



Quantum RTMD

Protocol Specification and Service Access Guide

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About This Document

Purpose

This document defines the technical requirements and protocol considerations that need to be addressed by data vendors interested in subscribing to Quantum RTMD or migrating from the existing market data services to Quantum RTMD.

Scope

This specification describes the services provided by TMX for market data dissemination. It does not deal with issues of order entry or order routing. The document focuses on the protocol for market data message dissemination as opposed to the format used for business content. Information about business content specific to each service is provided in References [1] to [8].

Intended audience

This document is intended for direct recipients of TMX market data, including:

- Business staff involved with market data and its dissemination
- Software developers
- Network and other support personnel

Chapter 1 Introduction

1.1 Infrastructure for market data dissemination

Market data dissemination on the TMX Quantum infrastructure provides the following benefits:

- Message framing is standardized across all services, to facilitate use of common feed readers.
- Use of the IP multicast protocol for feed delivery provides better scalability and flexibility. Vendors can subscribe to only the feeds they need.
- Message recovery for each service uses reliable TCP/IP for both requests and responses.
- Dual feeds for each service facilitate message arbitration and hence reduce the number of recoveries required.
- Benefiting from the TMX Quantum infrastructure, low latencies can be achieved in each service.

1.2 Feed naming convention

Names of feed services follow the format TLx, CLx, and ALx

- T indicates that the feed is from TSX.
- C indicates that the feed is from TSX Venture.
- A indicates that the feed is from Alpha.
- Lx (where x = 1 or 2) stands for Level 1 or Level 2.

TMX feeds may be disseminated on one or more partitions. To obtain the complete feed, the client must read at least one instance of all the partitions for the given feed type.

A feed disseminated on a particular multicast channel can be uniquely identified by the Feed Service, Feed Partition and Feed Instance. The naming convention of the feeds is: Feed Name = Feed Service-Feed PartitionFeed Instance.

- The Feed Partition is a two-digit number.
- The Feed Instance is a single letter.

For example:

- The TL1 feed has two partitions with two instances each, called TL1-11A, TL1-11B, TL1-21A, and TL1-21B. To receive the complete feed, the client must subscribe to TL1-11A and TL1-21A or TL1-11B and TL1-21B
- The CL2 feed has one partition and two instances, CL2-11A and CL2-11B.

1.3 Disseminating partitioned feeds

Figure 1 and Figure 2 show the feeds and recoveries for feeds with one partition and two partitions.

Figure 1: Feeds and recoveries, one partition

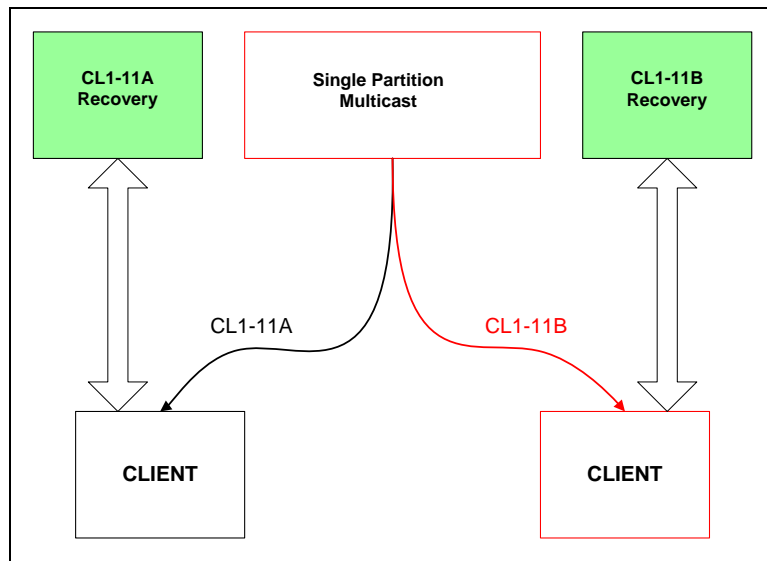
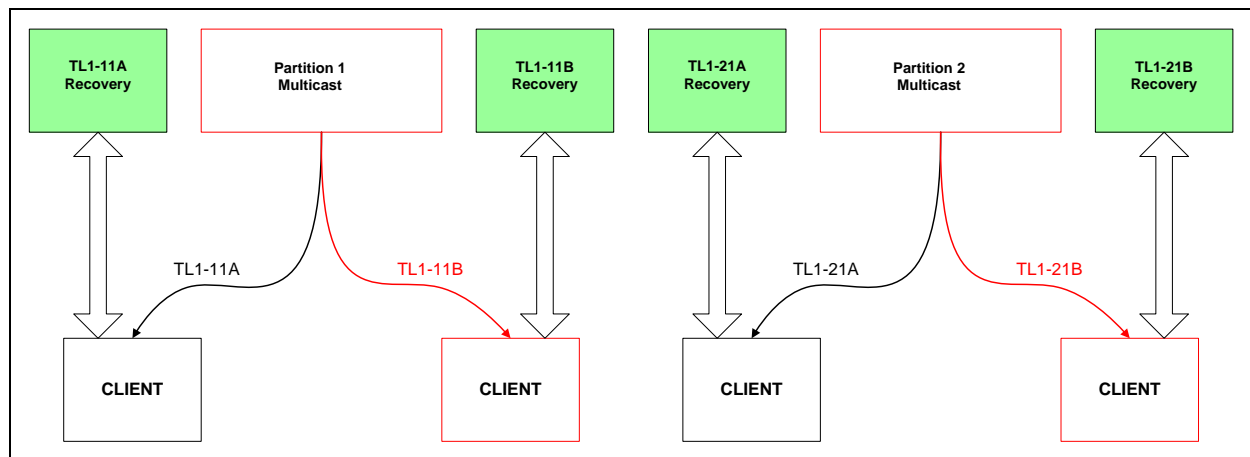


