



Market Management Consultation 3:

ASX Testing Uplift, Environments and BCP

28 February 2023

Invitation to comment

ASX is seeking submissions on aspects of ASX’s BCP and testing approach.

Submissions due by **Friday 14**

April 2023 by email to:

consultations@asx.com.au

or by mail to:

ASX Limited

PO Box H224

Australia Square NSW 1215

Attention: ASX Consultations

ASX would prefer to receive written submissions in electronic form. If you would like to meet and discuss the consultation paper please call:

Ben Jackson on +61 2 9227 0897

Rob Nash on +61 2 9227 0032.

If you would like your submission, or any part of it, to be treated as confidential, please indicate this clearly in your submission. ASX reserves the right to publish the non-confidential submissions it receives and consider publishing those submissions in whole or on a summary basis. Where a submission, or part thereof, is marked confidential ASX will consider publishing the content on a summarised and anonymous basis. Where ASX is required by a regulator or otherwise required by law to produce a submission it has received, ASX will use its best endeavours to advise the submitter ahead of the production of the submission.

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Contents

1. Introduction	3
1.1 Background	3
1.2 ASX’s consultation approach	3
1.3 ASX’s third market consultation	3
1.4 Stakeholders invited to comment	4
1.5 Due date for responses to this consultation paper	4
1.6 Summary of Consultation 3	5
2. Enhancements to ASX Platform Test Strategy	8
2.1 Background	8
2.2 Business Objectives—QE&T	8
2.3 ASX Trade Test Strategy—Enhancements	8
3. Simulation Testing with Market Participants	11
3.1 Background	11
3.2 Business Objectives	11
3.3 Industry Wide Testing (IWT) Scenarios.....	12
3.4 Production-like Order Flow	12
3.5 Attendance and Readiness Attestation	12
4. Market Operators’ Interconnectedness	13
4.1 Background	13
4.2 Business Objectives	13
5. Improvements to BCP Strategy	15
5.1 Background	15
5.2 Business Objectives	15
5.3 International Exchange Comparison	15
5.4 Frequency of BCP Testing.....	16
5.5 Network Site Failover	16
5.6 CANCEL_ONLY, Order and Trade Download Services.....	19
5.7 Participation and Attestation	19
5.8 Performance Testing during BCP	19
6. Customer Test Environments	20
6.1 Background	20
6.2 Business Objectives	20
6.3 International Exchange Comparison	21
6.4 Customer Development Environments	21
6.5 Performance and Load Testing Requirements	21
Annexure A – International Exchange Comparison Matrix	23
Annexure B – Consultation Questions	27
Annexure C – Consultation Context	28
Annexure D – Glossary	29

1. Introduction

1.1 Background

This consultation is the third of three consultations ASX Limited (**ASX**) is undertaking as ASX implements its response to ASIC's Expectations of Market Operators set out in ASIC's Report 708¹.

Further context for this sequence of consultations was set out in section 1 of ASX's first Market Management Consultation published on 28 June 2022² (**Consultation 1**), adapted extracts from which are included as Annexure C.

Throughout this document, text in *italics* is verbatim from the sections of REP 708 that relate to ASIC's Expectations.

1.2 ASX's consultation approach

The timeline for ASX's intended three consultations to meet a number of ASIC's Expectations is:

- **28 June 2022: Consultation 1** which broadly assessed the current position and considers refinements and improvements based on current capabilities. The period for comment on this consultation closed on 23 August 2022 and ASX response was published on 19 October 2022.
- **31 October 2022: second Market Management Consultation (Consultation 2)** which incorporated feedback from Consultation 1 and considered improvements based on potential future capabilities. The period for comment on this consultation closed on 9 December 2022 and ASX response was published on 31 January 2023.
- **28 February 2023: testing consultation, (this consultation, Consultation 3)** covers potential improvements to Participant testing and incorporates agreed changes arising from Consultation 1 and Consultation 2. The period for comment will run until 14 April 2023.

1.3 ASX's third market consultation

The commentary in this consultation paper has been divided into sections addressing different topics:

- Section 2: Enhancements to ASX Platform Test Strategy
- Section 3: Simulation Testing with Market Participants
- Section 4: Market Operators' Interconnectedness
- Section 5: Improvements to BCP Strategy
- Section 6: Customer Testing and Environments

The first part of each section is a brief introduction to the topic.

This is followed by a statement of the business objective(s) of the proposal(s). Subsequent subsections discuss different issues relevant to the topic and typically contain more detailed technical information.

ASX is not providing final detail of changes to DR (Disaster Recovery) / BCP (Business Continuity Plan) testing (hereafter, BCP testing) and external test environments. Rather, ASX is seeking to provide sufficient business and technical detail to allow stakeholders to assess the technical and operational impact, business value and overall viability of each of the proposals. For our own benchmarking and market stakeholders' consideration, ASX has prepared an international peer comparison in areas of BCP testing and test environments. In short, there seems to be no global industry standard,

¹ <https://asic.gov.au/regulatory-resources/find-a-document/reports/rep-708-asic-s-expectations-for-industry-in-responding-to-a-market-outage/>

² <https://www2.asx.com.au/content/dam/asx/about/regulations/public-consultations/2022/market-management-consultation-28062022.pdf>

acknowledging of course the varying technical and regulatory nuances in each relevant jurisdiction. The information contained in Annexure A is also publicly available for your further consideration and analysis.

Proposals which market stakeholder feedback suggests have an acceptable impact, deliver meaningful value and are broadly deemed viable will be considered candidates for implementation.

The consultation questions are set out in orange boxes throughout the paper. For your convenience, ASX has also collated them together in Annexure B of this consultation paper.

1.4 Stakeholders invited to comment

ASX welcomes feedback to this consultation paper from all interested stakeholders. ASX is particularly keen to receive feedback from:

- ASX Participants or subscribers (collectively “customers”)
- relevant vendors of customers
- retail and wholesale investors
- industry bodies representing the groups above
- other Market Operators

This consultation covers proposals which necessarily require some detailed discussion of a technical nature. ASX expects such technical detail will be most relevant to ASX Participants and ASX subscribers; the business objectives of each proposal may be more relevant to a wider group of stakeholders. Stakeholders should feel free to limit their responses to those parts of the consultation paper and the consultation questions that are of particular interest to them.

