

NTP Failover and Recovery Guide

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1. Introduction

1.1. Purpose

The purpose of this document is to provide an overview of the expected behaviour of the New Trading Platform on failure, or unavailability, of some or all components of the architecture.

1.2. Readership

This document outlines the technical behaviour of the system and should be read in conjunction with the detailed specifications of the components that may be impacted.

- ASX FIX Order Entry Specification
- ASX FIX Market Data Specification
- ASX FIX Drop Copy Specification
- ASX Market Data Protocol Specification

This document is primarily relevant to technical staff within ASX 24 participants and information vendors and other market participants that connect directly to the New Trading Platform.

1.3. Document History

Issue	Date	Description
1.0	June 2016	First release
1.1	August 2016	Clarification regarding orders with non-replicated trades
1.2	November 2016	Section 6.2.2 content updated with information about emergency Matching Engine (ME) promotion.
1.3	December 2016	Section 6.2 content updated with information about exchange-side cancellation of spread orders.
1.4	December 2016	Addition of section 8 Customer Infrastructure Failure
1.5	January 2017	Section 2.2. Primary Gateway Failure enhanced providing more detail on customer response to gateway failover
1.6	May 2017	Section 6.2.1 FIX Order Entry gateways regarding reporting of cancelled SOG orders.
2.0	July 2017	Changes for the Service Release <ul style="list-style-type: none">• Additional FIX Order Entry gateways at ALC

1.4. Enquiries

Please contact your Technical Account Manager if you have questions about this document.



2. ASX FIX Order Entry Gateways (primary/secondary/tertiary service)

ASX operates a primary/secondary/tertiary FIX Order Entry Gateway model. Tertiary gateways are only available to collocated participants.

Each user will be permitted to interact with the New Trading Platform via one gateway in the Australian Liquidity Centre and one gateway in the ASX Disaster Recovery Site. Collocated participants will be permitted to interact with an additional gateway located in the Australian Liquidity Centre.

The locations of gateways are set out in the table below:

Gateway	Gateway location by participant location	
	Collocated participants	ASX Net participants
Primary	Australian Liquidity Centre	Australian Liquidity Centre
Secondary	Australian Liquidity Centre	Disaster Recovery Site
Tertiary	Disaster Recovery Site	(not available)

At any time, only one gateway will be enabled for each FIX user to establish a FIX connection (the enabled gateway). Under normal circumstances, the enabled gateway will be the Primary, located in the Australian Liquidity Centre.

Information from the enabled gateway is replicated to the other gateways to facilitate speedy re-establishment of service in the event of the enabled gateway becoming unavailable.

In the event of the enabled gateway failing ASX will enable the first available gateway in the sequence Primary-Secondary-Tertiary.

Primary and Secondary gateways are rapidly enabled; enablement of a Tertiary gateway will take longer.

2.1. Cancel on Disconnect

When a FIX OE connection is closed, any active orders marked as “*Cancel on Disconnect*” will be cancelled. The reason for the FIX connection being closed can include several scenarios: explicit logout by either client or exchange, network interruption, hardware/software failure.

2.2. Gateway Failure

In the case of an unexpected disconnection from the enabled gateway, participants should immediately attempt to reconnect using the following sequence:

- Attempt Primary
- Attempt Secondary
- Attempt Tertiary - collocated customers only



- Wait at least 5 seconds

Note that when connecting to newly enabled gateway, NextExpectedMsgSeqNum (789) must be specified on the Logon (A) message. See the FIX Order Entry guide for more details.

If connectivity cannot be re-established within 3 attempts per gateway (with at least 5 seconds between attempts), the ASX Customer Technical Support team (CTS) should be contacted for guidance.

2.3. Reconnection

If the underlying reason for needing to reconnect to the FIX gateway does not include a matching engine failure, the mechanism for reconnection follows normal FIX connection and message recovery procedures. These are described in the FIX protocol documents and ASX specific usage highlighted in the ASX FIX Order Entry specification.

