



CLSA AUSTRALIA PTY LTD

CROSSING ENGINE

USER GUIDE

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1 Summary

CLSA Australia Pty Limited ("**CLSA APL**") Crossing Engine is a continuous and anonymous order matching and automated trade reporting system. The Crossing Engine will match buy and sell orders during the continuous trading phase of the Australian securities market, and automatically report the trades to either the ASX or Chi-X exchange in real time. The Crossing Engine does not publish information regarding its order book to any other CLSA trading desk or to any other market participant.

CLSA APL's crossing system is called Crossing Engine and operates under code 2311. CLSA APL's Crossing Engine commenced operations on 15 October 2012. CLSA APL's Crossing Engine is only available to Wholesale Clients trading ASX listed securities. The Crossing Engine is available to all existing clients, unless that client has specifically requested to opt out of the Crossing Engine. Access to the Crossing Engine is uniform for all clients. All client orders access the Crossing Engine via CLSA APL's algorithmic trading system. No clients have direct access to the Crossing Engine.

The Crossing Engine is intended for use via the following mechanisms:

- CLSAAPL's internal traders will have the option to route their client orders, or parts of those orders through the Crossing Engine, before they are sent to the exchange.
- CLSAAPL's Direct Market Access (DMA) clients will have the option to directly route orders, or parts of those orders through the Crossing Engine, before they are sent to the exchange.

The Crossing Engine will additionally provide an option for holding an order in its own internal order book only, and not forward that order to the exchange. This option will be available for both the access mechanisms described above.

The Crossing Engine can be configured to send trade reports to either the ASX, or Chi-X.

2 Crossing Engine Flows

CLSAAPL's internal traders use Viper to route orders to the exchanges. The orders are created in Viper either manually by the relevant trader, or electronically via a FIX message sent directly from the client's Order Management System. CLSAAPL's execution traders typically split client orders into smaller slices, which may be sent directly to one of the exchanges, to the Crossing Engine only, or routed to one of the exchanges through the Crossing Engine.

DMA clients send orders to CLSAAPL's DMA system via their FIX enabled order management system. The FIX message will include an identifier to indicate whether or not the client would like to the order to be sent directly to the exchange, directly to the Crossing Engine, or to the exchange through the crossing engine. For clients who are unable to set this identifier, it will be defaulted to an agreed value on a per client basis, prior to the client being enabled.

Both internal traders, and external DMA clients, have the option to:

1. Bypass the crossing engine, sending orders directly to the exchange. These orders can only be matched on the exchange; or
2. Pass the order through the crossing engine, then to the exchange. These orders may be matched on either the exchange, or the Crossing Engine; or
3. Pass their orders to the Crossing Engine only. These orders can only be matched in the Crossing Engine.

3 Detailed Order Flows

The diagram below is a detailed order flow diagram, showing all major system components relative to the CLSA APL Crossing Engine.

