Client Connectivity Standards and Requirements

NZX Capital Markets

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Contact Information

Markets Development	Information Services
markets@nzx.com	data@nzx.com
+64 4 495 2807	+64 4 495 2807

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1. Introduction

NZX offers the ability for permissioned stakeholders to access fair, transparent, and orderly market information and systems. These deliverables are supported by the diverse connectivity options available to meet each stakeholder's specific needs. However, there is a need for this connectivity to be achieved through established standards for connectivity to our trade, post-trade, and market data systems. This document defines these minimum standards and requirements for connectivity.

Distinct services provided by NZX have differing requirements for connectivity given their latency demands. NZX's connectivity standards and requirements are designed to deliver efficient and timely support of these services.

NZX offers several connectivity options, and these should each be considered against latency requirements and risk tolerance for business continuity and strategy.

***Client** means any NZX client requiring connectivity to the NZX for purposes of subscribing to any of the NZX services outlined in this document.

2. Principles

2.1. Principle 1 - Client connectivity to NZX

Clients of NZX are required to have a suitable connection to the NZX Primary and Backup data centres. NZX offers two geographically diverse sites for all services. In the event of a disruption to the primary site, service may be restored through the secondary. Stakeholders must ensure they can switch to the secondary site with minimal delay if instructed by NZX.

2.2. Principle 2 – Security Posture Connectivity

All clients connecting to NZX services via any means of agreed connectivity will adhere to the approved security configuration and connectivity standards. This includes the terms of use in the agreement between NZX and participants. These are;

1. Participant Connection Agreement (WAN), dated May 2017
2. NZX Point of Presence Agreement (POP), dated November 2018

The agreements include participants' obligations around the appropriate and responsible use of these services as part of the wider WAN ecosystem.

These standards represent a secure connectivity posture utilising appropriate levels of encryption and security configuration, this also provides guidance around appropriate use and definitions of misuse.

2.3. Principle 3 - Sufficient bandwidth to access NZX markets

All clients are required to ensure they have sufficient bandwidth for the NZX services they consume. The bandwidth requirements must be measured against the client's business' need for real-time or close-to-real-time delivery of information. Market behaviour generally has a 'peak and trough' profile, therefore bandwidth usage and capacity must be weighed against individual client tolerance as it relates to latency.

2.4. Principle 4 - Clients must have a backup connection

Clients who connect to NZX Trading or Clearing and Depository services must have a backup connection to NZX services to ensure timely reconnection in the event that their primary connection is disrupted. This principle is to ensure minimal impact to market customers in the event of a disruption to the primary connection.

2.5. Principle 5 - Intentional protocol utilisation

NZX's approach to technology infrastructure focuses on ensuring the performance of its systems is tailored to the specific purpose for which they are designed. For Trading, via Nasdaq ME, NZX Trading Participants are required to utilise the available protocols (Native FIX, ITCH, OUCH) within Nasdaq ME for market data/order/execution management.

Clearing and Depository (post-trade management), via TCS BaNCS, is the delivery of a robust, resilient, and comprehensive post-trade clearing, settlement, and securities transfer & registration system. As such post-trade business processes such as trade reconciliation (gross vs. net), contract generation, and legal title transfer should occur within BaNCS via the GUI or ISO15022 protocol.

3. Connectivity Methods

NZX offers flexible connectivity methods for Clients to access NZX systems. Minimum requirements in terms of line capacity and service guarantees for various systems are set to ensure that services are delivered in an efficient and timely manner.

All NZX services delivered using these connectivity methods are Transmission Control Protocol (TCP).

3.1. Spark Digital WAN Services (SDWS)

NZX employs Spark as a provider for fibre-terminated Leased Line Circuits over Multiprotocol Label Switching (MPLS) VPN network. The minimum bandwidth provided over the SDWS is 100mbps.

3.2. Third-Party Provider (3rd Party)

The following third-party network service providers to allow connectivity into our Primary and DR data centres.

- BT Radianz
- IPC
- TNSI

3.3. Virtual Private Network (VPN)

IPSec Site-to-Site (S2S)

NZX provides the ability for Clients to connect to our internet-facing firewalls with an IPSec Site-to-Site VPN termination.

3.4. International Point of Presence (POP)

Access to NZX data centres can be facilitated via the global-network of Equinix data centres over their fibre interconnections. NZX tenancy is in the Sydney SY4 data centre.