These can be summarised as normal recovery mechanism: each side inspects the incoming MsgSeqNum (34) tag and requests any messages it has not seen. Each side must be able to resend messages the other requests. Alternatively, the initiator specifies NextExpectedMsgSeqNum (789) and the receiver checks against the last message it has sent and automatically resends missing messages.

Under certain circumstances, a newly enabled gateway may detect trading activity that occurred before it was enabled but it cannot determine if the client was sent FIX messages for the activity. These messages will be sent to the client as PossResend (97=Y) messages.

2.4. Failure of all FIX Order Entry Gateways

If all FIX OE gateways are unavailable, participants will be unable to access the New Trading Platform for order entry.

Such circumstances are likely to be indicative of a significant issue and may require ASX to undertake remedial technical and market control actions. Any such actions, and progress on resolution of the issue will be communicated via the ASX incident management process.

2.5. Recovery

In the event all FIX OE gateways failing, ASX will attempt, where circumstances permit, to recover Primary gateways before Secondary and Tertiary gateways. The circumstances of any particular incident may allow recovery with FIX sequence numbers being maintained or alternatively result in a sequence number reset to 1. ASX will communicate how the recovery will impact sequence numbering prior to reconnection.

ASX recommends that, on recovery, participants undertake:

- Reconcile their view of the order book with the ASX view by using the OrderMassStatusRequest (AF) message to return all active orders. This is sent on a FIX Order Entry connection.
- Reconcile their view of trades with that of the ASX by performing a TradeCaptureReportRequest (AD) message to return trades. This is sent on a FIX Drop Copy connection.



3. ASX FIX Market Data Gateways (concurrent service)

Each user will be permissioned to obtain market data from the New Trading Platform via one primary site gateway and one disaster recovery site FIX Market Data (FIX MD) gateway.

Primary site FIX MD gateways are located in the ALC. Disaster recovery site FIX MD gateways are located at the ASX Disaster Recovery site. For market data only, it is possible to be connected to the primary and disaster recovery sites at the same time. Note that due to differences in physical location and network access there will be differences in latency.

There is no replication between the FIX MD gateways. The FIX MD gateway model is designed to support intra-day connection and offers services to allow customers to establish the current market position through a combination of snapshot and subscription requests. Further details are provided in the ASX FIX Market Data Specification.

3.1. Primary Gateway failure

In the case of an unexpected disconnection from a primary site FIX MD gateway, participants should attempt to reconnect to the same primary site FIX MD gateway a maximum of 3 times with a gap of at least 5 seconds between each attempt. If the 3 attempts are unsuccessful, the participants should attempt to connect to the disaster recovery site FIX MD gateway.

A connection to the disaster recovery site FIX MD gateway should also be attempted a maximum of 3 times with a gap of at least 5 seconds between each attempt.

If connectivity cannot be re-established within 6 connection attempts (3 per gateway), CTS should be contacted for guidance.

3.2. Reconnection

On re-connection participants should follow their standard ASX FIX MD connection process.

3.3. Primary and Secondary Gateway Failure

If both primary and secondary FIX MD gateways are unavailable, participants will be unable to receive FIX market data from the New Trading Platform.

Such circumstances are likely to be indicative of a significant issue and may require ASX may undertake to take remedial technical and market control actions. Any such actions, and progress on resolution of the issue will be communicated via the ASX incident management process.

3.4. Recovery

ASX will attempt, where circumstances permit, to recover primary site FIX MD gateways before disaster recovery site gateways.

ASX recommends that, on recovery, participants:



- Re-subscribe to relevant messages using the “Snapshot + Subscribe” parameter.
- Re-subscribe to trades applying the last seen trade sequence number.

See ASX FIX Market Data specification for specifics of using these messages.



