



CHIXMMD 1.1 Multicast Feed Specification

Synopsis: This document describes the protocol of the Nasdaq CXC, CX2 and CXD CHIXMMD Feed. This feed provides a recoverable stream of orders and trades to Nasdaq Canadian Equities' customers and vendors through a Multicast feed.

Revision Date: March 2, 2017

©2017, Nasdaq CXC Limited. Nasdaq CXC Limited is a member of IIROC and CIPF. All rights reserved. Nasdaq is a registered trademark.

This information is provided for informational purposes only. It does not take into account the particular investment objectives, financial situation, or needs of any individual or entity. Under no circumstances is it to be used or considered as an offer to purchase or sell any security, or as a solicitation or recommendation of the purchase, sale, or offer to purchase or sell any security. While the information has been obtained from sources deemed reliable, neither Nasdaq CXC Limited, nor its licensors, nor any other party through whom the user obtains any such information: (i) makes any guarantees that it is accurate, complete, timely, or contains correct sequencing of information; (ii) makes any warranties with regard to the results obtained from its use; or (iii) shall have any liability for any claims, losses, or damages arising from or occasioned by any inaccuracy, error, delay, or omission, or from the use of the information or actions taken in reliance on the information. Reproduction or redistribution of this information is prohibited except with written permission from Nasdaq CXC Limited.

System response times may vary for a number of reasons including market conditions, trading volumes and system performance.

© 2017 Nasdaq CXC Limited. All rights reserved.

CHIXMMD Feed

1. Introduction

The CHIXMMD Feed is the Multicast data feed for Nasdaq CXC, CX2 and CXD. It disseminates information about orders and executions in real time. The feed is a series of sequenced and unsequenced variable length messages. The messages themselves are encoded in printable ASCII bytes.

This document describes the Multicast version. Technical aspects of this data feed including the connection protocol, message types and message structures are described in this document.

2. Revision History

| Name | Description | Date |
|-------------|--|--------------------------|
| Version 1.0 | Initial document | 2011-03-28 |
| Version 1.1 | Added multicast address information | 2011-11-01 |
| Version 1.2 | Minor format edits | 2011-11-09 |
| Version 1.3 | Added Listing Market on Stock Status messages. Added Attribute to support Bypass ('B' = Bypass) on Trade messages. Added Cross Type on Trade messages. | 2012-05-29 |
| Version 1.4 | Added CX2 connectivity details Added UAT connectivity details Updated comments and examples to incorporate CX2 | 2013-02-19 |
| Version 1.5 | Changed multicast ports for production CX2 stream 1 and stream 2 and CX2 UAT stream 1 | 2013-04-24 |
| Version 1.6 | Updated heartbeat interval in Section 3.1 Updated Bandwidth Recommendation | 2013-05-15 2013-11-27 |
| Version 1.7 | Added Attribute to support Market On Close ("C" = Market On Close) on Trade messages. | 2015-05-28 |
| Version 1.8 | Updated Network Address Summary | 2015-07-16 |
| Version 1.9 | Added Attributes to support Settlement Terms on Cross orders ('T' = Cash Today, 'C' = Cash Tomorrow, 'D' = Delayed Delivery). | 2016-04-12 |
| Version 2.0 | Updated Network Address Summary to Include CX2 Secondary Site. Updated Message Descriptions to Reference Nasdaq CXD where applicable. | 2016-06-21 |
| Version 2.1 | Added value 'X' to Cross Type field on Trade messages. Added Nasdaq CXD UAT network addresses. | 2016-08-17 |
| Version 2.2 | Added Nasdaq CXD production multicast addresses. | 2016-10-06 |

| | | |
|-------------|--|------------|
| Version 2.3 | Added all remaining production and UAT network addresses for Nasdaq INET platform. | 2017-01-05 |
| Version 2.4 | Added Chicago (CH4) and Markham (3500 Steeles POP) addresses. | 2017-03-02 |

3. Overview

The Multicast Market Data system consists of two data services:

- Real-time Multicast Market Data Feed (CHIXMMD)
- Multicast Message Recovery Service (MMRS)

The real-time multicast market data feed delivers market data in UDP multicast packet streams over the multicast market data network. There are multiple data streams published over the network for resilience purposes. They all carry identical content. By subscribing to these data streams, market data clients receive latest market data updates from the trading system.

The multicast message recovery service offers message recovery to market data clients. Clients can connect to a designated MMRS server and request for past message retransmission. The recovery process is implemented via a TCP connection established by the request client to the MMRS server.

The two data services are made available in both primary and secondary site for resilience purposes. Market data clients may want to rely on primary site services and switch to secondary site services only when necessary due to matching engine location.

The following diagram shows the overall delivery mechanism:

