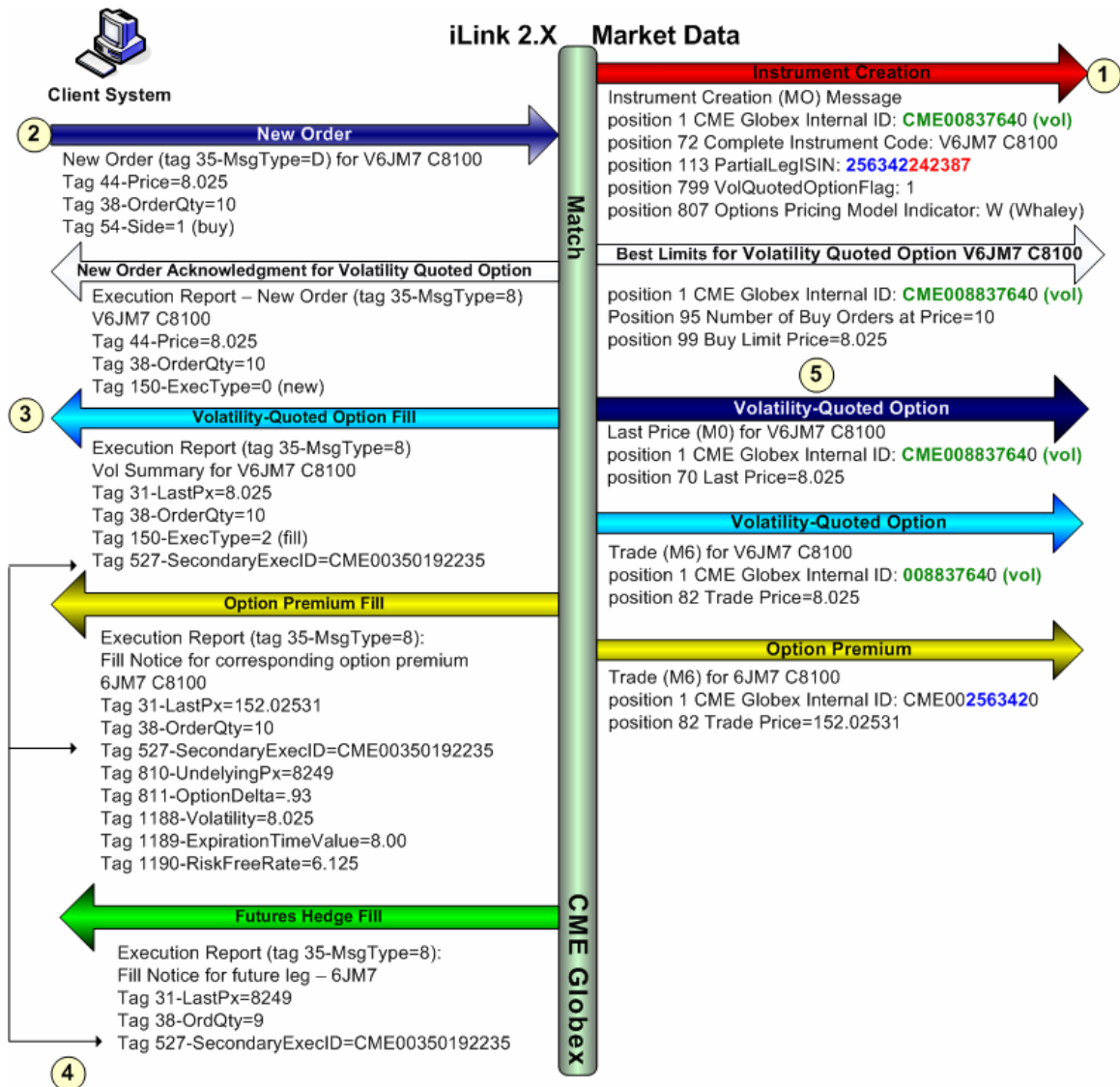
Step 1: CME Globex broadcasts the Instrument Creation (MO) message for the volatility-quoted instrument.