4. ASX Market Data Protocol Gateways (MDP)

Each user will be permissioned to obtain market data for the New Trading Platform from the primary and/or disaster recovery sites. Primary site MDP gateways are located in the ALC. Disaster recovery site MDP gateways are located at the ASX Disaster Recovery site.

There is no replication between the MDP gateways. The MDP gateway model is designed to support intra-day connection and offers services to allow customers to establish the current market position through a combination of snapshot and message recovery and real-time feeds. Further details are provided in the ASX Market Data Protocol Specification.

4.1. Redundant Concurrent Connections

Customers are advised to subscribe to both multicast feeds for a given site. The next expected sequence message is to be processed, with duplicates ignored. If a gap in sequence is detected, utilise the Blink service to fill in gap. In the event of a large gap, it may more efficient to re-establish the market picture by utilising Glance to get a snapshot of the current market.

4.2. Primary and Secondary Gateway failure

If both feeds for both sites are unavailable, participants will be unable to receive MDP market data from the New Trading Platform.

4.3. Recovery

ASX will attempt, where circumstances permit, to recover primary MDP gateways before secondary MDP gateways. ASX recommends that, on recovery, participants:

- Establish a real time connection and buffer, but not apply, messages.
- Glance to obtain a known order book state.
- Apply previously stored real-time messages until the current position is established (when the buffer is exhausted).
- If a gap exists between the last sequence number of the Glance snapshot and the first multicast sequence number issue a Blink request to request missing data.



5. ASX FIX Drop Copy Data Gateways (primary/secondary service)

Each user will be permissioned to obtain drop copy information from the New Trading Platform via one or primary and secondary FIX Market Drop Copy (FIX DC) gateways.

Primary FIX DC gateways are located in the ALC. Secondary FIX DC gateways are located at the ASX Disaster Recovery site.

5.1. Primary Gateway Failure

In the case of an unexpected disconnection from a primary FIX DC gateway, participants should attempt to reconnect to the same primary FIX DC gateway a maximum of 3 times with a gap of at least 5 seconds between each attempt. If the 3 re-attempts are unsuccessful, participants should attempt to connect to their secondary FIX DC gateways. Note that when connecting to the secondary server NextExpectedMsgSeqNum (789) **must** be specified on the Logon (A) message. See the FIX Drop Copy guide for more details.

Connection attempts to the secondary FIX DC gateway should also be attempted a maximum of 3 times with a gap of at least 5 seconds between each attempt.

If connectivity cannot be re-established within 6 connection attempts (3 per gateway), CTS should be contacted for guidance.

5.2. Reconnection

If the underlying reason for needing to reconnect to the FIX gateway does not include a matching engine failure, the mechanism for reconnection follows normal FIX connection and message recovery procedures.

These are described in the FIX protocol documents and ASX specific usage highlighted in the ASX FIX Drop Copy specification.

These can be summarised as normal recovery mechanism: each side inspects the incoming MsgSeqNum (34) tag and requests any messages it has not seen. Each side must be able to resend messages the other requests. Alternatively, the initiator specifies NextExpectedMsgSeqNum (789) and the receiver checks against the last message it has sent and automatically resends missing messages.

5.3. Primary and Secondary Gateway failure

If both primary and secondary FIX DC gateways are unavailable, participants will be unable to receive drop copy information from the New Trading Platform.

Such circumstances are likely to be indicative of a significant issue and may require ASX may undertake to take remedial technical and market control actions. Any such actions, and progress on resolution of the issue will be communicated via the ASX incident management process.

5.4. Recovery

ASX will attempt, where circumstances permit, to recover primary FIX DC gateways before secondary FIX DC gateways. The circumstances of any particular incident may allow recovery with FIX sequence numbers being



maintained or alternatively result in a sequence number reset to 1. ASX will communicate how the recovery will impact sequence numbering prior to reconnection.

ASX recommends that, on recovery, participants follow their normal FIX DC connection process.