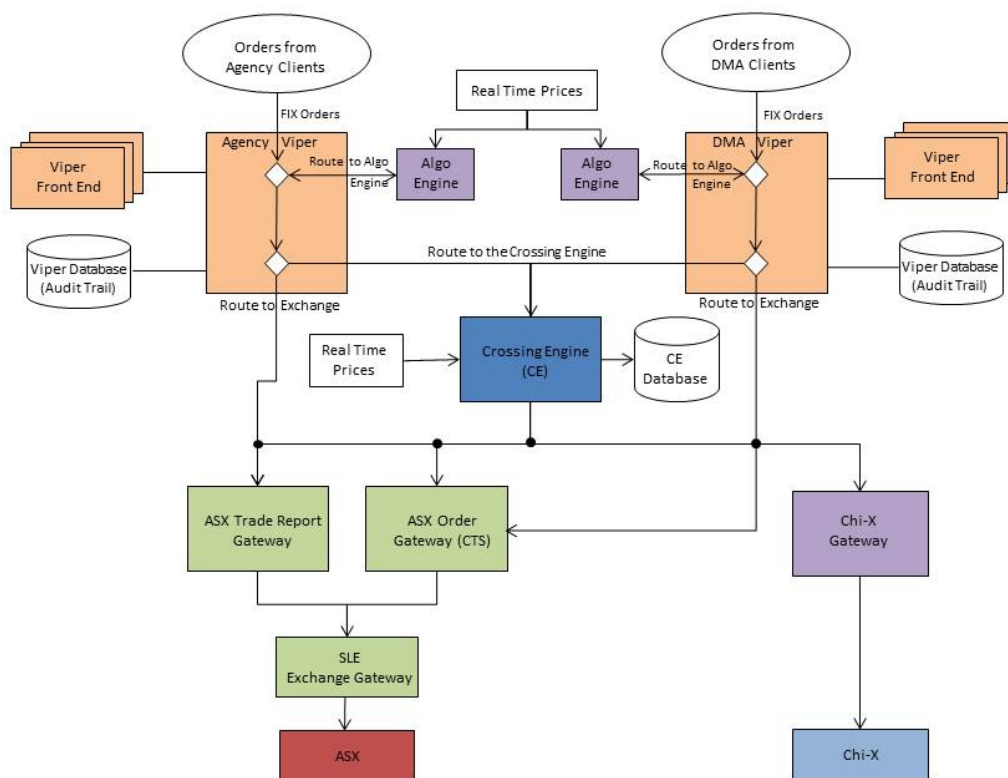


Figure 3.1 Detailed Flow Diagram

4 Order Flow System Components

Viper

Viper is CLSAAPL's internal order management and execution management system (EMS). All client orders are entered into Viper, either manually, or via FIX. CLSAAPL use separate instances of Viper for DMA flow and for agency flow to ensure the flows are segregated.

Viper Front End

Viper Front End is the graphical user interface for Viper. The Viper Front End is used by execution and sales traders to enter, route and monitor client orders.

Viper Database

The Viper Database is an oracle database used to store a record of all orders, trades and a complete history of all transactions that have been performed.

Algo

The Algo system is an algorithmic trading system. The Algo system interfaces with Viper for order management and routing. Users make use of the Viper front end to manage orders in the Algo system.

Crossing Engine (CE)

The Internal Crossing Engine (CE) is the subject of this document.

Real Time Prices

The Crossing Engine uses a real time price feed.

CE Database

The CE Database is an oracle database used by the Crossing Engine for persistence. This database maintains a record of the state of all orders that have been sent to the crossing engine, and all trades that were crossed in the crossing engine.

ASX Order Gateway (CTS)

CTS is a process used to convert the FIX message protocol, which is used by Viper and the Crossing Engine, into the GL message protocol which is used by SLE (Exchange Gateway). CTS is used only for order messages, it does not support trade report messages.

ASX Trade Report Gateway

The Exchange Trade Report Gateway is a process used to convert the FIX message protocol, which is used by Viper and the Crossing Engine, into the GL message protocol which is used by SLE. The Exchange Trade Report Gateway is used only for trade report messages, it does not support order messages.

SLE Exchange Gateway

SLE is a third part product supplied by Sunguard, to provide connectivity to the ASX.

Chi-X Gateway

The Chi-X Gateway is a FIX server used to connect internal CLSA trading systems, Viper and the Crossing Engine, to Chi-X. The gateway internally uses the Fuse risk management tool to perform risk checks before sending orders to Chi-X.

5 Crossing Engine and Algo Engine Interaction

The Algo Engine which forms part of the order flow, it is independent of the Crossing Engine. Traders may choose, on a per order basis, whether or not slices sent to the exchange via the Algo engine, will first pass through the crossing engine.

The Algo engine views the crossing engine as an executing destination, similar to a stock exchange.

6 Crossing Mechanism

The CLSAAPL Crossing Engine is a continuous order matching system. The order matching algorithm is triggered to run under the following conditions:

1. A new order is received by the Crossing Engine;
2. The limit price of an existing order is amended; and
3. Periodically run the algorithm from a timer.

The order that initiates the algorithm will be termed the “initiator”.

The initiator will be one of the following:

1. The new order that has just arrived; or
2. The existing order that is being amended.

If the initiator is a buy order, then it will search through the list of existing sell orders for the same instrument. The search is conducted to ensure that the lowest priced sell orders are checked first. If there are more than one existing sell order at the same price, then they are searched in order of the time priority at which they arrived in the Crossing Engine, at that price. This search algorithm will be known as “Price Time Priority”.

If an existing order is found with a limit price lower than or equal to the limit price of the initiator, then the two orders can match. The quantity of the match will be lower of either the initiator outstanding quantity, or the existing order outstanding quantity. The price of the match will be the limit price of the existing order.

If the initiator is a sell order, then it will search through the list of existing buy orders for the same instrument using the same Price Time Priority search algorithm described above, with the exception that higher priced orders will have priority over any lower priced orders.