FIX/FAST Format

CME Globex broadcasts the Security Definition (tag 35-MessageType=d) message for the volatility-quoted instrument.

Note: Volatility-quoted instruments will have a Product Code, Instrument Group Code, and CME Globex Internal ID value distinct from the corresponding premium instruments.

Step 2: Client system submits a New Order (tag 35-MessageType=D) message for the volatility-quoted instrument with a valid volatility value in tag 44-Price; upon order accept, CME Globex sends a New Order Acknowledgment (tag 35-MessageType=8) message to the client system and a Best Limits (MA) message to the market.



Step 3: Upon trade execution, CME Globex sends the client system that originated the order the following Execution Report messages:

- Execution Report (tag 35-MsgType=8) for the volatility-quoted instrument with the volatility value at which the instrument traded in tag 31-LastPx.
- Execution Report (tag 35-MsgType=8) for the equivalent premium option with tag 31-LastPx containing the premium value.
- Execution Report (tag 35-MsgType=8) for futures hedge.

Note: CME Globex does not send an Execution Report for a futures hedge when no future is traded because the futures hedge ratio is < 0.50 and > -0.50 .

Step 4: Use tag 527-SecondaryExecID to correlate outright volatility-quoted instrument with premium and futures instruments.

Step 5: Upon trade execution, CME Globex broadcasts the following market data messages:

- Last Price (M0) for volatility-quoted option instrument with the volatility value at which the instrument traded in position 70 Last Price.
- Trade (M6) for volatility-quoted option instrument with the volatility value at which the instrument traded in position 82 Trade Price.
- Trade (M6) for the premium option with the premium value in position 82 Trade Price.

FIX/FAST Format

CME Globex broadcasts the Market Data Incremental Refresh (tag 35-MsgType=X) message for the trade.

No market data is broadcast for the futures hedge.

6.2 Volatility-Quoted Spread Trade

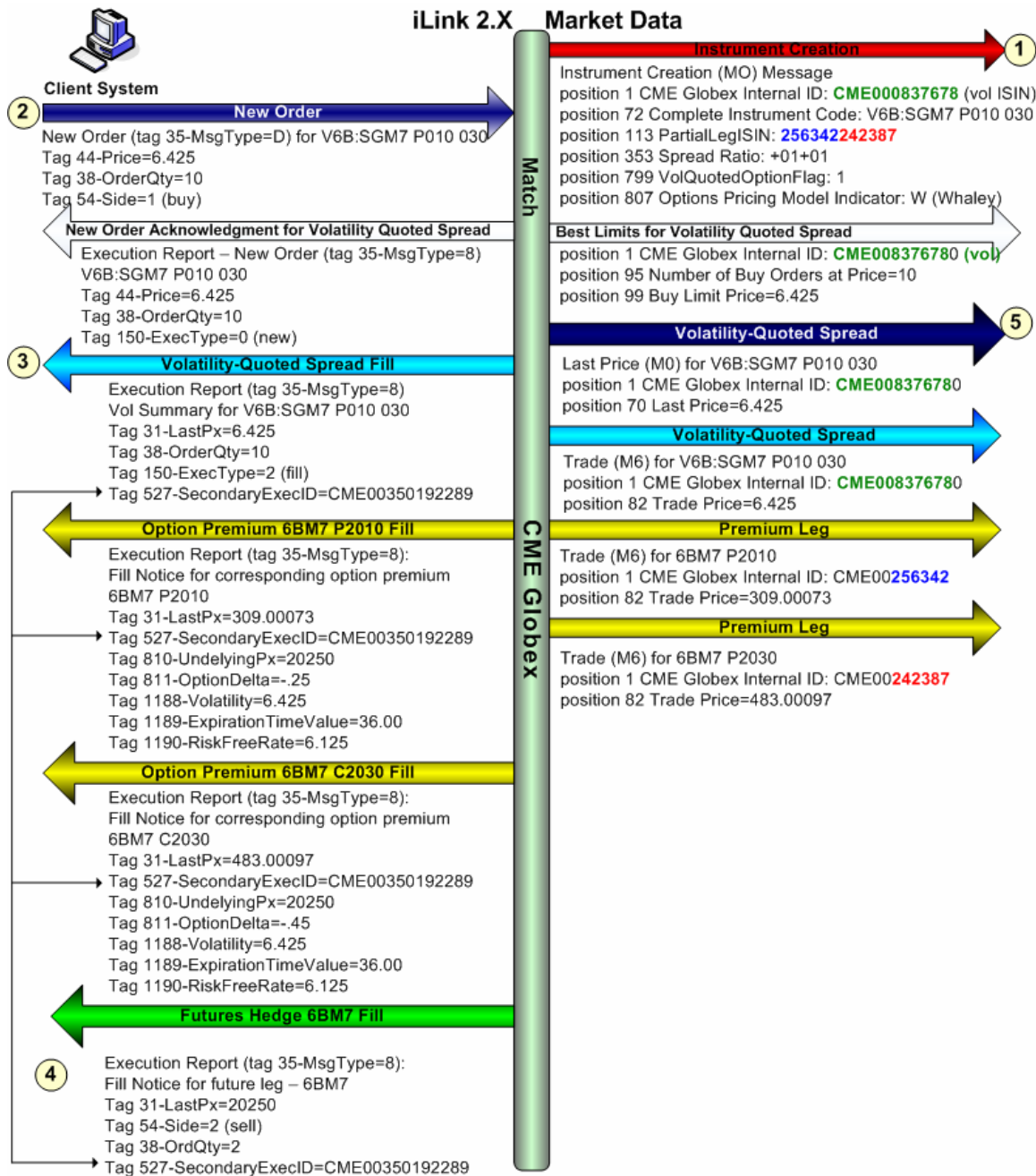
Step 1: CME Globex broadcasts the Instrument Creation (MO) message for the volatility-quoted spread instrument.