1.5 Due date for responses to this consultation paper

Stakeholders interested in making a submission to this consultation are asked to do so in writing by the **close of business on Friday 14 April 2023** by:

- email to:
consultations@asx.com.au
- mail to:
ASX Limited
PO Box H224
Australia Square NSW 1215
Attention: ASX Consultations

ASX would prefer to receive written submissions in electronic form. If you would like to meet and discuss the consultation paper please call Ben Jackson on +61 2 9227 0897 or Rob Nash on +61 2 9227 0032.

If you would like your submission, or any part of it, to be treated as confidential, please indicate this clearly in your submission. ASX reserves the right to publish the non-confidential submissions it receives and consider publishing those submissions in whole or on a summary basis. Where a submission, or part thereof, is marked confidential ASX will consider publishing the content on a summarised and anonymous basis. Where ASX is required by a regulator or otherwise required by law to produce a submission it has received, ASX will use its best endeavours to advise the submitter ahead of the production of the submission.

1.6 Summary of Consultation 3

This section outlines a summary of the five topics discussed in this consultation paper:

ENHANCEMENTS TO ASX PLATFORM TEST STRATEGY (ASIC'S EXPECTATION 7)	
Summary of Actions <ul style="list-style-type: none"> - Implement an uplift of Testing and Quality Assurance at ASX, transforming to a Quality Engineering and Testing (QE&T) capability. - Enhance the ASX Trade Platform Test Strategy by aligning to ASX's QE&T practice, applying a standardised risk-based test approach to all changes and releases, and utilising specialised independent third parties to provide and execute an autonomous approach to validate the release. - Specific adaptation to test planning and execution to allow for the complexity of the trading platform. <p>Refer to Section 2</p>	Potential Benefits <ul style="list-style-type: none"> - Uplift and contemporising existing Testing and Quality Assurance policy, processes and procedures. - Embedding a mature risk based approach to testing. - Supporting all quality engineering practices with required capabilities, skills and tooling. - Introducing a strong Quality Engineering (QE) governance framework, underpinned by continuous improvement, independent assurance and specialist review. - Ability to replay production scenarios to test all new releases and be used prior to and in preparation for IWT events.

SIMULATION TESTING WITH MARKET PARTICIPANTS (ASIC'S EXPECTATION 7)	
Proposal <ul style="list-style-type: none"> - ASX will continue to offer pre-production environments over multiple weekends prior to major ASX Trade upgrades. - During Industry Wide Testing (IWT) events, ASX will include: single component failures; network infrastructure failures; site failover /recovery events; closing events; and other session state changes. ASX will strongly encourage and require all market stakeholders, in accordance with their obligations under the MIRs (where applicable) to: 	Potential Benefits <ul style="list-style-type: none"> - ASX and ASX Participants will have confidence ahead of major equity market system changes.

SIMULATION TESTING WITH MARKET PARTICIPANTS

(ASIC'S EXPECTATION 7)

- participate
 - attend a minimum number of IWTs within a time period
 - enter production-like order flow
 - provide an attestation to their readiness, signed by both business and technical representatives.
- ASX will create a basic background load to ensure connected clients receive market data.
 - Simulation testing will be performed with usual order book activity.

[See Section 3](#)

MARKET OPERATORS' INTERCONNECTEDNESS

(ASIC'S EXPECTATION 7)

Summary of Actions

- ASX will continue to support the market and the interconnectedness to other relevant Approved Market Operators (**AMOs**) when they perform major changes by:
 - making the ASX production environment available over multiple weekends to market stakeholders
 - performing component failures
 - performing network infrastructure failures
 - creating a minimal background load to ensure connected clients receive at least some market data and broadcasts
 - testing all data flows to be working as expected under normal and failure conditions.

[See Section 4](#)

Potential Benefits

- Collaborating with AMOs, and working closely and constructively with one another whenever a new trading system or other major upgrade is implemented, will help ensure all relevant connections operate as expected on an end-to-end basis.

IMPROVEMENTS TO BCP STRATEGY (ASIC'S EXPECTATION 8)	
<p>Proposal</p> <ul style="list-style-type: none"> - ASX proposes to increase the number of BCP events to a minimum of two per year - ASX will strongly encourage Participants, in accordance with their obligations under the MIRs, to conduct performance validation testing of their normal business activities - Enhancements to ASX's BCP testing strategy to incorporate: <ul style="list-style-type: none"> o site based failover outage scenarios that include the new CANCEL_ONLY session state, testing of the new Order and Trade Download Services, increased participation and activity for all customer types encouraging customer attendance and performance testing o introduction of process requiring customers to attest their BCP test activity <p>See Section 5</p>	<p>Potential Benefits</p> <ul style="list-style-type: none"> - Enable Participants to develop test cases to practice recovery strategies, or switching to alternative arrangements for critical dependencies

CUSTOMER TEST ENVIRONMENTS (IBM RECOMMENDATIONS, IBM-R 6.4.2)	
<p>Content</p> <ul style="list-style-type: none"> - Explanation and description of the Customer Development Environments and test opportunities offered by ASX. - Investigate and determine any gaps or potential improvements to the current offering. - Assess if there is value or drivers for building a dedicated performance test environment. <p>See Section 6</p>	<p>Potential Benefits</p> <ul style="list-style-type: none"> - To maximise functions and availability of testing environments for better quality testing by Market Stakeholders, balancing industry-wide costs and benefits. <p>Potential Limitations</p> <ul style="list-style-type: none"> - Designated weekends available for production testing environment.

2. Enhancements to ASX Platform Test Strategy

2.1 Background

ASIC'S REP 708 Expectation 7 states that:

“Market operators need to have a comprehensive test strategy that includes a wide coverage of the system (functional, non-functional and operational aspects) and data.”

“Regression testing should be conducted across the entire suite of test scenarios to demonstrate that any changes will not introduce defects.”

IBM was engaged to provide an independent expert review of the conduct and performance of the ASX Trade refresh project as a result of the 16 November 2020 market outage. ASX, in agreement with ASIC and the Reserve Bank of Australia (RBA), committed to implement a set of recommendations, some of which relate to testing.

Prior to receiving the IBM recommendations, and in the context of the Delivery Excellence³ initiative, ASX had also completed two external reviews by independent consulting firms of its testing and QA capabilities in terms of test strategy, test planning, test governance and risk-based testing approach.

Following the consolidation of these inputs, a set of objectives and associated recommendations were created to shape a multi-year delivery plan under Delivery Excellence for implementing a capability uplift of Testing and Quality Assurance at ASX, **transforming to a Quality Engineering and Testing (QE&T) capability.**

The enhancements outlined above aim to achieve a “measured” maturity (i.e., highest possible maturity rating) by delivering the IBM recommendations and establishing the foundations for continuous improvement.