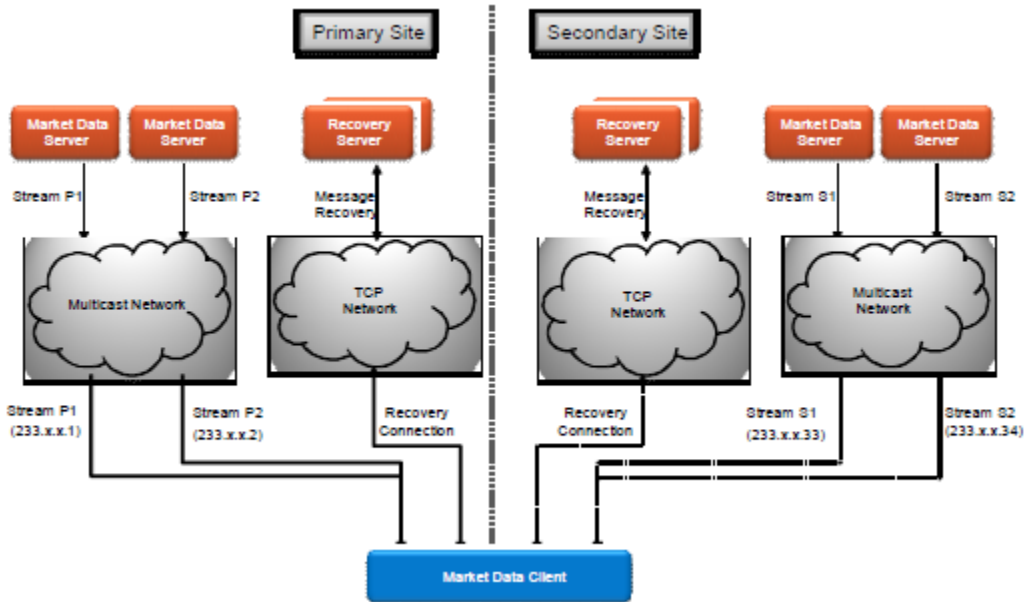


Figure: Multicast Market Data Delivery Mechanism

3.1 Real-Time Multicast Market Data Feed Service

The Nasdaq CHIXMMD feed delivers real-time market data in the form of UDP packet streams. There are two streams published from the primary site and another two from the secondary site. They are published in different multicast addresses. Refer to section 'Network Configuration Parameters' for address details.

All data streams are identical in terms of market data content. They are identical at message level. However, the protocol allows packing of multiple messages into a UDP packet and different market data servers at different sites may apply packing differently. Therefore the streams may differ at UDP packet level. Market data clients need to be aware of this nature when processing the feed.

Every market data message carries a unique message sequence number which starts at 1 and increments by 1 in the next message. Market data clients may use this sequence number to detect message gap and act on recovery accordingly.

There are regular heartbeat messages published in each data stream to indicate line connection status. The heartbeat message itself does not increment message sequence number and does not carry market data updates. It does carry the next expected sequence number so the market data client can use it to detect if the previous data messages are missing. Normally, the heartbeat message is published every 5 seconds but may be skipped when a data stream has a high volume of messages. Market data clients need to be aware of this nature when determining their heartbeat monitoring scheme.

3.2 Multicast Message Recovery Service

Market data clients may use the service provided by MMRS Server to recover missing messages of the current trading day. This is done so by establishing a TCP connection to a designated MMRS server and following the protocols described in the latter part of this specification to initiate the request. Basically, the client application needs to submit a Login Request together with the sequence number of the first missing message. After validation, the Recovery Server replays messages to the client starting from the requested message.

There is a limit on message volume to replay in a single recovery session. If the limit is reached, the server will terminate the connection. The Market data client has to start a new session and continue from the last recovery point. Refer to section 'Network Configuration Parameter' for details on server address and recovery limit setting.

3.3 Real-Time Multicast Market Data Feed Service

The multicast feed will be operating from 00:05 to 20:15. During the operation hours, market data clients may expect to see market data update messages and regular heartbeat messages in the data streams.

3.4 Network Configuration Parameters

The following tables summarize network address & parameter configurations needed for accessing the multicast market data services.

Production Nasdaq INET Platform Primary TR2 (45 Parliament St, Toronto)

| | Nasdaq CXC | Nasdaq CX2 | Nasdaq CXD |
|-----------------|------------------|------------------|------------------|
| Stream A | | | |
| Multicast Group | 233.128.23.97 | 233.128.23.105 | 233.128.23.113 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.138 | 207.251.255.138 | 207.251.255.138 |
| Source | 206.200.1.224/28 | 206.200.1.224/28 | 206.200.1.224/28 |
| MMRS | 206.200.1.192 | 206.200.1.193 | 206.200.1.194 |
| MMRS Port | 18170 | 18171 | 18172 |
| Stream B | | | |
| Multicast Group | 233.128.23.98 | 233.128.23.106 | 233.128.23.114 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.139 | 207.251.255.139 | 207.251.255.139 |
| Source | 206.200.1.240/28 | 206.200.1.240/28 | 206.200.1.240/28 |
| MMRS | 206.200.1.208 | 206.200.1.209 | 206.200.1.210 |
| MMRS Port | 18170 | 18171 | 18172 |

Production Nasdaq INET Platform DR CH4 (350 E. Cermak Rd, Chicago)

| | Nasdaq CXC | Nasdaq CX2 | Nasdaq CXD |
|-----------------|-------------------|-------------------|-------------------|
| Stream C | | | |
| Multicast Group | 233.187.20.20 | 233.187.20.21 | 233.187.20.22 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.102 | 207.251.255.102 | 207.251.255.102 |
| Source | 206.200.95.0/25 | 206.200.95.0/25 | 206.200.95.0/25 |
| MMRS | 206.200.92.121 | 206.200.92.122 | 206.200.92.123 |
| MMRS Port | 18170 | 18171 | 18172 |
| Stream D | | | |
| Multicast Group | 233.187.20.24 | 233.187.20.25 | 233.187.20.26 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.103 | 207.251.255.103 | 207.251.255.103 |
| Source | 206.200.95.128/25 | 206.200.95.128/25 | 206.200.95.128/25 |
| MMRS | 206.200.92.124 | 206.200.92.125 | 206.200.92.126 |
| MMRS Port | 18170 | 18171 | 18172 |

Production Nasdaq INET Platform MKM POP (3500 Steeles Ave E, Markham)

| | Nasdaq CXC | Nasdaq CX2 | Nasdaq CXD |
|-----------------|-------------------|-------------------|-------------------|
| Stream E | | | |
| Multicast Group | 233.128.23.72 | 233.128.23.73 | 233.128.23.74 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.16 | 207.251.255.16 | 207.251.255.16 |
| Source | 206.200.58.240/29 | 206.200.58.240/29 | 206.200.58.240/29 |
| MMRS | 206.200.58.224 | 206.200.58.225 | 206.200.58.226 |
| MMRS Port | 18170 | 18171 | 18172 |
| Stream F | | | |
| Multicast Group | 233.128.23.76 | 233.128.23.77 | 233.128.23.74 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.17 | 207.251.255.17 | 207.251.255.17 |
| Source | 206.200.58.248/29 | 206.200.58.248/29 | 206.200.58.248/29 |
| MMRS | 206.200.58.232 | 206.200.58.233 | 206.200.58.234 |
| MMRS Port | 18170 | 18171 | 18172 |