6. Other Components

The New Trading Platform consists of a number of components. The failure model for individual components may vary. The following situations may occur in the event of component failure:

- A temporary increase in message latency, potentially including a brief pause in message flow, as a primary process fails to its secondary.
- A change in session state to a closed trading status that will prevent order entry.

ASX may undertake various remedial technical and market control actions as the circumstances of the incident require. Any such actions, and progress on resolution of the issue will be communicated via the ASX incident management process.

6.1. Primary Matching Engine Failure

ASX operates synchronous hot standby matching engines in the primary site and asynchronous warm standby (emergency) matching engine in the disaster recovery site.

In the event of the failure of a primary matching engine, the hot standby matching engine will be automatically promoted to primary status.

6.1.1. FIX Order Entry Gateways

There are three possible outcomes to messages sent to the FIX server during a matching engine failover:

1. A response is sent after a higher than normal delay – increased latency.
2. A reject is sent.
3. No response is sent.

Rejects are sent to the following messages:

Message	Reject message type and key fields
NewOrderSingle (D)	35=8 39=8 150=8 103=0 58=Running servers are not yet active for partition <MatchingEngine1>
OrderCancelRequest (F)	35=9 39=<current order status> 102=2 58=Running servers are not yet active for partition <MatchingEngine1>
OrderCancelReplaceRequest (G)	35=9 39=<current order status> 102=2 58=Running servers are not yet active for <partition MatchingEngine1>
QuoteRequest (R)	35=AG 35=9 39=<current order status> 102=2 58=Running servers are not yet active for partition <MatchingEngine1>

In the event of no response being sent to a message, the client can resend the message with PossResend=true (97=Y). Additional validation will be performed to avoid duplicates being created.



6.2. Double Matching Engine failure

In the event of a double failure where the promoted hot standby matching engine fails, the emergency matching engine will be promoted. Due to the asynchronous replication of the Primary and Emergency matching engines, there can be circumstances where messages in flight at the time of failover may not be known by the emergency ME. The matching engine notifies all gateways of its current positions and the gateways take remedial action as described below.

As the emergency matching engine is brought on line, order books will be placed in a halted state and transition through the relevant states to move them to open, depending on the state they were at the point of the matching engine failure. For example, an order book that is open may go to closed, maintenance, and then pre-open. These state changes may happen in close succession. Any actions that would typically happen during these states would be taken out at that point. For example, expired orders in an order book are cleared during the close state. In addition, orders in any multi-leg order books, e.g. spreads, will be cancelled as a result of the leg order books being placed in halt.

6.2.1. FIX Order Entry gateways

All orders and quotes that the gateway has processed but that were not received by the emergency matching engine before it was promoted **will be cancelled**. Any necessary adjustments to trades will be notified separately by ASX.

Orders processed by the FIX server will be cancelled, if:

- The order was modified, but the modification was not replicated to the emergency matching engine.
- The order was partially or fully filled, but the trade was not replicated to the emergency matching engine.
- The order is a Shared Order Group (SOG) order with one or more FIX users in the SOG group and one of the above actions has occurred.

SOG orders are cancelled by the FIX servers using one of the users in the SOG. This may result in a change of the Party Role of Entering Trader (452=36) to a different user than the one that last touched the order.

To communicate these changes, the following table details the message type and key fields sent for each scenario.

Scenario	Messages sent (key fields only)
New Order placed on original ME, not received by emergency ME.	35=8 39=4 150=4 58=Order is CANCELED due to ReverseHandling for ME partition <partition number>
Emergency matching engine knows of original order, but not the amendment message sent by client	35=8 39=4 150=4
Emergency matching engine knows of original order, but not the trade message sent to the client	35=8 39=4 150=4



Emergency matching engine knows of original order, but not the cancellation message sent by client	35=8 39=4 150=4
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Emergency matching engine knows of original order, but not the fill sent by ME

6.2.2. FIX Market Data Gateways

All FIX MD gateways will automatically shut down and be restarted by ASX. All FIX sessions will disconnect during the shutdown when the emergency Matching Engine (ME) is promoted. Until the emergency ME is promoted, messages may be received, even if the primary ME is down or not fully operational. When the gateway has restarted, participants should follow their normal connection procedure and establish a current view of market data.