2.2 Business Objectives—QE&T

- Uplifting and contemporising existing Testing and Quality Assurance policy, processes and procedures, aligned to the wider ASX Software Development Lifecycle (SDLC) and delivery practices.
- Embedding a mature risk-based approach to testing.
- Supporting all quality engineering practices with required capabilities, skills and tooling.
- Introducing a strong Quality Engineering (QE) governance framework, underpinned by continuous improvement, independent assurance and specialist review.

2.3 ASX Trade Test Strategy—Enhancements

The new ASX Trade Test Strategy serves as a single source of truth for understanding how testing will be managed and executed across all ASX Trade Platform releases. There are a number of key enhancements that have been implemented within the ASX Trade Platform Test Strategy, as follows:

³ ASX is implementing a multi-year program titled **Delivery Excellence**. The aim of Delivery Excellence is to substantially improve the way ASX designs, builds, tests, implements and governs small and large change to ensure alignment with industry standards and quality

- Alignment to ASX’s QE&T practice, who are responsible for designing and implementing the framework and enabling capabilities for quality engineering and testing at ASX. This includes standardising and adoption of the following processes and test artefacts:
 - Test Methodology
 - Test Levels and Test Types
 - Test Automation (including Regression Testing)
 - Test Estimation Techniques
 - Defect Management Process
 - Test Status Reporting
 - Quality Metrics Framework.



Fig. 1: ASX Trade Test Strategy Uplift

- Application of a standardised test approach. For example, Risk Based Testing (**RBT**) to all changes and releases on the ASX Trade Platform. RBT describes a method for producing testing scopes which contain an appropriate level of testing for changes relative to their inherent risk of defect leakage into production. The introduction of RBT allows for a more consistent way of assessing test scope, impacts and risks to software testing and provides the following benefits:
 - Better accuracy in test estimation and planning
 - Improved product and process quality
 - Better testing effort/value ratio
 - Increased number of data points captured to feedback into continuous improvement process

- Clearer accountabilities within the testing lifecycle.
- For releases identified as a high risk across the ASX Trade Platform, ASX markets will engage specialised, 'independent third parties' to:
 - provide and execute an autonomous approach to validate the release
 - conduct an assessment on the Test Strategy and Test Approach implemented, ensuring alignment with the ASX Test Policy and ISO 29119 standards.
- Alignment to trading platform nuances covering the following areas for test planning and execution:
 - Test Architecture—the ASX Trade Platform is extremely complex and as such lends itself to unique test requirements.
 - Test Tools—a range of bespoke tools are utilised to validate a release.
 - Release Types—Five possible release types are applicable for the Platform (i.e. service releases/major upgrades, maintenance release, single subsystem release, patch releases and emergency release).
 - Test Environment—Fully integrated environments are required to perform end to end testing for a release.
 - Test Data—Requirement for production data (e.g., market reference data) to test with greater confidence.
- To simulate as close to real production scenarios as possible during internal testing, ASX has engaged and is working with a third party vendor to develop a 'Market Replay Tool' that will:
 - Act as real production participants and users and execute scenarios recorded from their actual production activity across all protocols
 - Aim to be as deterministic as possible when replaying data so that comparison of outputs can be used to identify anomalies or differences between minor and major releases
 - Provide a replay capability will allow ASX to apply an extra layer of testing in addition to dedicated functional and non-functional testing
 - Test all new releases and be used prior to and in preparation for IWT events.

N.B. Section 2.1-2.3 above is for information purposes only and does not require any consultation response from the market

3. Simulation Testing with Market Participants

3.1 Background

ASIC REP 708 Expectation 7 states that:

“Market operators should conduct simulation testing with participants and other market operators to simulate scenarios with their usual order book activities ahead of major equity market system changes.”

As standard practice, ASX provides access to the pre-production⁴ environment before the go-live of major platform changes. The environment is open to all market stakeholders⁵ and available for IWT over multiple weekends.

As noted in past ASX IWT technical updates⁶, ASX requests that all Participants attend and attest readiness. ASX strongly encourages production-like order book activity. ASX’s expectation of production-like activity is for all market stakeholders to perform order entry, modification, cancellation, and all other activity that would ordinarily occur during a typical business trading day and which are appropriate to the nature, scale and complexity of the production-like activity. This includes interaction with order books and depth within those order books.

ASX recognises the importance of AMOs actively participating and testing during these IWT weekends, due to the interconnectedness of the markets. For instance, in readiness for the go-live of the new trading platform of Cboe Australia (**CXA**) in March 2023, ASX participated in all IWTs, two internal only connectivity checks and seven externally with customers.

Historically, ASX has observed that Participants and vendors have primarily utilised IWT opportunities to complete connectivity tests, query the system and create limited order flows. Participants have typically not created production-like order flow during these IWT (and BCP) test events. ASX has created order flow to generate market data, and simulated market events such as the closing auctions sequence and regulatory halts in order facilitate a functional and reliable testing environment.

In addition, ASX records confirm that not all market stakeholder have all their applications connected during these events. Accordingly, active and meaningful stakeholder engagement during these events will be a major directive for ASX in future IWT weekends and BCPs.

3.2 Business Objectives

During major ASX Trade changes, ASX will:

- make the pre-production environment available over multiple weekends
- perform various scenarios, including
 - single component⁷ failures
 - network infrastructure failures
 - site failover and recovery events on specified IWTs
 - introduce scenarios and timed events

⁴ Typically a greenfield trading platform where the hardware, software and network components are new and separate from current production.

⁵ Participants, vendors, Approved Market Operators (AMOs) and ASIC.

⁶ <https://www2.asx.com.au/markets/trade-our-cash-market/asx-equities-trading/asx-trade-technical-updates> (ASX Trade Refresh Updates > 21 Oct 2020, p.3).

⁷ a single process or subsystem that performs a specific function within the trading platform e.g. matching engine partition 1, ITCH feed A.

- request Participants to use this opportunity to enter production-like order flow
- create a basic background load to ensure connected clients receive market data
- simulate closing auction events and regulatory halts
- encourage AMOs and ASIC to participate
- require Participants to attend a minimum number of IWT, and at least one DR IWT
- require market stakeholders' attestation on readiness.