Nasdaq Test Facility (NTF) INET Platform

| | Nasdaq CXC | Nasdaq CX2 | Nasdaq CXD |
|------------------------|-------------------|-------------------|-------------------|
| Multicast Group | 233.128.23.65 | 233.128.23.66 | 233.128.23.67 |
| Multicast Port | 18070 | 18071 | 18072 |
| RP | 207.251.255.136 | 207.251.255.136 | 207.251.255.136 |
| Source | 206.200.59.240/28 | 206.200.59.240/28 | 206.200.59.240/28 |
| MMRS (Private Network) | 206.200.59.224 | 206.200.59.225 | 206.200.59.226 |
| MMRS (Internet) | 198.55.222.224 | 198.55.222.225 | 198.55.222.226 |
| MMRS Port | 18170 | 18171 | 18172 |

Production Legacy Chi-X Platform

| | Nasdaq CXC | Nasdaq CX2 |
|--------------------------|----------------|----------------|
| Stream 1 (1 Gig) | | |
| Multicast Group | 233.128.23.1 | 233.128.23.16 |
| Multicast Port | 26470 | 26475 |
| RP | 199.204.1.243 | 199.204.1.243 |
| Source | 199.204.1.68 | 199.204.1.74 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |
| Stream 2 (1 Gig) | | |
| Multicast Group | 233.128.23.2 | 233.128.23.17 |
| Multicast Port | 26460 | 26465 |
| RP | 199.204.1.244 | 199.204.1.244 |
| Source | 199.204.1.69 | 199.204.1.70 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |
| Stream 1 (10 Gig) | | |
| Multicast Group | 233.128.23.3 | 233.128.23.18 |
| Multicast Port | 26471 | 26476 |
| RP | 199.204.1.241 | 199.204.1.241 |
| Source | 199.204.1.84 | 199.204.1.93 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |
| Stream 2 (10 Gig) | | |
| Multicast Group | 233.128.23.4 | 233.128.23.19 |
| Multicast Port | 26461 | 26466 |
| RP | 199.204.1.242 | 199.204.1.242 |
| Source | 199.204.1.85 | 199.204.1.94 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |

Secondary Legacy Chi-X Platform

| | Nasdaq CXC | Nasdaq CX2 |
|-------------------------|----------------|----------------|
| Stream 1 (1 Gig) | | |
| Multicast Group | 233.128.23.33 | 233.128.23.48 |
| Multicast Port | 26470 | 26475 |
| RP | 199.204.3.243 | 199.204.3.243 |
| Source | 199.204.3.68 | 199.204.3.70 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |
| Stream 2 (1 Gig) | | |
| Multicast Group | 233.128.23.34 | 233.128.23.49 |
| Multicast Port | 26460 | 26465 |
| RP | 199.204.3.244 | 199.204.3.244 |
| Source | 199.204.3.69 | 199.204.3.71 |
| MMRS | to be provided | to be provided |
| MMRS Port | 26480 | 26480 |

UAT Legacy Chi-X Platform

| | Nasdaq CXC |
|------------------------|---------------|
| Multicast Group | 233.128.23.62 |
| Multicast Port | 26490 |
| RP | 199.204.3.241 |
| Source | 199.204.3.78 |
| MMRS (Private Network) | 199.204.3.21 |
| MMRS (Internet) | 199.204.2.21 |
| MMRS Port | 26471 |

Bandwidth Recommendation

Market data clients are required to order line circuits with sufficient bandwidth to cater for market data volume published in our data streams. Below table provides guidelines on sizing the bandwidth calculation.

Note that all multicast data streams published in our data network carry identical content. For resilience purpose, market data clients are advised to subscribe to at least two data streams (one from primary site and one from secondary site).

Market data client also need to make provision for message recovery service. Sufficient bandwidth should be arranged so that message recovery can be completed timely.

| | |
|------------------------------------|----------------|
| Multicast Data Stream ¹ | 30Mbps |
| Recovery Server | 2 Mbps minimum |

Figure: Production Bandwidth Recommendation for Nasdaq CXC

| | |
|------------------------------------|----------------|
| Multicast Data Stream ¹ | 18Mbps |
| Recovery Server | 2 Mbps minimum |

Figure: Production Bandwidth Recommendation for Nasdaq CX2

| | |
|------------------------------------|----------------|
| Multicast Data Stream ¹ | 2Mbps |
| Recovery Server | 2 Mbps minimum |

Figure: Production Bandwidth Recommendation for Nasdaq CXD

CHIXMMD Parameters

| | |
|-----------------------------|-------------------------------|
| MTU setting | 1500 |
| Heartbeat message frequency | At least 1 in every 5 seconds |

Figure: CHIXMMD Configuration Parameters

MMRS Parameters

The MMRS Server applies limit checks in serving recovery requests. If a request exceeds the preset limit, the server will disconnect the connection automatically. Market data clients are required to start a new session and continue from the last recovery point.

| | |
|------------------------------|------------------|
| Message Recovery Range Limit | 100,000 messages |
| Session Time Limit | TBD |

Figure: MMRS Configuration Parameters

¹ Bandwidth requirement of the multicast stream – the figure indicates the requirement for one multicast stream. If the client intends to subscribe to both streams from a single site, the figure should be doubled.

4. Protocol

4.1 CHIXMMD Protocol

The Real-time Multicast Market Data Feed protocol contains the definition of market data messages and the definition of the multicast packets. The market data messages describe the activities of the trading system. For example, order addition and trade execution are activities in the trading system. The format of the market data messages is described in the next section.

The multicast packet definition describes how market data messages are encoded in a multicast packet.