FIX/FAST Format

CME Globex broadcasts the Security Definition (tag 35-MsgType=d) message for the volatility-quoted instrument.

Note: Volatility-quoted instruments will have a Product Code, Instrument Group Code, and CME Globex Internal ID value distinct from the corresponding premium instruments.

Step 2: Client system submits a New Order (tag 35-MsgType=D) message for the spread instrument with a volatility value in tag 44-Price; upon order accept, CME Globex sends a New Order Acknowledgment (tag 35-MsgType=8) message to the client system and a Best Limits (MA) message to the market.



Step 3: Upon trade execution, CME Globex sends the client system that originated the order the following Execution Report messages:

- Execution Report (tag 35-MsgType=8) for the volatility-quoted spread instrument with the volatility value in tag 31-LastPx.
- Execution Report (tag 35-MsgType=8) for each equivalent premium leg of the volatility-quoted spread with tag 31-LastPx containing the premium value.
- Execution Report (tag 35-MsgType=8) for future leg with tag 31-LastPx containing the futures price.

Step 4: Use tag 527-SecondaryExecID to correlate volatility spread instrument with component premium options legs and underlying future.

Note: Volatility-quoted instruments will have a Product Code, Instrument Group Code, and CME Globex Internal ID value distinct from the corresponding premium instruments.

Step 5: Upon trade execution, CME Globex broadcasts the following market data messages:

- Best Limits (MA) for spread instrument.
- Last Price (M0) for volatility-quoted spread instrument with the volatility value in position 70 Last Price.
- Trade (M6) for volatility-quoted spread instrument with the volatility value in position 82 Trade Price.
- Trade (M6) for each premium leg of the volatility-quoted spread with the premium value for the leg in position 82 Trade Price.

FIX/FAST Format

CME Globex broadcasts the Market Data Incremental Refresh (tag 35-MsgType=X) message for the spread trade.

No market data is broadcast for the futures hedge.