Cloud Provider Interconnect

NZX can leverage cloud provider (Azure, AWS) interconnects to deliver services across the International Point of Presence in Sydney.

3.5. Existing Client Connectivity

New Clients to NZX may leverage existing network connections that existing Clients use to transmit and receive data should that be applicable.

3.6. SWIFT

NZX is a member of the SWIFT network. Clients connecting for Clearing and Depository services may use the SWIFT network to exchange ISO15022 messaging for Back Office Systems.

3.7. SSL over Internet

For a limited set of services and for connectivity with no latency or throughput requirements, data may be transmitted over the internet wrapped in TLS (Transport Layer Security).

3.8. Application and Service Standards and Requirements

3.8.1. Minimum Standards - by Application or Service

Service	Protocol	Minimum Bandwidth	Primary Connectivity	Backup Connectivity
Trader Workstation Connection	TCP	256kbps per user session	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Equities Order Routing	TCP, FIX, OUCH	2Mbps per session	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Fixed Income Order Routing	TCP, FIX, OUCH	2Mbps per session	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Market Data	TCP, ITCH, MDF	5Mbps per connection	SDWS POP S2S VPN 3rd Party	SDWS POP S2S VPN 3rd Party
Clearing and Depository	TCP, ISO15022	2Mbps per connection	SDWS POP S2S VPN 3rd Party SWIFT	SDWS POP S2S VPN 3rd Party SWIFT
End of Day Price Report	TCP, SFTP, HTTPS	256kbps	SDWS POP S2S VPN 3rd Party SSL	SDWS POP S2S VPN 3rd Party SSL

3.8.2. Minimum Standards - by Stakeholder type

Stakeholder	Minimum Bandwidth	Primary & DR Connectivity	Backup Connectivity
Trading Participant*	256kbps per Front-end connection 2Mbps per order routing FIX/OUCH connection	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Participant Authorised - Third Party Direct Market Access System	2Mbps per order routing FIX/OUCH connection	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Clearing Participant	2Mbps per connection	SDWS POP 3rd Party SWIFT	SDWS POP S2S VPN 3rd Party VPN Client SWIFT
Depository Participant	2Mbps per connection	SDWS POP S2S VPN 3rd Party SWIFT	SDWS POP S2S VPN 3rd Party SWIFT`
Data vendor - Market Data Feed (MDF) subscriber	5Mbps per connection	SDWS POP S2S VPN 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client
Data vendor - FIX drop copy subscriber	10Mbps per connection	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party SSL
Data vendor - ITCH data subscriber	5Mbps per connection	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party SSL
Registry	2Mbps per connection	SDWS POP 3rd Party	SDWS POP S2S VPN 3rd Party VPN Client

**Trading participants require two (2) primary connections to NASDAQ ME.*

4. System Integration Principles

NZX has developed a set of guiding principles to be considered by Clients when connecting and interacting with NZX systems. These principles span across the entire exchange ecosystem and include the Trading system, Clearing and Depository system, and Data feeds. The purpose of these principles is to maintain a set of best practice guidelines to ensure the market ecosystem as a whole is operating at full capacity and to avoid bottlenecks for Client customer processing.

4.1. Trading Messaging

4.1.1. Order Management Systems

The following principles apply for Order Management systems:

- Utilisation of low latency functionality of the Trading system for order management
- Relevant FIX or ITCH protocol messages are used to receive information regarding the lifecycle of an order
- Real-time trade execution is retrieved from the Trading system protocol (FIX, OUCH, ITCH etc) messages and not Clearing and Depository system ISO15022 messages.
- Clients directly connected to Nasdaq ME for order management related reference data should utilise Market Data from an ITCH permissioned Data Vendor or directly from NASDAQ ME (ITCH).
- OMS/ISV systems must be able to manage the order throttling behaviour of the Nasdaq ME system as set by NZX. Order throttling is set at the discretion of NZX and may be subject to change. Key to note:
    - The order throttling rate is currently set to 500 orders per second
    - Every second when throttling is exceeded, all order messages get rejected until the next throttling period (1 second).

4.1.2. Pre-trade Risk Management

Pre-trade risk management is possible through the BaNCS registry messaging functionality.