4.1.1 Multicast Packet Layout

Each multicast packet contains a packet header followed by one or more data messages as illustrated in the following diagram.

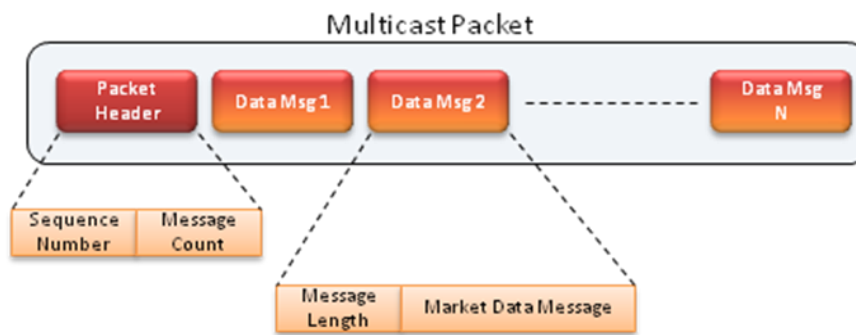


Figure: CHIXMMD Multicast Packet Layout

The following table describes the packet header layout.

| PACKET HEADER | | | | |
|---------------|--------|--------|---------|---------------------------------------|
| NAME | OFFSET | LENGTH | VALUE | REMARKS |
| Sequence | 0 | 4 | Numeric | Sequence number of the first message. |
| Message Count | 4 | 2 | Numeric | Number of messages in the packet |

The following table describes the data message layout. The following layout may repeat in the multicast packet to deliver multiple data messages in one packet.

| DATA MESSAGE | | | | |
|---------------------|----------|----------|---------------------|------------------------------------|
| NAME | OFFSET | LENGTH | VALUE | REMARKS |
| Length | Variable | 2 | Numeric | Length of the Market Data Message |
| Market Data Message | Variable | Variable | Market Data Message | Content of the Market Data Message |

4.1.2 Heartbeat Message

The heartbeat message is used in the multicast feed to indicate health of the multicast feed. The message is delivered regularly by the Market Data Servers.

The heartbeat message is delivered in a single multicast packet and indicated by the message count value of zero in the packet header described below.

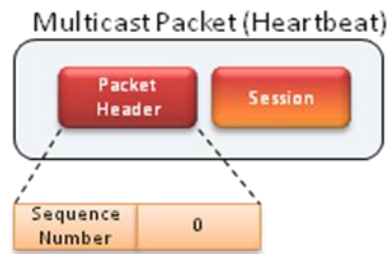


Figure: CHIXMMD Heartbeat Packet Layout

The following table describes the heartbeat message layout including the packet header.

| HEARTBEAT MESSAGE | | | | |
|-------------------|--------|--------|--------------|---|
| NAME | OFFSET | LENGTH | VALUE | REMARKS |
| Sequence | 0 | 4 | Numeric | Sequence number of the next Market Data Message |
| Message Count | 4 | 2 | 0 | A zero value indicating this is a heartbeat message |
| Session | 6 | 10 | Alphanumeric | Current Session value |

The Session field contains the current session of the market data stream being delivered. Client applications should use this field to fill-in the Session field in the Login Request of the Recovery Service.

The Session field will not change during a normal trading day. In unlikely events (e.g. the trading system is restarted in the middle of the day), it may change to a different value. When this happens, the sequence number of the market data messages will be reset to 1.

4.2 MMRS Protocol

The Multicast Message Recovery Service protocol follows the one used in the TCP version of the CHIXMD Feed. The protocol definition is described in the document "CHIXMD Feed Specification". In terms of Market Data Message format, the MMRS protocol uses the same message format in the multicast feed described in section 5 of this document.

The following diagram describes a typical recovery scenario:

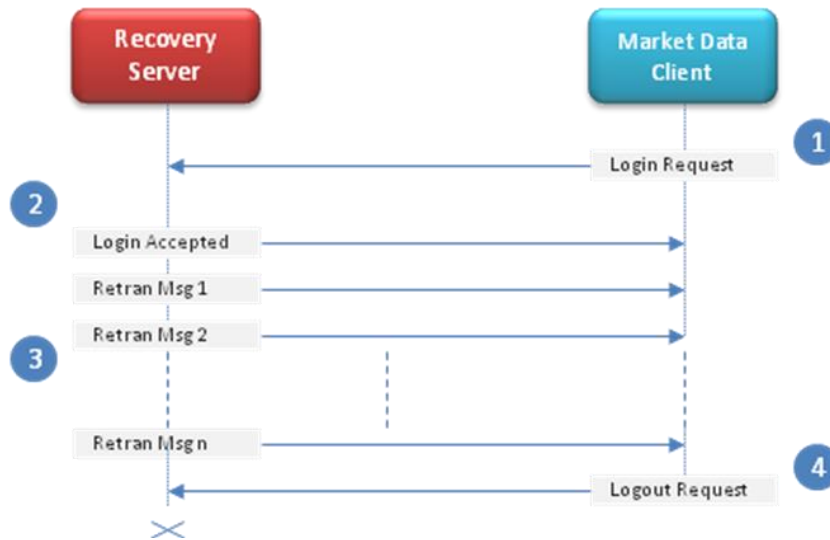


Figure: Example Recovery Scenario

In the diagram, there are 4 steps involved in the message recovery process.

Step 1: Market Data Client identified missing message(s) from the multicast stream and needs to recover the message using the recovery service. The client has to establish a TCP connection with the recovery server and format a Login Request message to request message retransmission.

Step 2: After receiving the login request, the Recovery Server will validate the user authentication information in the request. The session and message sequence number in the request will also be checked to ensure relevant messages are available for retransmission. A Login Accepted message will be replied to the client to indicate the request is accepted and message retransmission will start soon.

Step 3: The recovery server starts replaying the past messages one by one, starting from the one requested by the client.