Figure 2: Feeds and recoveries, two partitions



Chapter 2 Service Message Protocol

2.1 Offered services

In its role of market data administrator for the Canadian Exchange Group (CEG), TMX distributes market data for the following markets:

Service	Identifier	Business Content Format	Content
Toronto Level 1	TL1	Fixed-length fields	TSX market (Trades, Quotes, Index, and Summaries)
TSX Venture Exchange Level 1	CL1	Fixed-length fields	TSX Venture Exchange market
Alpha Level 1	AL1	Fixed-length fields	Alpha
Toronto Level 2	TL2	STAMP	TSX market (Trades and Orders, except encrypted private content)
TSX Venture Exchange Level 2	CL2	STAMP	TSX Venture Exchange market (Trades and Orders)
Alpha Level 2	AL2	STAMP	Alpha
Index Service Level 1	TX1	Fixed-length fields	Closing values and constituents of S&P/TSX index
Reference Data Feed	TRD/VRD	Fixed-length fields	TSX and TSX Venture Exchange markets (equity summaries, dividend information, and bulletins)

The transport layer for feed distribution uses IP multicast and the recovery channel use the Transmission Control Protocol (TCP).

2.2 Framing

Each market data market message uses the following basic structure:

STX	Header	Message	ETX
-----	--------	---------	-----

where:

- STX is the Start of Text character, or Hex 02.
- ETX is the End of Text character, or Hex 03.
- Message is the original market data content received from the originating exchange.
- Header is a 22-byte section coded in ASCII and structured as follows:

Field	Length	Contents
Length	4	Total length of header and message business content (excludes STX and ETX), padded with zeros to the left.
Sequence Number	9	Sequence number assigned at service broadcast, padded with 0s to the left. Blank on Heartbeat messages.
ServiceID	3	Service code identifying the service as defined in Section 2.1.
Recovery Identifier	1	0 – Normal transmission
Continuation Indicator	1	0 – A stand-alone packet. (All of the message fits in one packet).
Message Type	2	Unique code assigned to each message type, specific to each market service. Left-justified, padded with blanks.
Exchange Identifier	2	Code assigned to the originating exchange (padded with blanks to the right): <ul style="list-style-type: none"> • T – Toronto Stock Exchange • V – TSX Venture Exchange • A – TSX Alpha Exchange

Every message is assigned a sequence number from 000000001 to 999999999 (decimal ASCII), with wrap-around. The sequence is reset to 1 each day and incremented by 1 for each packet sent.

The Message portion of the frame contains business content; this is specific to each service and market and follows the respective specification (see References [1] to [8]).

2.2.1 Recovery Identifier

The Recovery Identifier field is used for normal transmission only.

The value of the Recovery Identifier field is set as follows:

0 - Used for normal transmission, except Heartbeat messages, on which it is always blank.

NOTES:

- The Recovery Identifier is *not* used to mark messages requested for recovery by customers.
- The Recovery Identifier field value is not changed when messages are sent on a Recovery requested by a customer.