6.2.3. ASX Market Data Protocol Gateways

All ASX Market Data Protocol services (multicast, Glance and Blink) will be shut down and restarted. A new session ID will be established on start up.

Packets on the ASX MDP multicast will contain a new session ID. This indicates the ITCH client should re-establish a new market picture utilising Glance and verify the sequence number in the login accept packet against the current MoldUDP64 session sequence number.

ASX recommends that, on recovery, participants:

- Establish a real time connection and buffer, but not apply, messages.
- Glance to obtain a known order book state.
- Apply previously stored real-time messages until the current position is established (when the buffer is exhausted).
- If a gap exists between the last sequence number of the Glance snapshot and the first multicast sequence number issue a Blink request to request missing data.

6.2.4. FIX Drop Copy Gateways

The FIX DC gateways will issue cancellation messages for all orders and quotes that the gateway has processed but that were not received by emergency matching engine before it was promoted. Any necessary adjustments to trades will be notified separately by ASX. To communicate these changes the following table details the messages type and key fields sent for each scenario.

Scenario	Messages sent; key fields only
New Order placed on original ME, not received by emergency ME.	35=8 39=4 150=4 58=Order is CANCELED due to ReverseHandling for ME partition <partition number>



Scenario	Messages sent; key fields only
Emergency matching engine knows of original order, but not the amendment message sent by client	35=8 39=<order status> 150=D 378=8 58=Order is RESTATED due to ReverseHandling for ME partition <partition number> If order entered or disseminated by FIX Order entry Gateway 35=8 39=4 150=4
Emergency matching engine knows of original order, but not the trade message sent to the client	35=8 39=<order status> 150=D 378=8 58=Order is RESTATED due to ReverseHandling for ME partition <partition number> If order entered or disseminated by FIX Order entry Gateway 35=8 39=4 150=4
Emergency matching engine knows of original order, but not the cancellation message sent by client	35=8 39=<order status> 150=D 378=8 58=Order is RESTATED due to ReverseHandling for ME partition <partition number> If order entered or disseminated by FIX Order entry Gateway 35=8 39=4 150=4
Emergency matching engine knows of original order, but not the fill sent by ME	35=8 39=<order status> 150=D 378=8 58=Order is RESTATED due to ReverseHandling for ME partition <partition number> If order entered or disseminated by FIX Order entry Gateway 35=8 39=4 150=4

6.2.5. Recovery

ASX recommends that, on recovery, participants undertake:

- Reconcile their view of the order book with the ASX view by using the OrderMassStatusRequest (AF) message to return all active orders. This is sent on a FIX Order Entry connection.
- Reconcile their view of trades with that of the ASX by performing a TradeCaptureReportRequest (AD) message to return trades. This is sent on a FIX Drop Copy connection.



7. Loss of Primary Site

The New Trading Platform Disaster Recovery site operates in asynchronous warm standby mode.

In the event of total loss of the primary site, ASX will activate the ASX Disaster Recovery site. Communication about the open and pre-open times will be advised.

Once the disaster recovery site is active, ASX will request participants connect to their designated gateways at the Disaster Recovery site.

FIX sequence numbers will not be reset but may have changed if messages have been lost.



8. Customer Infrastructure Failure

Please note that User IDs are Customer site specific. Participants are advised that in order to achieve full redundancy in the event of a failure of their connecting infrastructure (primary), a second set of users is required to connect to the ASX NTP Gateways for both Order Entry and Market Data Protocols.

Shared Order Group (SOG) functionality can be used here to ensure that working orders can be acted upon in the event of Customer site or Customer equipment failure. This requires both sets of users to be part of the same Shared Order Group.



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