Step 4: When the client receives the necessary retransmissions, it should send a Logout Request to disconnect the recovery session. After the request is sent, the client may close the TCP connection immediately.

There is a limit on message volume to replay in a single recovery session. If the limit is reached, the server will terminate the connection. Market data client has to start a new session and continue from the last recovery point. The recovery limit is described in the previous section 'Network Configuration Parameter'.

In addition, the recovery server will disconnect a client when playback of the past messages finishes. This is different from the CHIXMD feed which would continue to broadcast the real-time messages.

5. Market Data Messages

The market data message format described below is the same in the multicast service and the TCP based CHIXMD recovery service.

5.1 Data Types

All numeric fields are composed of a string of ASCII coded digits, right justified and space filled on the left.

All alphanumeric text fields are left justified and padded on the right with spaces, and can include letters or digits.

Standard prices are given in decimal format with 6 whole number places followed by 4 decimal digits. Long form prices are given in decimal format with 12 whole number places followed by 7 decimal digits. The whole number portion is padded on the left with spaces; the decimal portion is padded on the right with zeros. The decimal point is implied by position; it does not appear inside the price field.

Timestamp fields are given in milliseconds past midnight Local Time.

6. Application Protocol - Market Data

The CHIXMMD Feed service is composed of a series of messages that describe orders added to, removed from, and executed on Nasdaq CXC, CX2 and CXD. All of these messages will be contained in a 'Sequenced Data Message' and are inbound messages to the client.

The introduction of long form messages are used when either the price or size is larger than the standard messages can permit. This will be done on a per order basis.

6.1 Add Order Message

An Add Order Message indicates that Nasdaq CXC or CX2 has accepted a visible order into the book. It includes a day-unique Order Reference key assigned to the order. (Note: the issuing of an Add Order Message is not necessarily always for a new order. See section "Modification of Existing Orders".)

Note that the Broker is always set to 001 (Anonymous) for Nasdaq CXC only. This applies to the Long Form version as well.

Not applicable to Nasdaq CXD.

| Add Order Message | | | | |
|--------------------|--------|--------|--------------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "A" | Add Order Message |
| Order Reference | 9 | 9 | Numeric | Day unique order reference number |
| Buy/Sell Indicator | 18 | 1 | Alphanumeric | 'B' = Buy Order 'S' = Sell Order |
| Shares | 19 | 6 | Numeric | Total number of shares being added to the book (may be less than the number of shares entered because part of the order may trade before being posted to the book). |
| Stock | 25 | 10 | Alphanumeric | Stock symbol right padded with spaces. |
| Price | 35 | 10 | Price | The display price of the order. |
| Broker | 45 | 3 | Numeric | The three digit numeric TSX Broker Number or 001 for anonymous. |

| Long Form Add Order Message | | | | |
|-----------------------------|--------|--------|--------------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "a" | Add Order Message |
| Order Reference | 9 | 9 | Numeric | Day unique order reference number |
| Buy/Sell Indicator | 18 | 1 | Alphanumeric | 'B' = Buy Order 'S' = Sell Order |
| Shares | 19 | 10 | Numeric | Total number of shares being added to the book (may be less than the number of shares entered because part of the order may trade before being posted to the book). |
| Stock | 29 | 10 | Alphanumeric | Stock symbol right padded with spaces. |
| Price | 39 | 19 | Price | The display price of the order. |
| Broker | 58 | 3 | Numeric | The three digit numeric TSX Broker Number or 001 for anonymous. |

6.2 Order Execution Message

An Order Execution Message is sent whenever an order on the book is executed in whole or in part.
Not applicable to Nasdaq CXD.

| Order Execution Message | | | | |
|-------------------------|--------|--------|---------|------------|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |

| | | | | |
|------------------------|----|---|--------------|---|
| Message Type | 8 | 1 | "E" | Order Execution Message |
| Order Reference | 9 | 9 | Numeric | The reference key of the order that was executed. |
| Executed Shares | 18 | 6 | Numeric | The number of shares executed on this trade |
| Trade Reference | 24 | 9 | Numeric | Day unique trade reference number |
| Contra Order Reference | 33 | 9 | Numeric | The reference key of the contra-order that was executed. |
| Trade Attribute | 42 | 1 | Alphanumeric | 'B' = Bypass |
| Broker | 43 | 3 | Numeric | The three digit numeric TSX Broker Number or 001 for anonymous. |
| Contra Broker | 46 | 3 | Numeric | The three digit numeric TSX Broker Number of the contra order or 001 for anonymous. |

| Long Form Order Execution Message | | | | |
|-----------------------------------|--------|--------|--------------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "e" | Order Execution Message |
| Order Reference | 9 | 9 | Numeric | The reference key of the order that was executed. |
| Executed Shares | 18 | 10 | Numeric | The number of shares executed on this trade |
| Trade Reference | 28 | 9 | Numeric | Day unique trade reference number |
| Contra Order Reference | 37 | 9 | Numeric | The reference key of the contra-order that was executed. |
| Trade Attribute | 46 | 1 | Alphanumeric | 'B' = Bypass |
| Broker | 47 | 3 | Numeric | The three digit numeric TSX Broker Number or 001 for anonymous. |
| Contra Broker | 50 | 3 | Numeric | The three digit numeric TSX Broker Number of the contra order or 001 for anonymous. |

6.3 Order Cancel Message

An Order Cancel Message is sent whenever an order on the book is fully canceled, its quantity revised down or when a pegged order is re-priced. **Not applicable to Nasdaq CXD.**

| Order Cancel Message | | | | |
|----------------------|--------|--------|---------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "X" | Order Cancel Message |
| Order Reference | 9 | 9 | Numeric | The reference number of the order being canceled. References a previously sent <i>Add Order Message</i> . |
| Canceled Shares | 18 | 6 | Numeric | Number of shares cancelled |

| Long Form Order Cancel Message | | | | |
|--------------------------------|--------|--------|---------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "x" | Order Cancel Message |
| Order Reference | 9 | 9 | Numeric | The reference number of the order being canceled. References a previously sent <i>Add Order Message</i> . |
| Canceled Shares | 18 | 10 | Numeric | Number of shares cancelled |

6.4 Modification of Existing Orders

A price modification of an existing order is represented in CHIXMD by the issuing of a Cancel Message (for full open quantity) on the existing order followed by an Add Order Message that uses the same Order reference.