2.2.2 Continuation Indicator

The header provides for message fragmentation by means of the Continuation Indicator field, to allow for the possibility of market messages exceeding the Maximum Transmission Unit (MTU) size used with the IP protocol¹. The maximum message size used by TMX is set at 1,400 bytes. The Continuation Indicator is set as follows:

0 - This is a stand-alone packet (all messages fit in one packet).

¹For IEEE 802.3, the MTU is 1,492 bytes.

2.3 Heartbeat message

The Heartbeat message is unsequenced and used for circuit assurance. It is sent only when the feed is idle for a consecutive 60 seconds.

The Heartbeat message provides three informative sections regarding real-time message delivery, delimited by square brackets:

- HEARTBEAT section, including the date and time and decimal seconds since 1970 up to the microsecond
- LAST SENT section, including the sequence number of the last message sent, time sent, and decimal seconds up to the microsecond
- LAST HB section, including the last sent information passed in the last Heartbeat message sent.

The Heartbeat message allows clients to track real-time delivery latencies. The following layout defines the contents of the Heartbeat message (message type “V “):

Field	Length	Value	Description/Format
	1	“[“	Separator
	10	“HEARTBEAT”	Section identifier
Date	10		Date in format YYYY-MM-DD
	1	blank	Separator string
TimeOfDay	8		Time of day in format HH:MM:SS
	1	“-“	Separator string
SecondsSince1970	19	6 decimals with embedded decimal point	Formatted with “%012d.%06d” in C language
	2	“][“	Separator
	10	“LAST SENT “	Section identifier
SeqNbrOfLastMsgSent	9		Last sequence number sent, padded with 0s to the left
	1	“-“	Separator
TimeLastMsgSent	8		Time last message sent in format HH:MM:SS
	1	“-“	Separator
SecondsSince1970LastMsg	19	6 decimals with embedded decimal point	Formatted with “%012d.%06d” in C language
	2	“][“	Separator
	10	“LAST HB “	Section identifier – Last Heartbeat data, right-padded with blanks
SeqNbrOfLastMsgSent	9		This number lets the client know if they missed a heartbeat`

Field	Length	Value	Description/Format
	1	"_"	Separator
TimeLastMsgSent	8		Time last message sent in format HH:MM:SS in last heartbeat
	1	"_"	Separator
SecondsSince1970LastMsg	19	6 decimals with embedded decimal point	Formatted with "%012d.%06d" in C language in last heartbeat
	1	"J"	Separator
Feed Name	20	E.g., "TL2-11A"	Feed Service-Feed PartitionFeed Instance
Reserved	2		Padded with spaces
Hostname	8	"Primary" or "DR"	Originated Host
Version	4	E.g., "2.00"	Version of the service being delivered

Total length: 185

The length of the message with header included is 207 bytes.

2.4 Multicast addressing

TMX broadcasts each service using the Protocol Independent Multicast (PIM) Sparse Mode routing protocol.

TMX market data services are available for delivery over Multicast protocol, public, or globally unique, IP multicast addresses. Public IP multicast addresses are specified as per RFC 2770 (GLOP addresses) and are available for use on a public network. (See Reference [13]).

Different IP multicast group addresses are assigned to each service and each site. For addresses of multicast groups, refer to Section 4.3.2.

Chapter 3 Service Recovery

The new services provide a recovery capability for clients to handle situations of missed messages. *Only client-initiated recovery is provided.* This section defines the recovery protocol and message formats.

3.1 Client-initiated recoveries

At the client's end, the feed reader must track the integrity of the message stream using message sequence numbers. Upon detection of one or more missing messages, a Recovery Request can be submitted to have the missed data resent.

Recovery Requests are sent to a TMX-assigned IP address and port number using the TCP protocol. The request includes the missing sequence numbers. If the request is accepted, the requested messages are retransmitted on the associated recovery port number for the service using the same TCP/IP session.

Recoveries are reliable and requested messages are sent using the same session.

The following constraints exist on Recovery Requests:

- Recoveries can only be requested by sequence ranges. Recovery by date or by time is not supported.
- Recovery Requests are limited to a maximum threshold value per session. If more than the threshold value messages are requested, the request is rejected, and the Recovery Request must be submitted to another recovery service. For more information about the threshold value, contact Vendor Services.
- Only one recovery per session is supported at any one time. Recovery Requests submitted when a client-initiated recovery is in progress are queued and if allowable limits are exceeded, they will be rejected.