- The registry messaging functionality can be used for pre-trade risk controls to validate client holdings before placing orders on the Trading system
- Participants should be aware of the latency limitations involved with the registry messaging interface when relying on real-time feedback before placing orders. The registry messages via BaNCS are not designed or intended to be low latency.
- Best practice is to use this interface for sell orders only
- It is recommended that the use of this interface is only once per order placement and not for intra-day amendments that do not increase the order quantity

4.2. Clearing and Depository

4.2.1. Registry messaging

NZX's registry messaging functionality is based on the previous FASTER system's connectivity architecture and is approved by the Securities Transfer (Approval of FASTER System) Order 2001 as an electronic transfer system for financial products.

The system design provides synchronous connection to the three registries supporting New Zealand's capital markets, Link Market Services (LNK), Computershare New Zealand (RML) and Computershare Australia (CPU).

4.2.2. Bulk Message Delivery - Registry Messaging

Taking the synchronous nature of Registry messaging into account, the following principles are recommended:

- Messaging acknowledgement messages provided by the system should be leveraged to ensure successful delivery
- Large volumes should be submitted continuously throughout the day, or:
- Large volumes should be batched into lots of no more than 500
- Batches are recommended to be spaced five minutes apart

4.2.3. Inward Transfers - Registry Messaging

The following principles apply to Inward Transfers using the registry messaging functionality:

- Observe the recommendations regarding Bulk Message Delivery (section 4.2.2)
- Scrip operations may begin as early as possible with Registry interfaces online from 07:45
- Inward transfer registry messaging is recommended to be complete before market open
- Inward Transfers should be avoided during market open to allow maximum capacity for risk management messaging
- Inward transfers should be limited to a single movement per security, per holder. i.e. Inward Transfers should reconcile at an order level at the end of each day

4.2.4. Outward Transfers

NZX recommends that Outward Transfers occur outside peak processing times of 3:45PM to 5:00PM.

4.3. Intraday Connectivity Restoration

NZX outlines below general guidelines for Participants, Independent Software Vendor (ISV), and Back Office Systems (BOS) in relation to a live Trading or Clearing and Depository system.

4.3.1. Trading System Reconnection Events

NZX provides the following guidelines for reference during reconnection events.

- The relevant primary and secondary gateway IP addresses are known in both geographical locations
- Order flow systems are designed so they can reconnect automatically. Exceptions may be considered by NZX for algorithmic trading connections.
- NZX will not halt trading for clients who do not implement an automatic reconnect when they suffer an isolated disconnection event. NZX will work with the impacted client to assist in their prompt reconnection.
- Message state history should be maintained between reconnections
- Duplicate messages should be able to be handled if retransmitted

4.3.2. Clearing and Depository Reconnection Events

NZX provides the following principles regarding reconnecting to the Clearing and Depository system.

- Reconnection should occur with the more recent PDM key received by the Back-Office System
- Reconnection with a PDM key of 0 should be avoided unless a retransmission of all historical messaging is required

4.3.3. NZX approach to restoring connectivity

- NZX considers the key priority to be least-possible disruption to market messaging
- NZX will prioritise a timely communications restart where the whole market has been disconnected or services have degraded to the point of a required restart.
- NZX will consider reasonable actions based on ensuring the overall integrity of the Trading and the Clearing and Depository system.

5. Directly Connected Vendors

NZX partners with Data, ISV's and BOS vendors who connect directly to NZX systems. These connections are a critical part of the Capital Markets ecosystem. It is vital that all parties align on the technical aspects of each connection to ensure that there are agreed standards.

The following areas have been added to the connectivity standards for further discussion with each partner:

5.1. Service Level Guidelines (SLG)

Introduce SLG's on all the various system connectivity options. This will be aligned to feedback from Vendors and our specific requirements, for example (but not limited to):

- Nasdaq Matching Engine from 06:00 – 18:15
- MDF from 00:00 – 18:15 (Note: Please refer to the specification and ensure you parse the date on the first GS message)
- BaNCS runs 24x7 with 15 minutes/day for a system restart. Core market hours are 07:30 to 20:30

Hours may change as business needs evolve and stakeholders will be notified with sufficient warning.

5.2. Connectivity

This is covered in the minimum standards table of the connectivity document. Market Data participants are invited to consider their latency and resiliency requirements.

5.3. Change Management

Conformance is required for any new vendors connecting to Nasdaq ME to safeguard the market ecosystem and ensure data integrity.

NZX Limited
Level 1, NZX Centre, 11 Cable Street
Wellington 6011, New Zealand

PO Box 2959
Phone: +64 4 472 7599
www.nzx.com