When the Crossing Engine has determined that two orders can cross, the match is then subjected to a series of validations checks, as defined in section 10 of this User Guide. The rules are executed sequentially. If any one of the rules fail, then the match is not performed. If the initiator is not matched with any existing orders, then it will be entered into the crossing engine internal order book as an existing order, so it may match with any future initiators.

If all the crossing rules pass, the Crossing Engine can match both opposing orders with the match quantity, at the match price, as defined above. If either the buy or the sell order has been sent to the exchange, then the crossing engine retrieves the match quantity back from the exchange, by either reducing, or cancelling the order. When the match quantity has been successfully retrieved from the exchange, the Crossing Engine sends a National Bid Best Offer (“**NBBO**”) trade report to either the ASX or Chi-X. When the trade has been successfully reported, the crossing engine applies the trade on the initiator order and the existing order.

7 Crossing Indicator

The Crossing Engine accepts a FIX tag on the order message, to indicate whether or not the order can be considered for crossing, and whether or not it should be sent to the exchange.

FIX Crossing Indicator	Meaning	Description
0	Do Not Cross	Do not cross the order, pass it through to the exchange.
1	Can Cross	Cross the order if / when there is a match Send the order to the exchange
2	Cross Only	Cross the order if / when there is a match Do not send the order to the exchange
3	Cross Mid	Cross the order if / when there is a match, only if the price is the midpoint, or better Send the order to the exchange
4	Cross Mid Internal	Cross the order if / when there is a match, only if the price is the midpoint, or better Do not send the order to the exchange

Table 7.1 Crossing Indicator

Crossing Indicator Default

If the crossing indicator is not present on the new order FIX message received by the crossing engine, then the crossing engine will assume that the order is not to be crossed. It will be sent to the exchange, and it will not be stored in the crossing engine internal order book. This is the same behavior as setting the indicator to "Do Not Cross".

8 Pass Through Orders

If the Crossing Indicator is set to either 1 or 3, and the order cannot be matched on arrival in the Crossing Engine, then it will be stored in the Crossing Engine Internal Order Book (IOB), and then passed through to the stock exchange, either the ASX or Chi-X. These orders shall be referred to as pass-through orders. If there are multiple pass-through orders in the IOB from the same client consecutively at the same price, then those orders will be matched in reverse time priority. This provides the best execution performance for that client, by maintaining those orders with the best queue priority on the exchange.

9 Dark Orders

If the Crossing Indicator is set to either 2 or 4, and the order cannot be matched on arrival in the Crossing Engine, then it will be stored in the Crossing Engine Internal Order Book (IOB) only, and it will not be passed through to the exchange. These orders shall be referred to as dark orders. If there are dark orders and pass-through orders in the IOB from the same client consecutively at the same price, then dark orders will be matched with a higher priority than pass-through orders. This provides the best execution performance for that client, by maintaining those orders with the best queue priority on the exchange.

10 Crossing Examples

7.1 Initiator is a New Order with type "Can Cross"

This example demonstrates the case where the matching algorithm is triggered based on a new order arriving.

Best Bid = \$5.00 Best Ask = \$5.01

10:40am	Order 1 received to buy 20K at \$5.005 as "Can Cross"
10:40am	Crossing Engine cannot find a suitable matching order
10:40am	Order 1 is added to the crossing engine internal order book
10:40am	Order 1 is sent to the exchange at \$5.00
10:45am	Order 2 received to sell 3K at \$4.95 as "Can Cross"

10:45am Crossing Engine finds Order 1 as a match
 10:45am Order 1 is reduced to 17K on the exchange
 10:45am An NBBO trade report for 3K at \$5.005 is sent to the exchange
 10:45am Both orders receive a trade of 3K at \$5.005

7.2 Initiator Order's Limit Price is Amended

This example demonstrates the case where the matching algorithm is triggered based on a limit price amendment for an existing order.

Best Bid = \$5.00 Best Ask = \$5.01

10:40am Order 1 received to buy 20K at \$5.005 as "Can Cross"
 10:40am Crossing Engine cannot find a suitable matching order
 10:40am Order 1 is added to the crossing engine internal order book
 10:40am Order 1 is sent to the exchange at \$5.00

 10:45am Order 2 received to sell 3K at \$5.01 as "Can Cross"
 10:45am Crossing Engine cannot find a suitable matching order
 10:45am Order 2 is added to the crossing engine internal order book
 10:45am Order 2 is sent to the exchange at \$5.01

 10:48am Limit Price of Order 2 is amended to \$5.00
 10:48am Crossing Engine finds Order 1 as a match
 10:48am Order 2 is cancelled from the exchange
 10:48am Order 1 is reduced to 17K on the exchange
 10:48am An NBBO trade report for 3K at \$5.005 is sent to the exchange
 10:48am Both orders receive a trade of 3K at \$5.005

7.3 Initiator is a New Order with type "Cross Only"

This example demonstrates the case where the matching algorithm is triggered based on the periodic timer.