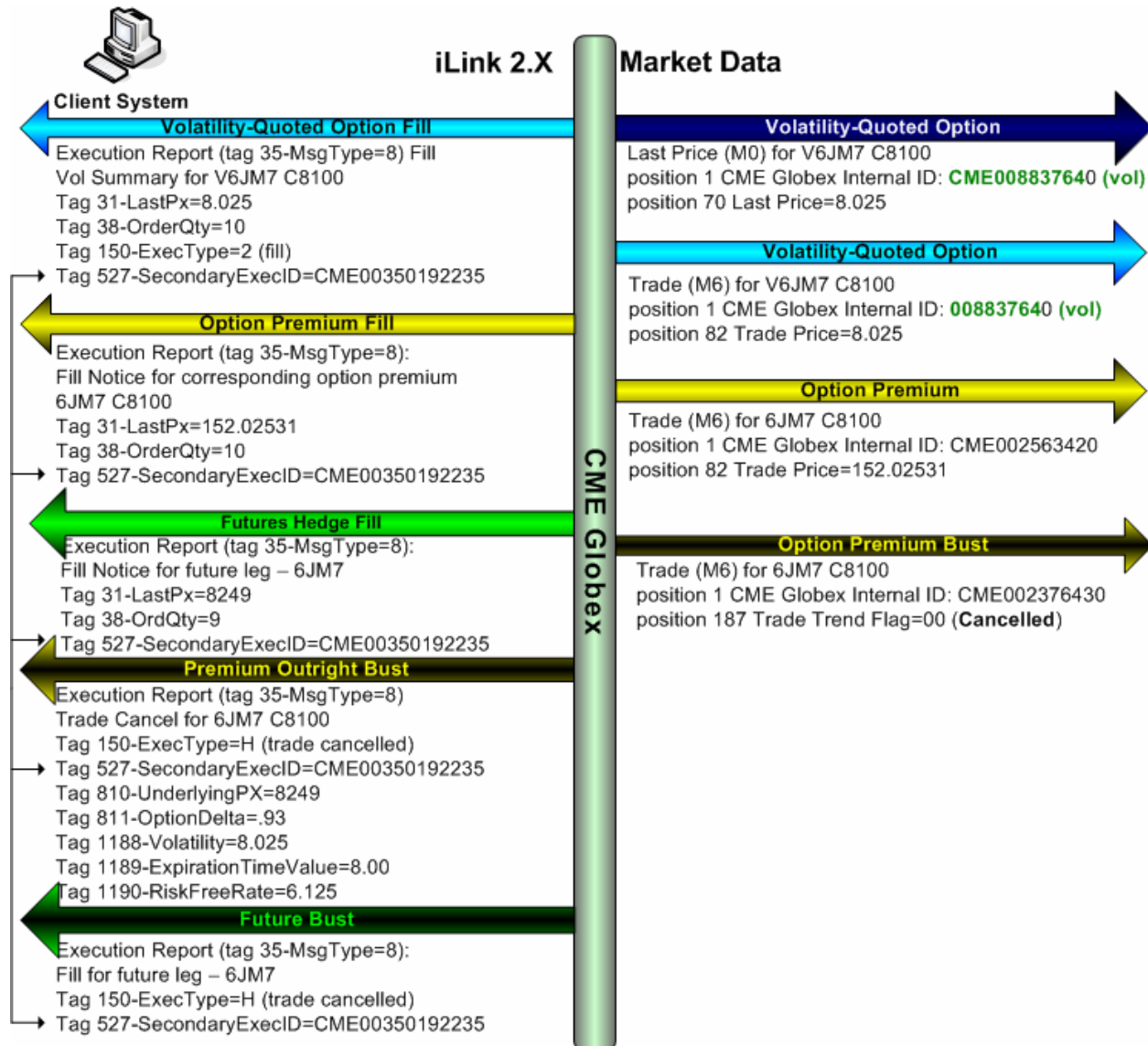
6.3 Trade Bust

This section provides trade bust examples for both outright and spread trade busts.

6.3.1 Outright Bust

In the event of a bust for an outright volatility trade, CME Globex will send the client system an Execution Report – Trade Cancellation (tag 35-MsgType=8, tag 150-ExecType=H) message for the premium outright instrument and future (if applicable). The client system must correlate this Execution Report-Cancel message with the Execution Report-Fill message sent for the original trade by means of tag 527-SecondaryExecID.