3.3 Industry Wide Testing (IWT) Scenarios

ASX will be enhancing IWT scenarios and the requirements of stakeholders' interactivity during IWT events. ASX will be more prescriptive of what activities stakeholders must perform based on their normal production activities at set times throughout the event e.g., enter and respond to quote requests, enter orders into specific symbols for an auction event

3.4 Production-like Order Flow

ASX appreciates that market stakeholders may find it challenging to create or simulate production order flow in the absence of a fully operational market and all the components that make up that market. ASX also recognises that not all customer systems are connected to exchanges on an IWT weekend, as it adds risk to the next business day, and the clean-up to downstream systems is challenging. Whilst ASX will continue to generate order book activity during IWT simulation testing, and will explore how this activity can be extended, the expectation is that Participants endeavour to generate as close to possible to their usual production profile. This level of participation helps ensure that the simulated scenarios are as realistic as possible.

3.5 Attendance and Readiness Attestation

The number and scope of IWTs leading up to an upgrade or new release can vary relative to the scale and complexity of the changes being implemented. In addition to ASIC's Expectation 13, ASX expects that all market stakeholders that would normally connect to the production system will participate in IWT to ensure readiness of their applications and completion of tests in the production environment.

ASX will require market stakeholders to attest that they have completed all testing successfully in IWT. The scope of the attestation should cover connectivity, execution of production-like messaging and readiness. Depending on the type of changes, ASX may also require additional attestation, specifically around any new functionality or infrastructure being introduced.

Question 3.1: Do you require ASX to extend order book activity during IWT, to help Participants simulate scenarios with their production-like order profile? Describe what type of activity would assist you and any challenges and/or opportunities you see with this proposal?

Question 3.2: Describe your current capabilities or challenges you have in generating order activity that is representative of your typical production order profile flow during IWT? Are you able to generate activity that is in reaction to broadcasted changes in market data?

Question 3.3: What opportunities and/or challenges do you see arising from ASX running more prescriptive IWTs that also require attestation?

Question 3.4: Describe your capabilities or challenges you may have ensuring all your production applications are logged in during IWTs?

4. Market Operators' Interconnectedness

4.1 Background

ASIC REP 708 Expectation 7 states that:

“Given the interconnectedness of market infrastructure, market operators must work closely and constructively with one another whenever a new trading system or other major upgrade is implemented and make every effort to ensure that all relevant connections operate as expected on an end-to-end basis.”

During major ASX Trade changes, including the last ASX Trade major upgrade in November 2020:

- ASX makes the pre-production environment available over multiple weekends to all market stakeholders
- ASX requests AMOs' participation.

During the ASX Trade Upgrade go-live in November 2020, ASX identified an issue with an interface that consumes external AMO orders and injects the external best bid and offer (**eBBO**) into ASX Trade. The interface had stalled and was unable to maintain a stable eBBO feed. A consequence of the eBBO feed failure was that CXA prices that had previously been used to calculate the 'national best bid and offer' (**NBBO**) were not being refreshed, and as such had become 'stale'. In accordance with our FOT obligations, ASX was required to force a removal of all CXA prices from the NBBO within ASX Trade. The impact being that the ASX BBO (best bid and offer) was being used for Centre Point executions and NX Trade Report validations instead of the NBBO as required by the MIRs. ASX subsequently made the decision to disable the following day.

The applications and infrastructure to calculate the NBBO is a good example of the interconnectedness between market operators. Constructive engagement in meaningful and productive activities by AMOs, whenever a new trading system or other major upgrade is implemented, will help ensure that all relevant connections operate as expected on an end-to-end basis and under failure scenarios.

4.2 Business Objectives

ASX actively engaged CXA during the CXA Migration project development stages throughout 2022 and 2023, and participated in all nine IWTs. The first two were internal ASX-only tests, and all advertised IWT test weekends saw the ASX Trade production environment made available to all market stakeholders.

ASX and CXA connected all inter-AMO systems, verified all flows and conducted failure scenarios of those systems. Participants were connected during testing and experienced no interruption to regulatory halts or NBBO functionality utilised for Centre Point executions and NX trade report validations.

When another AMO performs major changes, ASX-operated exchanges will continue to support the market and the relevant AMO by:

- making the production environment available over multiple weekends to market stakeholders
- endeavour to perform component failures related to interconnectedness to other AMOs
- endeavour to perform network infrastructure failures related to interconnectedness to other AMOs
- creating background load to ensure ASX Trade customers receive market data and broadcasts
- testing all data flows⁸ between AMOs to be working as expected under normal and failure conditions.

N.B. This scope only applies to the market data flows between the ASX market and other AMOs. This paper is issued by ASX Limited and deals only with ASX's market. It does not deal with post trade aspects provided across AMOs by other ASX entities (including under the Trade Acceptance Service provided to AMOs by ASX Clear and ASX Settlement).

It is anticipated that prior to the next ASX Trade major release, the functionality included in Consultation 2 will be in operation. ASX will need to prove failure scenarios involving ASX Trade experiencing an outage, allowing Participants to confirm their playbooks to re-direct order flow to alternative markets.

Question 4.1: What benefits do you see in having AMOs participating in IWTs and BCPs?

⁸ External best bid or offer (eBBO) from CXA for the purpose of NBBO calculations, Market Announcement Platform (MAP), Surveillance (SMARTS), Regulatory Halt (HOWARD), Warrant maintenance (WMI).

5. Improvements to BCP Strategy

5.1 Background

ASIC's Expectation 8 states that:

"AMOs should facilitate testing of simulated market outage events during business continuity plan testing to enable participants to develop test cases to practice recovery strategies or switching to alternative arrangements for critical dependencies".

"Recovery strategies or alternative arrangements for identified critical dependencies should be exercised (or, where appropriate, tested) as part of or in addition to standard business continuity plan exercises and tests".

As outlined in Consultation 1, ASX is consulting with customers around a proposed uplift in the ASX BCP testing strategy. The intention is to incorporate more simulated market outage scenarios which will enable customers to develop more comprehensive test cases to practice their recovery strategies. These strategies may include alternate trading arrangements where the ASX market is unavailable.

5.2 Business Objectives

The objective of this consultation paper and proposal, is to uplift ASX's BCP testing strategy so that:

- a site-based failover is incorporated into BCP testing weekend
- outage scenarios incorporating the new CANCEL_ONLY session state are included
- the new Order and Trade Download Services are made available for Participant playbook verification
- participation and activity for all customer types is increased
- introduce a new process requiring customers to attest around their BCP test activity
- customers are able to conduct performance testing on BCP test weekends
- customers are expected to simulate production-like order activities that are representative of their typical order flow on BCP test days. ASX will be monitoring and provide a reporting summary for the regulator if requested.