Recovery functionality for the TL2 feed is split into two channels - regular recovery (<1,000,000 messages) and long recovery (all messages):

- **Regular recovery:** Allows clients to recover less than 1 million messages in a single request. The messages available are the latest rolling 1 million messages.
- **Long recovery:** Allows clients to request back to message 1 at any point during the day.

Each channel has a unique IP address and clients will need a port or ports on each channel.

To confirm the presence of an active connection when messages are not being sent, Heartbeat messages are sent to the client's recovery session every 60 seconds.

Original Heartbeat messages sent with the real-time service delivery are not retransmitted.

3.2 Recovery availability

Recovery is available to clients on demand. However, TMX may disable recovery for some services at certain times of day. In this case, Recovery Requests received during these periods will be denied.

3.3 Recovery Protocol

The Recovery Protocol provided consists of:

- An IP address and port number for each service provided, assigned by TMX
- A Recovery Request sent by the client via TCP
- An Acknowledgement Response sent to the client by TMX via TCP
- The recovery stream, sent via the same TCP session, including header, requested market data, and trailer, optional Error Report, and Heartbeat messages

3.3.1 Message flow

To start a recovery, clients connect using TCP to the IP address and port number of the TMX recovery server for the service.

Quantum RTMD responds to each received Recovery Request with an acknowledgment that is also sent in TCP. It then sends market data requested for recovery to the client's recovery session via TCP.

The following table summarizes the recovery message flow between service recipients and TMX:

Quantum RTMD	Flow	Client (Protocol)
	< =====	TCP Recovery Request
Acknowledgment Response	===== >	TCP
StartOfTransmission Header	===== >	TCP Recovery Stream
First Retransmitted Message	===== >	TCP
...		
Last Retransmitted Message	===== >	TCP
EndOfRecovery Trailer	===== >	TCP
Error Report	===== >	TCP Sent only if recovery is interrupted

The Error Report is optional and is sent only when a recovery fails to complete normally.

3.3.2 Recovery Request

Only Request by Sequence Number is available.

Request by Sequence Number

Field	Length	Value	Description
FormatCode	4	"SEQN"	Message Sequence Number format
StartSeqNbr	9	≥ 1	Padded with 0s to the left
EndSeqNbr	9	$\geq \text{StartSeqNbr}$	Padded with 0s to the left

Messages with sequence number starting with StartSeqNbr and ending with EndSeqNbr inclusive are sent. The number of messages to be retransmitted is (EndSeqNbr – StartSeqNbr + 1).

Note: Quantum RTMD processes only the first 22 characters for a SEQN type request. Any more data appearing past these limits is ignored.

STX and ETX characters are not used on the Recovery Request or the Acknowledgement Response sent over TCP.

3.3.3 Acknowledgement Response

Field	Length	Value	Description
ResponseCode	4	"ACK " or "NACK"	Left-justified. Indicates success or failure
StartSeqNbr	9	Padded with zeros	0 is used when no data is sent
EndSeqNbr	9	Padded with zeros	0 is used when no data is sent
StatusCode	8	"ACCEPTED" "INVALID" "DENIED" "REJECTED"	
ErrorDescription	100	ASCII text	More information about the error
ReceivedRequest	50	ASCII text	Recovery request string received from client

The Acknowledgement Response contains an ACK code and Start and End sequence numbers of 0 when no data exists to be sent.

The Recovery Requests and Acknowledgement Response do not include STX/ETX framing or header sections.

ErrorDescription includes one of the following values, depending on the StatusCode:

- ERR001: Wrong command code
- ERR002: Wrong command parameters
- ERR003: Requested message count is too large

- ERR004: Unable to Satisfy Request at this Time. Please try again later.
- ERR005: Recovery already in progress to this recipient.
- ERR006: Recoveries are disabled at this time. Please try again later.
- ERR008: Request not allowed, IP address not recognized.
- ERR009: Requested sequence number greater than last broadcast sequence.

The ReceivedRequest field is not populated when error ERR006 (disabled recoveries) or ERR008 (IP address validation failure) occurs.

3.3.4 Message format for recoveries

Except for the Recovery Request and Acknowledgement Response, all other messages are sent using the following frame format:

STX	Header	Message	ETX
-----	--------	---------	-----

where

- STX is Hex 02.
- ETX is Hex 03.
- The Header section is the same 22-byte ASCII section defined in Section 2.2.
- Message is the original message being retransmitted or one of the recovery control messages, as described in Section 3.3.5.