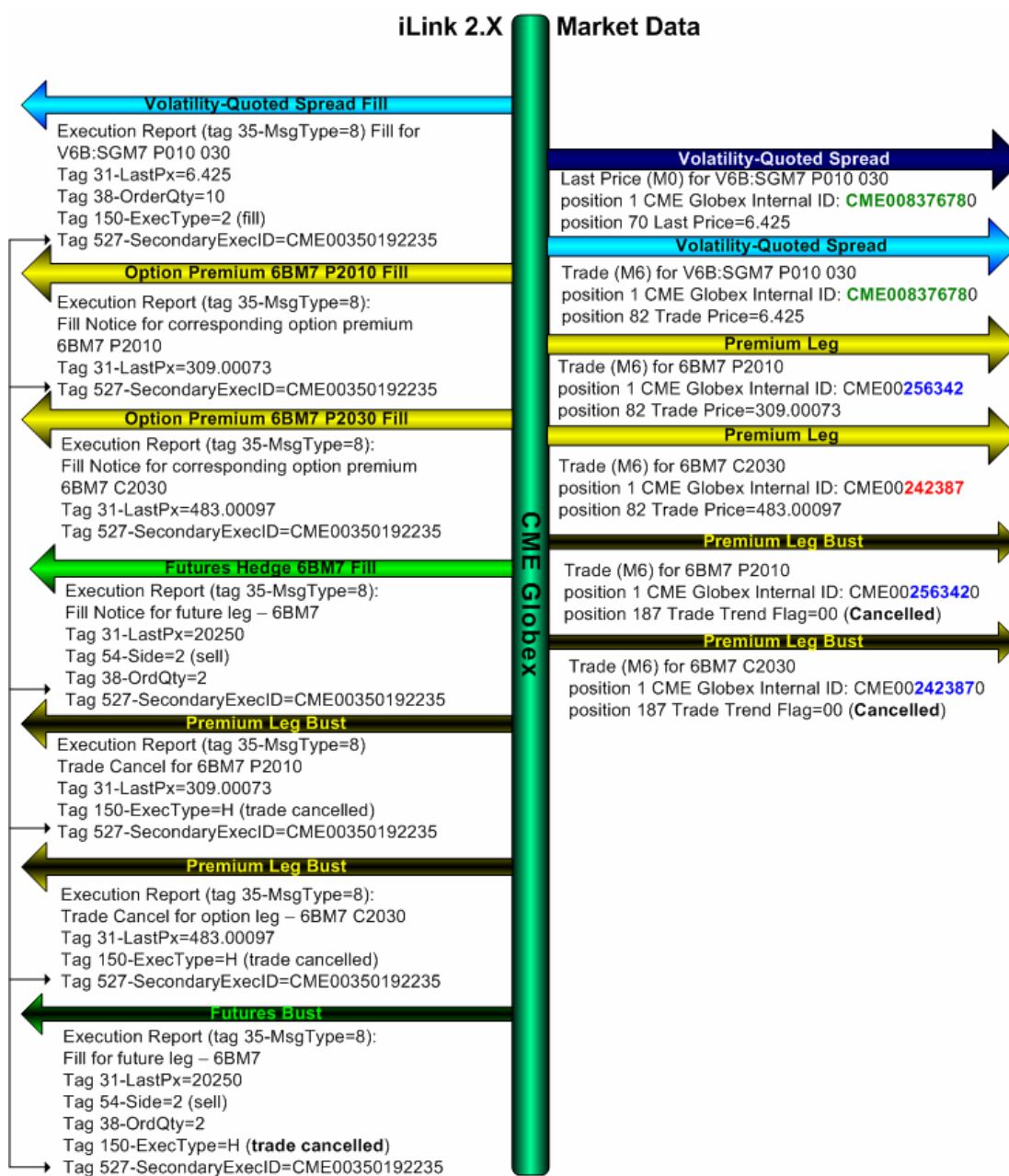
CME Globex will also broadcast market data trade cancellation messages for the premium outright instrument. **No market data message for the trade bust is sent for the future or the volatility-quoted outright.**



6.3.2 Spread Bust

In the event of a bust for a volatility-quoted spread trade, CME Globex will send the client system an Execution Report – Trade Cancellation (tag 35-MsgType=8, tag 150-ExecType=H) message for each corresponding premium outright option instrument and future fill (if applicable). The client system must correlate these Execution Report-Cancel messages with the Execution Report-Fill messages sent for the original trade by means of tag 527-SecondaryExecID.