Reduction of quantity order is represented in CHIXMD by the issuing of a Cancel Message on the existing order. The cancel message can reduce the number of shares currently pending in the referenced open order by the number of shares indicated. When the number of currently pending shares for an order reaches zero, the order is dead and should be removed from the book.

6.5 Trade Message

A Trade Message is sent when a trade occurs against order quantity not visible on the book (i.e. a fully or partially hidden order). They do not affect the book and can be ignored if you are building a book. Trade Messages are required to provide time-and-sales and other execution based data; they fill in the gaps left when an order that is not otherwise visible on the order book is executed.

By combining the executions received separately via both Order Execution Messages and Trade Messages, it is possible to build a complete view of all executions that occur.

Note that the Order Reference is always set to 0 (zero) and the Buy/Sell indicator to 'B'. This applies to the Long Form version as well.

| Trade Message | | | | |
|--------------------|--------|--------|--------------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "P" | Trade Message |
| Order Reference | 9 | 9 | Numeric | The reference number of the order executed. (always 0) |
| Buy/Sell Indicator | 18 | 1 | Alphanumeric | 'B' = buy order executed 'S' = sell order executed (Always 'B') |
| Shares | 19 | 6 | Numeric | Number of shares executed |
| Stock | 25 | 10 | Alphanumeric | Symbol, right padded with spaces |
| Price | 35 | 10 | Price | Match price of the order |

| | | | | |
|------------------------|----|---|--------------|--|
| Trade Reference | 45 | 9 | Numeric | Trade reference number generated for this trade. |
| Contra Order Reference | 54 | 9 | Numeric | The reference number of the contra order executed. |
| Broker | 63 | 3 | Numeric | The three digit numeric TSX Broker Number of the buyer or 001 for anonymous. |
| Contra Broker | 66 | 3 | Numeric | The three digit numeric TSX Broker Number of the seller or 001 for anonymous. |
| Trade Attribute | 69 | 1 | Alphanumeric | 'B' = Bypass 'C' = Market On Close |
| Cross Type | 70 | 1 | Alphanumeric | 'I' = Internal 'B' = Basis 'C' = Contingent 'V' = VWAP 'X' = Intentional Cross |
| Settlement Terms | 71 | 1 | Alphanumeric | 'T' = Cash Today 'C' = Cash Tomorrow 'D' = Delayed Delivery |

| Long Form Trade Message | | | | |
|-------------------------|--------|--------|--------------|---|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "p" | Trade Message |
| Order Reference | 9 | 9 | Numeric | The reference number of the order executed. (always 0) |
| Buy/Sell Indicator | 18 | 1 | Alphanumeric | 'B' = buy order executed 'S' = sell order executed (Always 'B') |
| Shares | 19 | 10 | Numeric | Number of shares executed |
| Stock | 29 | 10 | Alphanumeric | Symbol, right padded with spaces |
| Price | 39 | 19 | Price | Match price of the order |
| Trade Reference | 58 | 9 | Numeric | Trade reference number generated for this trade. |
| Contra Order Reference | 67 | 9 | Numeric | The reference number of the contra order executed. |
| Broker | 76 | 3 | Numeric | The three digit numeric TSX Broker Number of the buyer or 001 for anonymous. |
| Contra Broker | 79 | 3 | Numeric | The three digit numeric TSX Broker Number of the seller or 001 for anonymous. |
| Trade Attribute | 82 | 1 | Alphanumeric | 'B' = Bypass 'C' = Market On Close |

| | | | | |
|------------------|----|---|--------------|--|
| Cross Type | 83 | 1 | Alphanumeric | 'I' = Internal 'B' = Basis 'C' = Contingent 'V' = VWAP 'X' = Intentional Cross |
| Settlement Terms | 84 | 1 | Alphanumeric | 'T' = Cash Today 'C' = Cash Tomorrow 'D' = Delayed Delivery |

6.6 Broken Trade Message

A Broken Trade message is sent whenever an execution is broken. A Broken Trade is final; once a trade is broken it cannot be reinstated.

Broken Trades happen only rarely and will only affect applications that build a time-and-sales database or maintain cumulative volumes or high/low calculations. If you are only building a book, you can ignore these messages; they have no effect on the book.

| Broken Trade Message | | | | |
|----------------------|--------|--------|---------|--|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "B" | Broken Trade Message |
| Trade Reference | 9 | 9 | Numeric | The trade reference number of the execution that was broken. This refers to a trade reference number from a previously transmitted Order Execution or Trade Message. |

7.0 System Event Message

The system event message type is used to indicate a market state event.

| System Event Message | | | | |
|----------------------|--------|--------|---------|----------------------|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "S" | System Event Message |

| | | | | |
|------------|---|---|--------------|---|
| Event Code | 9 | 1 | Alphanumeric | 'O' = First message of the day 'S' = Start of Nasdaq Trading Session 'Q' = Start of Primary Market Trading Session 'M' = End of Primary Market Trading Session. Indicates that Pegged orders are no longer available for execution. 'E' = End of System Hours. Nasdaq is closed and not accepting orders. It is still possible to receive Broken Trade messages and Order Cancel Messages. 'C' = End of Messages. Last message of the day. |
|------------|---|---|--------------|---|

8.0 Stock Status Message

This message indicates the current trading status of a stock. At the start of day, the feed will send out a stock status message for each of the symbols trading on Nasdaq CXC, CX2 and CXD. Subsequently, stock status messages will be sent when a stock is halted or is released for trading.