Best Bid = \$5.00 Best Ask = \$5.01
 Day Low = \$5.01 Day High = \$5.25

10:40am Order 1 received to buy 20K at \$5.005 as "Can Cross"
 10:40am Crossing Engine cannot find a suitable matching order
 10:40am Order 1 is added to the crossing engine internal order book
 10:40am Order 1 is sent to the exchange at \$5.00

10:45am Order 2 received to sell 3K at \$4.95 as "Cross Only"
 10:45am Crossing Engine finds Order 1 as a match at price \$5.00
 10:45am Cross Validation fails because day low is \$5.01
 10:45am Order 2 is added to the crossing engine internal order book

The two orders cannot cross because the match would violate the rules listed in Section 10. The Crossing Engine will periodically re-check if this match can occur once every 30 seconds.

10:46am Day Low = \$5.00 Day High = \$5.25

10:46am Periodic Cross Check finds a match between Order 1 and Order2
 10:46am The day low price has moved to \$5.00, all cross rules pass
 10:46am Order 1 is reduced to 17K on the exchange
 10:46am An NBBO trade report for 3K at \$5.005 is sent to the exchange
 10:46am Both orders receive a trade of 3K at \$5.005

The Periodic Cross Check runs once every 30 seconds. It re-checks any orders that previously failed the cross rules defined in section 10.

11 Intra-Spread Crossing

The Crossing Engine will only accept orders with limit prices that are aligned on an exchange tick boundary, or the mid-point price. The orders will be stored in the crossing engine internal order book at the price set by the client. If that price is not on a tick boundary, and the order cross indicator is set to "Can Cross", it will be rounded to a tick boundary before being sent to the exchange. Buy orders will be rounded down, and sell orders will be rounded up.

The Crossing Engine will store orders in the crossing engine internal order book with the price limited to at most four decimal places, since this is the maximum number of decimal places that can be reported to the ASX or Chi-X on an NBBO trade report.

The crossing engine will only cross at the one of the following prices:

- i. Higher than the Best Available Bid and lower than the Best Available Offer by one or more Price Steps
- ii. the Best Mid-Point

12 Crossing Sessions

The Crossing Engine will cross orders during the continuous trading phase of the ASX securities market only. It will not cross orders during the pre-open session, nor during the closing auction.

The crossing engine will stop crossing orders fifteen seconds before the close of the continuous trading session of the ASX securities market. This will allow the crossing engine time to report any crossed trades before the session closes.

13 Crossing Rules

Crossing rules are specific to each exchange. Following are the current rules for the ASX:

- The Crossing Engine will only match orders between the best national bid and best national offer prices, at the time the match occurs.
- The Crossing Engine will only match orders between the day high and day low prices on the ASX, at the time the match occurs.
- The Crossing Engine will not cross any instrument that is suspended from trading on the exchange.
- The match price must have at most 4 decimal places.
- The Crossing Engine will not cross buy and sell orders from the same client.

From 26 May 2013, ASIC Market Integrity Rule 4.2.3 – Trades with price improvement comes into effect. To ensure ongoing compliance with the requirements, CLSA APL will have implemented the following changes:

- The Crossing Engine will only match orders where the transaction entered into at a price (at the time of execution) that is:
 - at a valid price step (i.e. tick size) that is both above the best available bid and below the best available offer; or
 - at the midpoint of the best available bid and best available offer (where $\text{midpoint} = (\text{best available bid} + \text{best available offer}) \div 2$).

The best available bid and best available offer are the highest pre-trade transparent bid and lowest pre-trade transparent offer available across all pre-trade transparent order books of licensed markets (also known as the national best bid and offer or NBBO).

CLSAPL will not use any non-pre-trade transparent (e.g. hidden orders) in calculating the NBBO.

14 Order Types

For orders with the Crossing indicator set to either “Do Not Cross” or “Can Cross”, the Crossing Engine will pass the order through to the exchange. As such, the order types accepted by the Crossing Engine are the same as those that are supported by the exchange, either ASX or Chi-X. None of the order details are changed as a part of passing an order through to the exchange.