For market messages being resent, the header and business content of the original message are sent. For recovery control messages described in Section 3.3.5, the header is populated except that fields Sequence Number, Recovery Identifier and Message Type are left blank.

For each of the recovery response messages described in Section 3.3.5 (Header Control Message, Trailer Control Message, Error Report, and Heartbeat), the framing characters STX, ETX, and Header are not explicitly shown. For these messages, the header is populated as follows:

Field	Length	Contents
Length	4	Total length of header and message business content (excludes STX and ETX)
Sequence Number	9	Blank
ServiceID	3	Service identifier code to uniquely identify the service. Refer to Section 2.1.
Recovery Identifier	1	Blank
Continuation Indicator	1	0
Message Type	2	Blank
Exchange Identifier	2	<ul style="list-style-type: none"> • "T" for TSX • "V" for TSX Venture • "A" for Alpha

3.3.5 Recovery stream

The recovery stream will include the following:

- Recovery Header control message
- Market data messages being retransmitted (content depends on the service being used)
- End Of Recovery Trailer control message
- Error Report control message (if an error occurs)
- Heartbeat control messages

Recovery Header control message

Field	Length	Value	Description
TypeCode	5	"HDR "	
StartSeqNbr	9	>=1	Padded with 0s to the left
EndSeqNbr	9	>= StartSeqNbr	Padded with 0s to the left

The StartSeqNbr and EndSeqNbr provide the sequence numbers to expect.

Recovery Trailer control message

Field	Length	Value	Description
TypeCode	5	"TLR "	
CountOfMessages Requested	9	Integer	>= 0
CountOfMessages Sent	9	Integer	(MessagesSent <= MessagesRequested)
StatusMessage	100	ASCII text	Optional status information

Note: If a client requests more messages than the maximum number allowed for the service, the CountOfMessagesRequested will be greater than the CountOfMessagesSent. In this case, the StatusMessage indicates "Maximum request size exceeded."

Error Report

The Error Report message is sent only when a scheduled recovery does not complete normally.

Field		Value	Description
TypeCode	5	"ERROR"	
ErrorCode	8	"EXPIRED"	EXPIRED: Messages no longer available
ErrorDescription	100	ASCII text	More information about the error.

The code EXPIRED is sent when the requested messages are no longer available. The ErrorDescription field contains more description of the error detected.

Recovery Heartbeat

Field	Length	Value	Description
TypeCode	5	"HBEAT "	
	1	"["	Separator
	10	"HEARTBEAT"	Section identifier
Date	10		Date in format YYYY-MM-DD
	1	blank	Separator string
TimeOfDay	8		Time of day in format HH:MM:SS
	1	"_"	Separator string
SecondsSince1970	19	6 decimals with embedded decimal point	Formatted with "%012d.%06d" in C language
	1	"]"	Separator
Hostname	8		ID of the originating host
Version	4		Version of the service being delivered
MaxMessages	9		Maximum number of messages allowed per Recovery Request

To inform the remote side that the recovery service is active, the Quantum RTMD sends the Recovery Heartbeat message every 60 seconds on each service's recovery session. The sequence number in the header is blank. The length of this message, including header, is 99 characters.

Heartbeat messages sent during the original real-time service delivery are not retransmitted.

3.3.6 Other considerations

When developing code for handling recoveries, consider the following:

- Recovery will be provided within the established TCP session.
- No data messages will flow on the recovery stream if the Recovery Request is not accepted.
- An Error Report is not sent when the number of messages requested exceeds the set limit. For information on message limit thresholds, contact Vendor Services.
- If the number of requests or the frequency of the requests exceeds the predefined thresholds allowed, ERR004 is returned in the Acknowledgement Response message.

When the Recovery Request is validated by the TMX market data system, the following outcomes are possible:

- The request is accepted and honoured.
The StartSeqNbr and EndSeqNbr fields are set to the corresponding sequence numbers. The ResponseCode is set to "ACK" and StatusCode is set to "ACCEPTED". The requested data is sent in the recovery stream.
- The request is correctly formed but there is no data to send.
This could happen when the Recovery Request references data not yet eligible for recovery; for example, "read ahead" in a delayed service. In this case, the Acknowledgement Response message is set to "NACK", StatusCode is set to "REJECTED", StartSeqNbr and EndSeqNbr are set to 0, and ErrorDescription is set to ERR009.
- The Recovery Request is accepted, but only a portion of the requested messages are retransmitted.
This can happen when the number of messages requested exceeds the limit set by TMX. The ResponseCode is set to "ACK", the StatusCode is set to "ACCEPTED", and the maximum allowed number of retransmitted messages is sent in the recovery stream. The End Of Transmission Trailer indicates the count of requested messages and count of messages sent.
- The request is rejected as invalid because of incorrect format, invalid start and end sequence numbers or times, or a source IP address that is not recognized.
The ResponseCode is set to "NACK", the StatusCode is set to "INVALID", StartSeqNbr and EndSeqNbr are set to 0, and ErrorDescription is set to the corresponding error message. The RequestReceived field is set to the user request received.
- The request is valid but is denied because TMX has disabled client recoveries for the required service when the recovery was requested.
ResponseCode is set to "NACK", StatusCode is set to "DENIED", and the ErrorDescription is set to ERR006.

In case of a loss of connectivity to TMX or other failure, when receiving the acknowledgement response message, use a time-out no longer than one minute.

On a Recovery Request, the recovery response will contain no data if data is no longer available for recovery because the allowable range is exceeded. An Error report with EXPIRED is returned.

Chapter 4 Technical Requirements

4.1 Service bandwidth allocation

Bandwidth allocation is the minimum bandwidth, expressed as megabits per second, required to deliver a service without loss of packets.

A pre-set bandwidth allocation for each service is a requirement. The UDP protocol does not use session state or acknowledgements, and lack of bandwidth may lead to missed packets and client recoveries.

The bandwidth used by a service depends on volume of trading activity in each market and may change over time.

The network path from the receiving router to the destination host on the recipient's local LAN must also be dedicated or isolated to prevent dropped UDP packets.

4.2 Recovery bandwidth allocation

The recovery bandwidth required depends on the number of recoveries and is limited by the bandwidth of the client's circuit.

4.3 IP addresses

To establish the subscription to a service over IP multicast, three IP addresses are involved:

- The Protocol Independent Multicast Rendezvous Point address defined at the router level to be joined by the customer is 142.201.227.254 for Production multicast groups. The GTE multicast groups use different Rendezvous Point (RP) addresses, which are provided in Section 4.3.3.
- The Service IP multicast group addresses and ports to which the market data is disseminated (See Section 4.3.2)
- Recovery IP addresses, which are provided as part of the recovery bundle

4.3.1 Joining a multicast group

To join the multicast group for the service, clients receiving the service through IP multicast should:

1. Bind the IP socket to the port number assigned to the service,
2. Add the IP address of the multicast group to the socket.

4.3.2 Public IP addresses and port numbers – Production

QRTMD Production feed source and recovery IP addresses are advertised to clients as four segments with a 26-bit mask:

- TL1/CL1/TL2/CL2-11A: 142.201.226.0/26
- TL1/TL2/AL1/AL2-21A: 142.201.226.64/26
- TL1/CL1/TL2/CL2-11B: 142.201.226.128/26
- TL1/TL2/AL1/AL2-21B: 142.201.226.192/26

Feed Name	Feed			Recovery
	Group IP	Port	Source IP	Recovery IP
TL1-11A	224.0.72.13	30680	142.201.226.1 142.201.226.2	142.201.226.3
TL1-11B	224.0.72.77	30685	142.201.226.129 142.201.226.130	142.201.226.131
TL1-21A	224.0.72.29	30681	142.201.226.65 142.201.226.66	142.201.226.67
TL1-21B	224.0.72.93	30686	142.201.226.193 142.201.226.194	142.201.226.195
TL2-11A	224.0.72.14	30690	142.201.226.1 142.201.226.2	142.201.226.4 142.201.226.7 (Long)
TL2-11B	224.0.72.78	30695	142.201.226.129 142.201.226.130	142.201.226.132 142.201.226.135 (Long)
TL2-21A	224.0.72.30	30691	142.201.226.65 142.201.226.66	142.201.226.68 142.201.226.70 (Long)
TL2-21B	224.0.72.94	30696	142.201.226.193 142.201.226.194	142.201.226.196 142.201.226.198 (Long)
TRD-11A	224.0.72.40	30730	142.201.226.1 142.201.226.2	142.201.226.25
TRD-11B	224.0.72.64	30735	142.201.226.129 142.201.226.130	142.201.226.145
TRD-21A	224.0.72.42	30906	142.201.226.65 142.201.226.66	142.201.226.71
TRD-21B	224.0.72.61	31081	142.201.226.193 142.201.226.194	142.201.226.192
TX1-11A	224.0.72.12	30720	142.201.226.1 142.201.226.2	142.201.226.8
TX1-11B	224.0.72.76	30725	142.201.226.129 142.201.226.130	142.201.226.136