| Stock Status Message | | | | |
|----------------------|--------|--------|--------------|--------------------------------------|
| Name | Offset | Length | Value | Notes |
| Time Stamp | 0 | 8 | Numeric | Time Stamp |
| Message Type | 8 | 1 | "H" | Stock Trading Action Message |
| Stock | 9 | 10 | Alphanumeric | Stock symbol |
| Trading State | 19 | 1 | Alphanumeric | 'H' = Halted, 'T' = Trading |
| Short Exempt | 20 | 1 | Alphanumeric | 'Y' = Short Exempt, 'N' = Not Exempt |
| Listing Market | 21 | 1 | Alphanumeric | 'T' = TSX, 'V' = Venture |

9.0 Example Output

9.1 Multicast Packet Messages

9.1.1 Single message within packet

| MESSAGE TYPE | CHIXMMD FEED MESSAGE |
|---------------|--|
| Trade Message | 00 00 03 2f 00 01 00 3b 35 33 32 36 38 36 37 35 .../...;53268675 50 20 20 20 20 20 20 20 20 30 42 20 20 20 34 30 P 0B 40 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 OVOD.L 1000000 30 31 36 30 30 30 30 30 30 35 20 20 20 20 20 20 0160000005 20 20 30 0 |

| FIELD | HEX | MEANING |
|-----------------|---|---|
| Sequence Number | 00 00 03 2f | Decimal Value = 815 |
| Message Count | 00 01 | Decimal Value = 1 |
| Message Length | 00 3b | Decimal Value = 59 |
| Message | 35 33 32 36 38 36 37 35 50 20 20 20 20 20 20 20 30 42 20 20 20 34 30 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 30 31 36 30 30 30 30 30 30 35 20 20 20 20 20 20 20 20 30 | ASCII String 53268675 P 0B 400VOD.L 10000000160000005 0 |

9.1.2 Multiple message within packet

| MESSAGE TYPE | CHIXMMD FEED MESSAGE |
|---|--|
| Add Order, Order Execution and Order Cancel Message in one packet | 00 00 03 1c 00 03 00 2a 35 33 30 36 31 34 33 35 *53061435 41 20 20 20 20 20 20 20 20 20 34 42 20 20 20 35 30 A 4B 50 30 56 4f 44 2e 4c 20 20 20 20 31 30 30 30 30 30 30 0VOD.L 1000000 30 59 00 2a 35 33 30 36 36 34 36 37 45 20 20 20 0Y.*53066467E 20 20 20 20 20 34 20 20 20 34 30 30 31 36 30 30 4 4001600 30 30 30 30 31 20 20 20 20 20 20 20 20 20 35 00 18 00001 5.. 35 33 30 36 38 34 35 32 58 20 20 20 20 20 20 20 53068452X 20 34 20 20 20 31 30 30 4 100 |

| FIELD | HEX | MEANING |
|-----------------|--|---|
| Sequence Number | 00 00 03 1c | Decimal Value = 796 |
| Message Count | 00 03 | Decimal Value = 3 |
| Message Length | 00 2a | Decimal Value = 42 |
| Message | 35 33 30 36 31 34 33 35 41 20 20 20 20 20 20 20 34 42 20 20 20 35 30 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 30 59 | ASCII String 53061435 A 4B 500VOD.L 10000000Y |
| Message Length | 00 2a | Decimal Value = 42 |
| Message | 35 33 30 36 36 34 36 37 45 20 20 20 20 20 20 20 34 20 20 20 34 30 30 31 36 30 30 30 30 30 30 31 20 20 20 20 20 20 20 20 35 | ASCII String 53066467E 4 400160000001 5 |
| Message Length | 00 18 | Decimal Value = 24 |
| Message | 35 33 30 36 38 34 35 32 58 20 20 20 20 20 20 20 34 20 20 20 31 30 30 | 53068452X 4 100 |

9.1.3 Heartbeat message

| MESSAGE TYPE | CHIXMMD FEED MESSAGE |
|-------------------|--|
| Heartbeat Message | 00 00 03 16 00 00 32 30 31 30 30 39 30 33 30 30 2010090300 |

| FIELD | HEX | MEANING |
|-----------------|----------------------------------|----------------------------|
| Sequence Number | 00 00 03 16 | Decimal Value = 790 |
| Message Count | 00 00 | Always zero |
| Session ID | 32 30 31 30 30 39 30 33 30 30 | ASCII String 2010090300 |

9.2 Market Data Messages

9.2.1 Order added then fully trades. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message |
|---|---|
| Sell of 100 RIM shares entered at 85.89. Order Ref of 113 assigned. | 58473879A 113S 100RIM 858900001 |
| Matching buy order entered and trade results with Trade Ref 1000060. Both sides are anonymous by default for Nasdaq CXC. (Nasdaq CX2 is not anonymous by default) | 58474382E 113 100 1000060 114 001001 |

| Action | CHIXMD Message |
|--|---|
| Sell of 100 RIM shares entered at 85.89. Order Ref of 172 assigned. On the order Tag Anonymous (6761)=N, but add message will show 001 for Nasdaq CXC only (Nasdaq CX2 would show the appropriate broker #). | 58549449A 172S 100RIM 858900001 |
| Matching buy order entered and trade results with Trade Ref 1000094. | 58549950E 172 100 1000094 173 007001 |

Note: There is no Add Order message for the buy order. It is not displayed on the book so no alert goes out.

Note: The Execution message has no price. The consumer must infer the execution price based on the limit of the original order.