5.3 International Exchange Comparison

ASX has conducted an international comparison study between global exchanges to determine what is currently offered to customers for BCP testing, highlighting the following key findings:

- **BCP/ DR Frequency:** A wide range from **compulsory test twice a year and two days of live trading from DR** (NSE India), **compulsory for selected Participants once a year** (US exchanges), to **voluntary once a year** (TSX, HKEX).

For additional details refer to Annexure A, p.23-26.

5.4 Frequency of BCP Testing

Historically, ASX has offered one BCP test day per year on ASX Trade outside of any major release implementations. ASX proposes to increase this number to a minimum of two per year. The increase in frequency will allow more opportunities for:

- simulation of a range of failure scenarios
- customers, ASX and AMOs to test these scenarios in the production environment
- customers and ASX to apply and test improvements based on findings from previous BCP events
- customers' and ASX's operations teams to execute and refine their incident playbooks
- customers, ASX and AMOs to note any observed problems or weaknesses in staff execution of the BCP⁹.

5.5 Network Site Failover

Prior to this consultation, ASX Trade BCP test weekends have consisted mainly of process-level failover, some of which are visible to customers and others which are not. ASX proposes that for future BCP test days, a full site failover is incorporated to prove that market stakeholders can access SDC gateway services, as prescribed under the following scenarios:

⁹ Requirement per ASIC RG 265.673

BCP Scenario 1

- ASX will simulate failures of the ALC trading environment. Customers will need to connect to ASX's SDC redundant trading gateway services via their existing network connections in colocation and/or ASX Net.
- Colocation customers will not have access to colocation gateway services in ALC, the matching engine, backend processes and gateway services at ALC will be failed over to SDC. Colocation customers will have a network path to SDC gateway services.
- ASX Net customers will be required to use the SDC ports advertised in the connectivity guide.

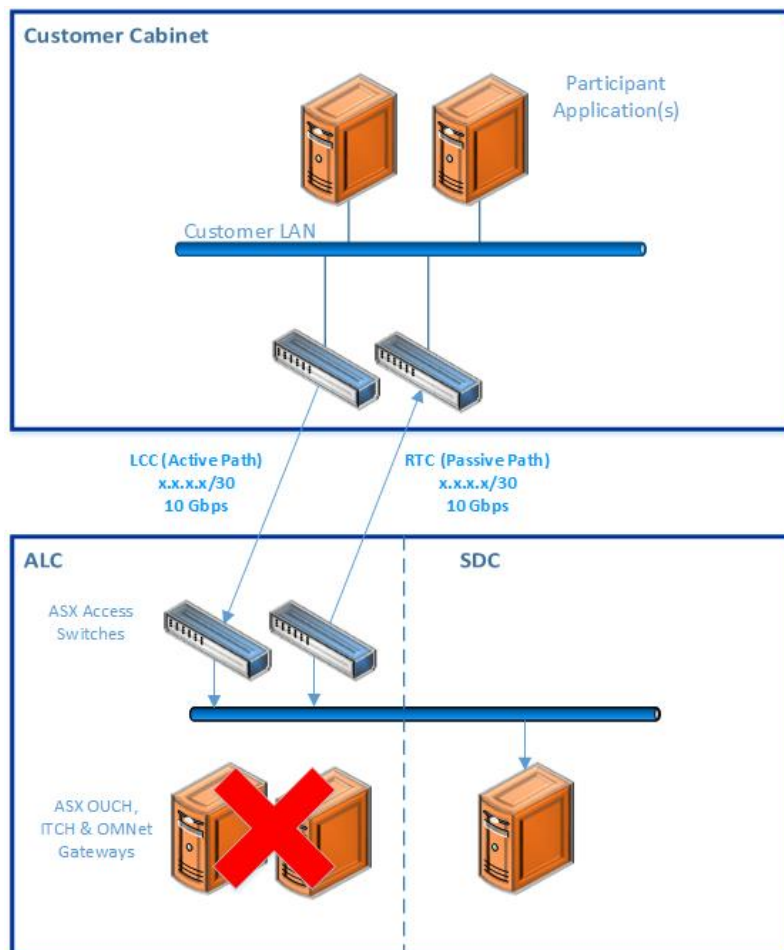


Fig 2: BCP Scenario 1 - conducting an application site-failover event where the trading platform is running at SDC entirely, that does not impact customers within ALC.

BCP Scenario 2

- ASX will simulate a network failure of the customer network at ALC, creating a total loss of access of the ALC trading environment and the colocation network path from ALC to SDC.
- Customer colocation racks, including power, and customers own network connectivity arrangements will remain unaffected.
- Colocation customers will not be able to access either ALC or SDC gateway services within ASX ALC. Therefore, customers can only access SDC gateway services via their ASX Net site(s).
- The intention of this test is for customers to validate that their trading systems can connect to ASX's SDC trading environment via their own alternate disaster recovery sites, utilising ASX Net connectivity.

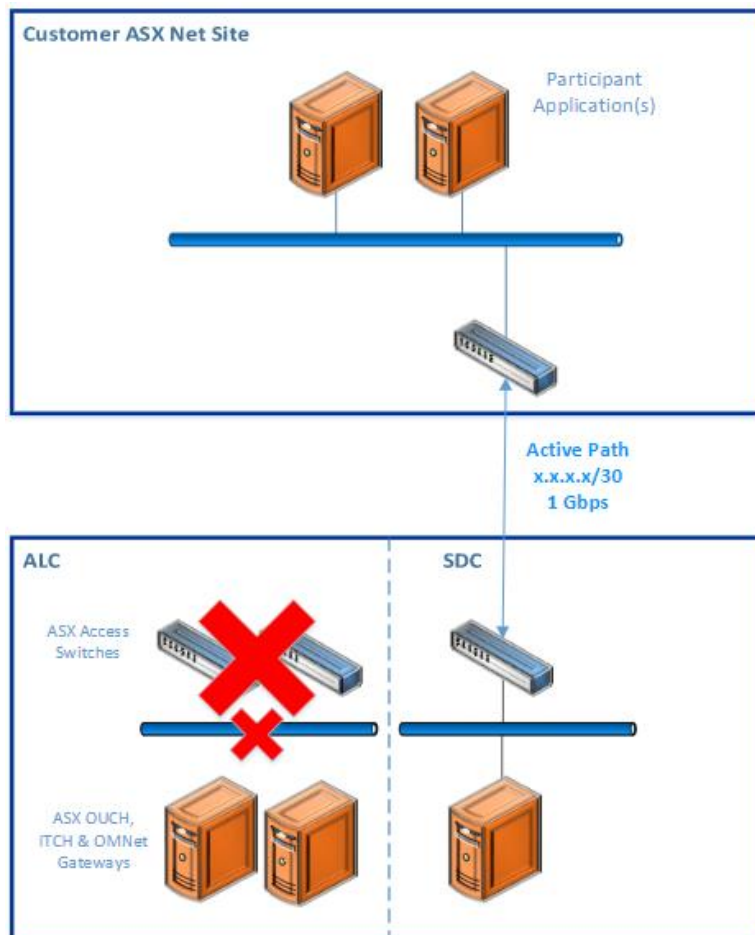


Fig 3: BCP Scenario 2 - initiates a network failure at ALC. The only means of connecting to SDC gateway services at that point is via an ASX Net site (for the customers that have chosen to take up this service).