Feed Name	Feed			Recovery
	Group IP	Port	Source IP	Recovery IP
CL1-11A	224.0.72.15	30700	142.201.226.1 142.201.226.2	142.201.226.5
CL1-11B	224.0.72.79	30705	142.201.226.129 142.201.226.130	142.201.226.133
CL2-11A	224.0.72.16	30710	142.201.226.1 142.201.226.2	142.201.226.6
CL2-11B	224.0.72.80	30715	142.201.226.129 142.201.226.130	142.201.226.134
VRD-11A	224.0.72.41	30740	142.201.226.1 142.201.226.2	142.201.226.26
VRD-11B	224.0.72.63	30745	142.201.226.129 142.201.226.130	142.201.226.146
AL1-21A	224.0.72.135	30826	142.201.226.65 142.201.226.66	142.201.226.29
AL1-21B	224.0.72.142	30833	142.201.226.193 142.201.226.194	142.201.226.201
AL2-21A	224.0.72.136	30827	142.201.226.65 142.201.226.66	142.201.226.30
AL2-21B	224.0.72.143	30834	142.201.226.193 142.201.226.194	142.201.226.202

Note: **PIM:** sparse mode
RP: 142.201.227.254
Multicast subnet: 224.0.72.0/24

4.3.3 Public IP addresses and port numbers – GTE

QRTMD GTE feed source and recovery IP addresses are advertised to clients as one segment with a 24-bit mask: 142.201.223.0/24

Feed Name	Feed			Recovery IP
	Group IP	Port	Source IP	
TL1-11A	233.102.209.12	37710	142.201.223.112	142.201.223.120
TL1-11B	233.102.209.14	37711	142.201.223.113	142.201.223.125
TL1-21A	233.102.209.67	37712	142.201.223.114	142.201.223.130
TL1-21B	233.102.209.90	37713	142.201.223.115	142.201.223.135
TL2-11A	233.102.209.13	37720	142.201.223.112	142.201.223.121 142.201.223.145 (Long)
TL2-11B	233.102.209.34	37721	142.201.223.113	142.201.223.126 142.201.223.146 (Long)
TL2-21A	233.102.209.79	37722	142.201.223.114	142.201.223.131 142.201.223.118 (Long)
TL2-21B	233.102.209.124	37723	142.201.223.115	142.201.223.136 142.201.223.119 (Long)
TRD-11A*	224.0.106.18	37760	142.201.223.112	142.201.223.234
TRD-11B*	224.0.106.146	37761	142.201.223.113	142.201.223.236
TRD-21A*	224.0.106.82	37782	142.201.223.114	142.201.223.147
TRD-21B*	224.0.106.210	37783	142.201.223.115	142.201.223.148
TX1-11A	233.102.209.22	37750	142.201.223.112	142.201.223.133
TX1-11B	233.102.209.41	37751	142.201.223.113	142.201.223.134
CL1-11A	233.102.209.53	37730	142.201.223.112	142.201.223.122
CL1-11B	233.102.209.93	37731	142.201.223.113	142.201.223.127
CL2-11A	233.102.209.54	37740	142.201.223.112	142.201.223.123
CL2-11B	233.102.209.94	37741	142.201.223.113	142.201.223.128
VRD-11A*	224.0.106.19	37770	142.201.223.112	142.201.223.235
VRD-11B*	224.0.106.147	37771	142.201.223.113	142.201.223.237
AL1-21A*	224.0.106.135	37862	142.201.223.114	142.201.223.198
AL1-21B*	224.0.106.142	37863	142.201.223.115	142.201.223.205
AL2-21A*	224.0.106.136	37872	142.201.223.114	142.201.223.199
AL2-21B*	224.0.106.143	37873	142.201.223.115	142.201.223.206

Note: **PIM** = sparse mode, **RP** = 142.201.52.1 except for feeds marked with * for which it is 142.201.223.254, **Multicast subnet** = 233.102.209.0/25 except for feeds marked with * for which it is 224.0.106.0/24

4.3.4 Port number for real-time data dissemination over multicast

This is the port number clients must listen to when receiving real time data for the service using the IP Multicast protocol.

4.3.5 Port number for Recovery Requests over TCP

Recovery Requests for a service use TCP and are available through a bundle request.