CME Globex will also broadcast market data trade cancellation messages for the premium outright option instruments. **No market data message is sent for the bust for the future or volatility-quoted spread.**



Appendix A: Pricing Models

Black Option Pricing Model for European-Style Options

Waiting for copyright approval to display Black Option model as defined in:

*Natenberg, S. (1994). *Option Volatility and Pricing*. New York: McGraw-Hill.

Whaley Option Pricing Model for American-Style Options

For a comprehensive description of the Whaley pricing model, please see:

<http://www.cme.com/trading/get/files/whaleymodel.pdf>

Also, please see the developer notes below, which include modifications made to the model described in the above article about improving calculation within CME Globex:

- On page 309, there is mention of an “acceptable tolerance level”. In their example, their tolerance equation is: $|LHS(S_i) - RHS(S_i)| / X < 0.00001$. The difference in the Falcon engine is that we actually go slightly further in our precision, to 0.000001 (one more decimal place).
- We also have a maximum number of iterations we will perform on the above equation to fall within the tolerance level. If after 10,000 iterations we are not within a tolerance of 0.000001, we will fall back to the European model instead.
- We do not implement any notion of a carrying-cost or foreign interest rate. The b variable is always equal to zero in the equations. If we did start to use b , note that if b is ever greater than or equal to the interest rate r , we automatically fall back to the European model.
- There is an edge case scenario not documented in the model, but implemented by SPAN and also included in our model. This scenario is extremely rare but prevents a delta from falling outside of -1.0 through 1.0.
 - For a call, if the underlying price is greater than or equal to S^{**} , we set the delta to 1.0 and the premium equal to the underlying price minus the strike price (or 0, if this value is < 0).
 - For a put, if the underlying price is less than S^{**} , we set the delta to -1.0 and the premium equal to the strike price minus the underlying price (or 0, if this value is < 0).

Appendix B: Option Premium Price Adjustment

The following table provides an example of the Option Premium Price Adjustment CME Globex will perform for each volatility-quoted options product.

Option Premium Rounding Tick			
Product*	Minimum Tick	Half Tick	Option Premium Rounding Tick
EuroFX	0.0001 = \$12.50	0.00005 = \$6.25	0.00001 = \$1.25
British Pound	0.0001 = \$6.25	N/A	0.00002 = \$1.25
Japanese Yen	0.000001 = \$12.50	0.0000005 = \$6.25	0.0000001 = \$1.25
Canadian Dollar	0.0001 = \$10.00	0.00005 = \$5.00	0.00001 = \$1.00
Swiss Franc	0.0001 = \$12.50	0.00005 = \$6.25	0.00001 = \$1.25
Australia Dollar**	0.0001 = \$10.00	0.00005 = \$5.00	0.00001 = \$1.00

*American and European style options

**Only American style

As with premium-quoted options, a bid of zero is not valid. A Volatility Price of 0.025% or greater will be rounded up to the minimum Option Premium Rounding Tick described above should the conversion premium price fall between 0 and the minimum Option Premium Rounding Tick.

Revision History

Version	Date	Author	Description
1.0	11/01/07	bif	Initial Release
1.1	11/14/07	bif	Updated graphics
1.2	12/17/07	bif	added link to Whaley options model on cmegroup.com
1.3	12/21/07	nru	Editorial updates included in sections 1, 2, Appendix A and Appendix B. Added additional notes regarding depth of book (5-deep) for Vol-quoted FX Options.