5.6 CANCEL_ONLY, Order and Trade Download Services

As outlined in Consultation 2, several system enhancements were proposed to be incorporated into ASX's market incident playbook. Following feedback from customers to Consultation 2, ASX will now add scenarios into future BCP events that will incorporate:

- disablement of processes publishing broadcasts e.g., BO5
- move of all markets to CANCEL_ONLY session state
- enablement of dedicated CANCEL_ONLY users
- running the TDS process (including subsequent cancellation of selected trades after FOT (Fair, Orderly, Transparent Market) assessments)
- running the ODS process.

5.7 Participation and Attestation

To ensure that the best possible outcomes are achieved during BCP testing, ASX proposes that all Market Participants, vendors and AMOs participate during BCP test days to execute their test cases across each scenario. ASX further proposes that, following each BCP test day, customers will be required to attest that they have:

- connected via all normal connection paths and protocols
- executed an array of transactions and queries based on a typical production day
- executed transactions and queries following the site failover via alternate paths
- provided details of any business functions and flows that could not be executed following the failover.

5.8 Performance Testing during BCP

ASX encourages Participants, during BCP test days, to make use of the opportunity to performance test and simulate in the production environment by conducting validation testing of normal business activities that each Participant would ordinarily perform under usual market conditions. The following lists some examples, however, they are not exhaustive:

- Opening and Closing Auctions
- Regulatory Halts
- Tailor Made Combinations
- Cancel on Disconnect validations
- Reference Data re-initialization intra-day
- Order types reflective of each Participant's normal usage (e.g., Sweeps, Centre Point, Hidden, Icebergs)
- Quoting, Market Maker activities
- Trade reporting, including normal, special size, special quotation, delayed with manual release.

Question 5.1: Describe any challenges you may have attending all BCP days, executing comprehensive test cases that include production-like order activity, and providing attestation?

Question 5.2: Given ASX allows for performance testing during BCP days, describe any opportunities or challenges you may have with testing of this nature?

Question 5.3: Describe the challenges and/or opportunities the proposed network site failover presents? Include any information around business processes that would be impacted in such a scenario.

Question 5.4: Would you make use of the opportunity to test the CANCEL_ONLY functionality during BCP testing?

6. Customer Test Environments

6.1 Background

One of the IBM recommendations published in December 2021 was that:

“ASX should engage the market to understand the benefits and demand for the re-introduction of a performance testing environment. Post market engagement, determine the required implementation, if any,”

As a point of clarification, ASX has never offered a separate and dedicated ‘performance test environment’. During the ASX Trade Upgrade project, ASX decided to remove the term Participant Test Environments (PTE)¹⁰, and replace the collective term with Customer Development Environment (CDE/CDE+). The removal of the PTE naming convention is where ASX believe there has been confusion.

ASX continues to make available two externally facing functional test environments (CDE/CDE+). ASX also makes the production or the ‘pre-production’ environments available on weekends prior to any major release deployment and during BCP testing days. This section is intended to describe the externally available environments and to consult on and identify any gaps in requirements or drivers for change.

6.2 Business Objectives

- Describe Customer Development Environments and test opportunities offered by ASX.
- Determine any gaps or potential improvements to the current offering.
- Assess if there is value in or drivers for building a dedicated performance test environment.

¹⁰ PTE was a collective term that described both test environments FTE (Functional Test Environment) and ETE (Enhanced Test Environment). Noting “Enhanced” meant the next ASX Trade release that was in testing and not yet promoted to production.

6.3 International Exchange Comparison

ASX have conducted an international comparison study between global exchanges to determine what is currently offered to customers for testing environments and weekend production testing, highlighting the following key findings below:

- **Test Environment:** Generally available, though details vary; **fees** (from nil to pay per hour, Day, Year); **operating hours** (from long hours 7 days a week (ASX) to shorter durations); **likeness to reality** (ASX refreshes daily up to production standard) and **connectivity** (test circuit only, VPN).
- **Weekend Test:** A wide range from **monthly availability at high cost** (Nasdaq); **monthly availability at no cost** (NSE India); **by appointment** (NYSE) to at least **once a year** (ASX).

For additional details refer to Annexure A, p.23-26.

6.4 Customer Development Environments

ASX offers two Customer Development Environments – ‘CDE’ and ‘CDE+’ – that are made available for Participants seven days per week. CDE runs the current production version. CDE+ runs either the current production version or the upcoming future release when one is available for test. Both environments offer connectivity for OMNet, ITCH and OUCH protocols and incorporate a full set of current production instruments.

In terms of the number of servers and gateways, these environments are not a direct replica of the production environment although Participants may see similar performance as production. ASX has scaled these environments to be able to support production message capacity across all protocols, although this level of activity has not historically been observed from external customers.

6.5 Performance and Load Testing Requirements

Although the CDE and CDE+ environments have been scaled to support production message counts to the production Service Level Agreement (SLA), they are still not considered ‘production replica’ environments. Depending on the performance testing requirements of customers, ASX notes that, even with an exact production replica environment, the performance would only be comparable where the levels of market activity on the system also mirrors that of production.

Given the levels of generated activity observed during IWT, BCP and on the CDE environments, it is not clear whether customer generated load and behaviour on any given day would produce the conditions necessary to give such environment a similar performance characteristic to production.

Another consideration is the location and connection type used by Participants to connect into test environments as this may also cause any results and measurements to lack resemblance to what is seen in the production environment.

This therefore raises the question on cost to the industry and practical value of a dedicated performance test environment.

Question 6.1: Provide any feedback you have on the current ASX CDE environments. What could we add to improve your experience?