4.4 Operating cycle

All services follow a daily operating cycle on which message sequence numbers revert back to 000000001. Sequence number roll-over is scheduled at 0:30 a.m. Eastern Time for all services. For specific operating sequence details, refer to the functional specifications of each service; see References [1] to [8].

4.5 Feed reader software and integrity checking

Recipients of TMX market data are responsible for creating their feed reader software to receive the new services. The following are the main considerations for feed handlers:

- Use of IP Multicast protocol
- Differences in business content of the services delivered
- Supports message arbitration
- Support for the recovery layer to automate recovery of missed messages
- Possible instancing of the feed reader to handle multiple TMX services

Refer to the functional specifications (see References [1] to [8] on page 26) of each service for details about message contents.

Client feed handler software must check the integrity of the message stream by comparing sequence numbers. Sequence numbers for successive incoming messages should always increase by 1. If a gap of missing messages is detected, a recovery can be requested to have the missed messages resent by the TMX market data system, as described in Chapter 3.

During recovery after a service outage, duplicate messages might be sent by the TMX market data system. Duplicate messages should be discarded by clients.

Appendix A Glossary

Acronym	Meaning
ASCII	American Standard Code for Information Interchange
AL1	Alpha Level 1 service
AL2	Alpha Level 2 service
CEG	Canadian Exchange Group
CL1	TSX Venture Exchange Level 1 service
CL2	TSX Venture Exchange Level 2 service
GLOP	Allocation of IP address bits as per RFC 2770
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
IP	Internet Protocol
ITM	Insider Trade Summaries
LAN	Local Area Network
MTU	Maximum Transmission Unit
PIM	Protocol Independent Multicast
STAMP	Securities Trading Access Message Protocol
TCP	Transmission Control Protocol
TL1	TSX Level 1 service
TL2	TSX Level 2 service
TSX	Toronto Stock Exchange
TX1	Index Service Level 1
UDP	User Datagram Protocol
XATS	TSX Alpha Exchange, Alpha

Appendix B References

- [1] STAMP Specification, Version 7.20, TMX Group, June 2014.
- [2] QRTMD TL1/CL1 Functional Specifications, Version 1.4, TMX Group, June 2014.
- [3] QRTMD TL2/CL2 Functional Specifications, Version 1.10, TMX Group, June 2014.
- [4] QRTMD TRD/VRD Functional Specifications, Version 1.15, TMX Group, June 2014.
- [5] QRTMD TX1 Functional Specifications, Version 1.14, TMX Group, January 2014.
- [6] QRTMD AL1 Functional Specifications, Version 1.10, TMX Group, January 2015.
- [7] QRTMD AL2 Functional Specifications, Version 1.10, TMX Group, January 2015.
- [8] TMX Equity Market Multicast Service Access Guide, Version 2.3, January 2015.
- [9] RFC 791, Internet Protocol, J. Postel, September 1981, <http://www.ietf.org>.
- [10] RFC 792, Internet Control Message Protocol, J. Postel, September 1981, <http://www.ietf.org>.
- [11] RFC 793, Transmission Control Protocol, J. Postel, September 1981, <http://www.ietf.org>.
- [12] RFC 2117, Protocol Independent Multicast Sparse Mode, <http://www.ietf.org>.
- [13] RFC 2770, GLOP Addressing in 233/8, <http://www.ietf.org>

Appendix C Revision History

Version	Date	Changes
2.10	2015/02/11	Throughout, removed references to and information about TMX Select. In "Offered services", removed the SL2 feed. In "Public IP addresses and port numbers – Production", removed SL2 feeds and revised AL1 and AL2 feeds. In "Public IP addresses and port numbers – GTE", removed SL2 feeds and revised AL1 and AL2 feeds.
2.01	2013/06/12	Correction to Heartbeat message section about when the message is sent.
2.0	2012/12/04	Added Alpha-related content.
1.14	2012/05/14	Updated GTE IP addresses. In "IP addresses", clarified RP address description.
1.13	2012/03/09	Added TX1 IPs for Production environment and TRD/VRD IPs for GTE and Production environments.
1.12	2012/02/03	Added TX1 IPs for GTE environment.
1.11	2011/11/21	Corrected port number for TL2-21B feed in GTE.
1.1	2011/10/27	In "Offered services". removed ITM Service, and added Reference Data Feed, removed pointer to references. Added GTE IP and port information Updated "References".
1.0	2011/07/28	Document published



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