9.2.2 Order added, fully trades and residual amount of matching order is placed on the book. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message |
|---|---|
| Buy of 200 RIM shares entered at 85.89. Order Ref of 269 assigned. | 60674054A 269B 200RIM 858900001 |
| Matching sell order entered for 100 shares of RIM. Execution message sent with Trade Ref 1000146. | 60674557E 269 100 1000146 270 001007 |

9.2.3 Pegged/Market Order added to book. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message |
|--------|----------------|
|--------|----------------|

| | | | | |
|---|-----------|------|--------|-----------|
| Sell of 800 RIM shares entered with a pegged order attribute. Order Ref 296 assigned. The display price is 85.95. | 60688465A | 296B | 800RIM | 859500001 |
| Each time the price moves and this order is re-priced a Cancel is sent. | 61205976X | 296 | 800 | |
| Then an Add message is sent but note that the Order Ref is the same. The display price is now 85.88. | 61205977A | 296B | 800RIM | 858800001 |

Note: Market orders will behave in the same way as above.

9.2.4 Price Revision. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message | | | |
|--|----------------|------|--------|-----------|
| Sell of 300 RIM shares entered. Order Ref 273 assigned. The display price is 85.99. | 60676069A | 273S | 300RIM | 859900001 |
| Price is revised to 85.89. Cancel is sent. | 60676585X | 273 | 300 | |
| Then an Add message is sent but note that the Order Ref is the same. The display price is now 85.89. | 60677089A | 273S | 300RIM | 858900001 |

9.2.5 Revision of Order Quantity Down. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message | | | |
|--|----------------|------|---------|-----------|
| Sell of 1000 RIM shares entered. Order Ref 276 assigned. The display price is 85.89. | 60678601A | 276S | 1000RIM | 858900001 |
| The order is then revised in quantity down by 500 shares; a Cancel message informs the consumer of this. | 60679106X | 276 | 500 | |

Note: The consumer is expected to calculate the residual amount of the original order still open.

9.2.6 Revision of Order Quantity Up. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message | | | |
|--|----------------|------|---------|-----------|
| Sell of 1000 RIM shares entered. Order Ref 278 assigned. The display price is 85.88. | 60680113A | 278B | 1000RIM | 858800001 |
| The order is then revised in quantity up by 500 shares, a Cancel message is sent. | 60680619X | 278 | 1000 | |
| Then an Add message is sent but note that the Order Ref is the same. The display quantity is now 1500. | 60680619A | 278B | 1500RIM | 858800001 |

9.2.7 Order Revision Results in Execution. *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message | | | |
|--|----------------|------|--------|-----------|
| A visible buy order for 300 RIM shares is placed on the book with a display price of 85.89. Anonymous (6761)=Y or blank. | 60675564A | 272B | 300RIM | 858900001 |

| | | | | |
|--|-----------|------|--------|--------------------|
| A visible sell order of 300 shares is placed on the book with a display price of 85.99. Anonymous=N, Broker=123. 001 shows on the Add message for Nasdaq CXC. 123 shows on the Add message for Nasdaq CX2. | 60676069A | 273S | 300RIM | 859900001 |
| The sell order is revised to a display price of 85.89. This results in a Cancel message. | 60676585X | 273 | 300 | |
| Then the sell order trades and an Execution message is sent. The broker shows anonymous. The Contra broker is attributed to TSX Broker Number 123. | 60676585E | 272 | 300 | 1000148 273 001123 |

9.2.8 Execution of a Fully Hidden Order (Minimum Fill)

| Action | CHIXMD Message |
|---|--|
| A non-displayed minimum fill sell order of 3000 RIM shares is put on the book with a price of 85.89. | [No message for non-displayed order] |
| A visible buy order of 3000 shares is entered at 85.89, Anonymous=N, Broker 123. This results in a Trade message against the hidden order quantity. The Contra broker is attributed to TSX Broker Number 123. | 60682140P 0B 3000RIM 858900 1000152 281123001 |

9.2.9 Trades against a Partially Hidden Order (Iceberg). *Not applicable to Nasdaq CXD.*

| Action | CHIXMD Message |
|--|--------------------------------------|
| A sell order of 10,000 RIM shares is put on the book with a visible quantity of 1000 shares, price is 85.89, Anonymous=N, Broker=123. This results an Add message for the visible amount. 001 shows on the Add message for Nasdaq CXC or 123 for Nasdaq CX2. | 60682681A 282S 1000RIM 858900001 |
| A Buy order for 500 shares is entered and crosses. 500 shares remain on the book. The Broker is attributed to TSX Broker Number 123. | 60683178E 282 500 1000153 283 123001 |
| Then a Buy order for 4000 shares is entered and crosses against the iceberg. We first get a visible trade of 500 shares. The Broker is attributed to TSX Broker Number 123. | 60683681E 282 500 1000154 284 123001 |

| | | | | | |
|--|------------------------|------|---------|-----------|---------|
| Then a Trade is sent against the not visible quantity of 3500 shares. The Broker is attributed to TSX Broker Number 123. | 60683681P 284123001 | 0B | 3500RIM | 858900 | 1000154 |
| Finally the peak is refreshed onto the book. An Add message is sent for 1000 shares. | 60683681A | 285S | 1000RIM | 858900001 | |

9.2.10 Trade Cancellation (Bust). Only Broken Trade message applicable to Nasdaq CXD.

| Action | CHIXMD Message |
|--|--|
| A sell order of 100 RIM shares is put on the book. The display price is 85.89. This results an A message for the visible amount. | 60643017A 206S 100RIM 858900001 |
| An Execution message is generated by a matching order. The Trade Ref is 1000111. | 60643519E 206 100 1000111 207 001001 |
| Then the trade is cancelled by Nasdaq. A Broken Trade message goes out for each side of the trade. | 62460063B 1000111 62460064B 1000111 |

9.2.11 Trade Correction. Only the Broken Trade message followed by a Print message is applicable to Nasdaq CXD.

| Action | CHIXMD Message |
|---|---|
| A sell order of 1000 ECA shares is put on the book. The display price is 10.00. This results an A message for the visible amount. | 33469031A 47B 1000ECA 100000001 |
| An Execution message is generated by a matching order. The Trade Ref is 0000010. | 33475511E 47 1000 0000010 48 001001 |
| Then the trade price is corrected. | 33528041B 0000010 33528041P 0B 1000ECA 100100 0000010 0001001 |