Question 6.2: Where is your test environment located in relation to the ASX test environment and how do you connect, i.e. ASX Net, VPN, Colocation? How does this compare to your production application(s)?

Question 6.3: What aspects are important to your performance testing, e.g., latency, rate of message, number of messages, recovery of processes, likeness of Participant settings, products, network topography?

Question 6.4: What aspects of testing cannot be covered unless ASX makes available a production replica performance environment? How often would you be likely to use such a service for performance testing?

Annexure A – International Exchange Comparison Matrix

ASX has conducted an international comparison study between global exchanges to determine what is currently offered to customers for BCP, testing environments and weekend production scenarios testing. The table below highlights the key findings across the following categories:

- BCP/ DR Frequency
- Test Environment, and
- Weekend Test.

Source: Global exchange websites, ASX data analysis

COUNTRY/ REGION	EXCHANGE	BCP / DR FREQUENCY	TEST ENVIRONMENT	WEEKEND TEST (BEYOND IWTS OR EQUIVALENT DUE TO NEW EXCHANGE SYSTEM ROLLOUTS)
Australia	ASX	Annual (voluntary)	CDE (current)/ CDE+ (future); 0700-1930 7 days a week (Groups 3, 4, 5 on exceptional schedules with various CSPA times); throttled at 10 or 50 TPS; first connection A\$800 per month, subsequent A\$400 per connection per month.	BCP weekend once a year (per platform).
	ASX 24	Annual (voluntary); note on CDE, daily testing available according to system event times	CDE (current)/ CDE+ (future) running on ASX 24 normal time schedule; first connection A\$800 per month, subsequent A\$400 per connection per month.	
United States	NYSE	According to Regulation Systems Compliance and Integrity (Reg SCI), certain important members, based on standards established by NYSE and NASDAQ , are	"Certification Environment".	"The NYSE platforms perform multiple weekend tests each year during which customers can utilise their DR sessions to test the NYSE platforms' DR environments."; "Individual DR testing requests may be requested through the NYSE Relationship

COUNTRY/ REGION	EXCHANGE	BCP / DR FREQUENCY	TEST ENVIRONMENT	WEEKEND TEST (BEYOND IWTS OR EQUIVALENT DUE TO NEW EXCHANGE SYSTEM ROLLOUTS)
	Nasdaq	required while all are encouraged to participate; annual (Exchange-specific + SIFMA coordinated in Oct).	" NASDAQ Testing Facility (NTF) " compared with production, has a reduced file structure and performance and is designed to accommodate customers testing their in-house applications with a reasonable volume of message traffic; available [cash] 0730-2200 (M-T) 0730-1600 (F) weekends by appointment; [options] 0400-2000 (everyday (low service level on weekends)); [cash] hourly testing fee US\$285 an hour (normal) US\$333 an hour (off) + monthly circuits/ installation charges (Members will get testing credits for Nasdaq-initiated changes).	Management team. Requests will be accommodated based on availability" " Saturday Testing ": once a month schedule published
United Kingdom	LSE	" Alternative Site Recovery Test ": Annual (voluntary) and all expected	" Legacy Customer Development Service (LCDS)": allow testing on production release of software at all times; 0505-1715 (M-F).	"Participant Test Weekends (PTW)": test trading and information systems in the production environment; can be pre-booked and scheduled on a regular basis throughout the year.
European Union	Euronext	"Euronext Disaster Recovery Test": Annual (voluntary but recommended); compulsory in " conformance test " to cover recovery scenarios "trading chain failures".	"External User Acceptance (EUA)": "Current EUA" software version is the same as prod, and "Next EUA (p-EUA)" for future development; 0900-1700 (M-T, T-F) 1400-1700 (W); weekly schedule covering various market segments/ partitions for	At least once a year

COUNTRY/ REGION	EXCHANGE	BCP / DR FREQUENCY	TEST ENVIRONMENT	WEEKEND TEST (BEYOND IWTS OR EQUIVALENT DUE TO NEW EXCHANGE SYSTEM ROLLOUTS)
			testing High Availability events (Primary-to-Mirror); available to subscribers free of charge .	
Canada	TSX	Annual (voluntary)	" General Testing Environment (GTE) ": 0730-2120 (M-F); some symbols in GTE follow hours more closely aligned with production hours; C\$2,000 per month .	C\$2,500 per test
Hong Kong	SEHK	Compulsory for new exchange system rollouts ; otherwise annual (voluntary) ; annual attestation program	"End-to-End (E2E) Testing": Test circuit, limited throttles, test tickers; 0900-1600, 1700-2300 (M-F); HK\$1,500 a day	Production-like/ Production; weekend only; at least once a month; HK\$2,500 a day
	HKFE	on priority areas (2021 includes BCP); end each annual program with relevant Compliance Reminders.	"Testing Environment": HK\$100 a day .	"Login Test" on request; HK\$1,000 a day
China	SSE + SZSE	Strongly encouraged to join; those not participating need to explain why; in addition to same city DR, they have reciprocal DR in place (i.e., SSE in Shenzhen, SZSE in Shanghai) utilizing each other's same city DR; Target at least once a year (same city DR once, different city DR another).	SSE: " All Weather Testing Environment " via VPN; 0915-1145 (M-F), no charge; SZSE: " Independent Testing Environment " via VPN or circuits; use current Participant Business Units (PBUs), historical securities accounts, day-end refreshed product list, 0915-1400 (M-F), no charge.	Periodic Testing to be arranged by the exchanges; systems to be connected and timetables vary; some compulsory to participate but others voluntary; no charge.

COUNTRY/ REGION	EXCHANGE	BCP / DR FREQUENCY	TEST ENVIRONMENT	WEEKEND TEST (BEYOND IWTS OR EQUIVALENT DUE TO NEW EXCHANGE SYSTEM ROLLOUTS)
India	NSE	Required by SEBI at least half-yearly (utilising Weekend Test); Compulsory live trading from DR (2 days a year); NSE issued guidelines on tech glitches .	" Test Market Environment ": Test circuit, limited throttles, test tickers; 1000-0700+1D (M-F), 1100-2300 (S); 1st set of user IDs free; subsequent sets Rs50k each a month.	"Mock": conducted monthly ; primary and/or DR upon system + timetable arrangements; no charge to participate.