Orders with the Crossing indicator set to “Cross Only” are not passed to the exchange. The list of accepted order types for Cross Only orders are as follows:

Limit	Orders may cross within the limit price
Market	Orders may cross at any permitted price
Immediate Or Cancel	Any unfilled quantity will be rejected immediately after order receipt.

15 User Treatment

The Crossing Engine processes orders from all sources in the same manner. The Crossing Engine implements price time priority matching only. There is no preferential treatment afforded to any individual user or group.

16 Anonymity

All orders in the Crossing Engine are anonymous. The Crossing Engine internal order book cannot be viewed by any trading users, either internally to CLS APL or externally. Orders within the Crossing Engine can only be viewed by compliance staff for compliance monitoring, and by technical support staff for technical support and maintenance. There are no indications of interest published based on orders within the Crossing Engine.

17 Principle Orders

CLSA APL does not engage in principle trading. As such, principle orders are not permitted in the Crossing Engine. This includes principle orders for any CLSA APL related companies.

18 Liquidity Providers

The Crossing Engine is populated with natural client agency flow only. There are no liquidity providers or market makers providing liquidity.

19 Fees

There are no additional fees charged to clients for accessing the Crossing Engine, other than the normal brokerage commission. The Crossing Engine is provided to clients as a free service to improve execution performance.

20 Crossing Suspension

The crossing function of the CLSAAPL Crossing Engine can be manually enabled or disabled at any time, by the front office production support team. While the crossing function is disabled, the Crossing Engine will continue to accept orders, and store them in the crossing engine internal order book. If the crossing indicator is set to "Can Cross" or "Do Not Cross", the order will be sent to the exchange. However, the Crossing Engine will not cross any orders while the crossing is disabled, and subsequently it will not send any trade reports to the exchange.

This function is intended to be used by CLSA APL production support staff as a safety measure in exceptional circumstances only. Examples of these circumstances are:

- Technical issues at the ASX or Chi-X which prevent securities trading; and
- Technical issues with CLSA's connection to either the ASX or Chi-X which prevent securities trading and sending trade reports.

Crossing will resume as normal, and any orders stored in the crossing engine internal order book may be crossed, when the crossing function is manually enabled.

21 Crossed Trade Indicator

For clients who trade with CLSAAPL electronically using the FIX protocol, any trades on their orders that have been matched in the Crossing Engine, will be indicated on the execution report messages sent to the client.

Trade matched on the ASX	FIX tag 30 (LastMkt) = "AU"
Trade matched on Chi-X	FIX tag 30 (LastMkt) = "AH"
Trade matched in CLSA Crossing Engine	FIX tag 30 (LastMkt) = "AUCE"

This will allow clients to readily identify the executing venue of each trade.

22 Resilience

The Crossing Engine runs on two servers located in two different data centers in Sydney. Source systems connect to the Crossing Engine via a virtual IP address, which will always point to the primary instance. If the primary instance fails, the virtual IP will point source systems to the backup server running in the other data centre.

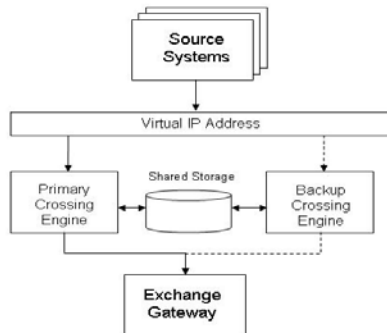


Figure 14.1 Crossing Engine Resilience

23 Outages

If technical or other system issues materially affect the efficiency of or proper functioning of the Crossing Engine, CLSA APL will provide the following information, in writing, to ASIC and all users with orders in the Crossing Engine:

- (a) A description of the effect of the technical or other system issues;
- (b) How the technical or other system issues are being managed;
- (c) Any alternative arrangements for users' orders that have been put in place by CLSA APL while the technical or other systems issues persist; and
- (d) When the technical or other system issues have been resolved,

as soon as practicable after the technical or other system issue arises, or the issue is resolved, as applicable.

24 Disclosures

The Crossing Engine allows clients to cancel orders at any time prior to execution in the Crossing Engine.

The Crossing Engine allows client to specify a minimum execution quantity of their choice.

All Crossing Engine orders are good for the day only and are purged at the close of trading each trading day.

The Crossing Engine does not allow Aggregators and does not interact with any other Crossing Engine service providers.

CLSA APL operates the Crossing Engine at all times in strict compliance with Chapter 4A: Crossing Systems requirements of the ASIC Market Integrity Rules (Competition in Exchange Markets) 2011 rules.