The above information has been provided for comparison purposes only and reflects key requirements and metrics as at the date of publication of this consultation paper. Any future reliance on the above information is at the sole discretion of the reader and should be verified by independently reviewing the relevant sources so as to ensure that the most accurate and up-to-date information is relied upon. ASX and its related bodies corporate excludes all liability for any loss or damage arising in any way in this regard.

Annexure B – Consultation Questions

3. Simulation Testing with Market Participants

Question 3.1: Do you require ASX to extend order book activity during IWT, to help Participants simulate scenarios with their production-like order profile? Describe what type of activity would assist you and any challenges and/or opportunities you see with this proposal?

Question 3.2: Describe your current capabilities or challenges you have in generating order activity that is representative of your typical production order profile flow during IWT? Are you able to generate activity that is in reaction to broadcasted changes in market data?

Question 3.3: What opportunities and/or challenges do you see arising from ASX running more prescriptive IWTs that also require attestation?

Question 3.4: Describe your capabilities or challenges you may have ensuring all your production applications are logged in during IWTs?

4. Market Operators' Interconnectedness

Question 4.1: What benefits do you see in having AMOs participating in IWTs and BCPs?

5. Improvements to BCP Strategy

Question 5.1: Describe any challenges you may have attending all BCP days, executing comprehensive test cases that include production-like order activity, and providing attestation?

Question 5.2: Given ASX allows for performance testing during BCP days, describe any opportunities or challenges you may have with testing of this nature?

Question 5.3: Describe the challenges and/or opportunities the proposed network site failover presents? Include any information around business processes that would be impacted in such a scenario.

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6. Customer Test Environments

Question 6.1: Provide any feedback you have on the current ASX CDE environments. What could we add to improve your experience?

Question 6.2: Where is your test environment located in relation to the ASX test environment, and how do you connect, i.e. ASX Net, VPN, Colocation? How does this compare to your production application(s)?

Question 6.3: What aspects are important to your performance testing, e.g. latency, rate of message, number of messages, recovery of processes, likeness of Participant settings, products, network topography?

Question 6.4: What aspects of testing cannot be covered unless ASX makes available a production replica performance environment? How often would you be likely to use such a service for performance testing?

ASX would encourage stakeholders to provide additional feedback on topics which they feel to be of relevance and which have not already been referenced in this series of consultation papers.

Annexure C – Consultation Context

The following sections are reproduced from Consultation 1 and are included for context

Background¹¹

On 24 November 2021, the Australian Securities and Investments Commission (**ASIC**) published Report 708 entitled ‘ASIC’s Expectation for industry in responding to a market outage’ (**REP 708**)¹². REP 708 outlines the findings from ASIC’s review of the market outage and other operational incidents that affected the ASX equity market in the week of 16 November 2020 (**November 2020 incident**).

REP 708 sets out *expectations to support the resilience and robustness of the Australian equity market* that are variously applicable to Market Operators (eight expectations), market participants (seven expectations) and large institutional investors (one expectation).

ASIC’s Expectations of Market Operators (**ASIC’s Expectations**) cover:

- Expectation 1: *Technology status and market monitoring*
- Expectation 2: *Session states*
- Expectation 3: *Certainty about order and trade positions*
- Expectation 4: *Frequency and content of communications*
- Expectation 5: *Intraday checkpoints and cut-off times*
- Expectation 6: *Policies for disabling market components*
- Expectation 7: *Software release testing framework*
- Expectation 8: *Business continuity planning and IT disaster recovery.*

ASX commissioned an independent expert review of the ASX Trade Refresh Project that culminated in the implementation of a new version of ASX Trade on 16 November 2020. This review was undertaken by IBM Australia Limited and the final report (**IBM Report**) was publicly responded to by ASX in August 2021. The executive summary of the report is available on ASX’s website¹³.

The IBM report sets out 17 high level recommendations (with 59 discrete tasks). Whilst the majority of these recommendations relate to internal ASX processes, tasks 6.4.2 (performance testing) and 7.1.1. (default time for closing the market) relate to matters that impact or potentially impact ASX Participants and the management of the ASX market, and will be covered in this consultation process.

ASX’s response to these tasks will also be discussed in ASX’s intended consultations in response to ASIC’s Expectations.

ASX is aware that the content and outcomes of ASX’s consultation process may directly impact programs of work underway at ASX Participants in response to the expectations on market Participants set out in REP 708.

¹¹ Extracted from Section 1.1, Consultation 1.

¹² <https://asic.gov.au/regulatory-resources/find-a-document/reports/rep-708-asic-s-expectations-for-industry-in-responding-to-a-market-outage/>

¹³ <https://www2.asx.com.au/content/dam/asx/markets/trade-our-cash-market/ibm-report-executive-summary-161221-redacted.pdf>

Annexure D – Glossary

Term	Description
ALC	Australian Liquidity Centre
ASIC	The Australian Securities and Investments Commission
ASIC's Expectations	ASIC's expectations of Market Operators as set out in REP 708
ASX	ASX Limited
ASX market	The markets in ASX-listed products offered by ASX as a licensed Market Operator
ASX Participant	An entity authorised to interact transactionally with, and receive private data from, ASX Trade
ASX subscriber	An entity authorised to receive market data from ASX Trade
ASX Trade	The trading platform through which ASX operates the ASX market
BCP	Business Continuity Planning
Corporations Act	Corporations Act 2001 (Cth)
IBM recommendations	The Final Report of the review of the ASX Trade Refresh project undertaken by IBM Australia, to which ASX responded publicly in August 2021
ITCH	A protocol used by ASX Trade to publish market data
IWT	Industry-Wide Testing
Market data	Data broadcast by ASX Trade to ASX subscribers that includes public non-confidential data about orders and trades
Market Operator	As defined in the MIRs
MIRs	ASIC Market Integrity Rules (Securities Markets) 2017
November 2020 incident	The market outage and other operational incidents that affected the ASX market in the week of 16 November 2020
ODS	Order Download Service
OMNet	A protocol used by ASX Participants to interact with ASX Trade and by ASX Trade to publish market data and private data

Term	Description
OUCH	A protocol used by ASX Participants to interact with ASX Trade and by ASX Trade to publish private data
Private data	Data published by ASX Trade directly to ASX Participants to whom the data relates that contains confidential data about orders and trades
REP 708	Report 708, entitled “ASIC’s expectation for industry in responding to a market outage” published by ASIC on 24 November 2021
RBT	Risk Based Testing
SDC	Secondary Data Centre
Site	ALC and/or SDC instance of ASX Trade
The market	The totality of all markets in ASX-listed securities operated by all Market Operators
TDS	Trade Download Service
