



Multicast PITCH Specification

Version 1.1

August 11, 2009

Overview

BATS members may use Multicast PITCH to receive real-time depth of book quotations and execution information direct from BATS. A WAN-Shaped and Gig-Shaped version of the Multicast PITCH feed will be available from both of BATS datacenters. Members may choose to take one or more of the 4 Multicast PITCH feeds options depending on their location and connectivity to BATS.

Multicast PITCH Feed Descriptions:

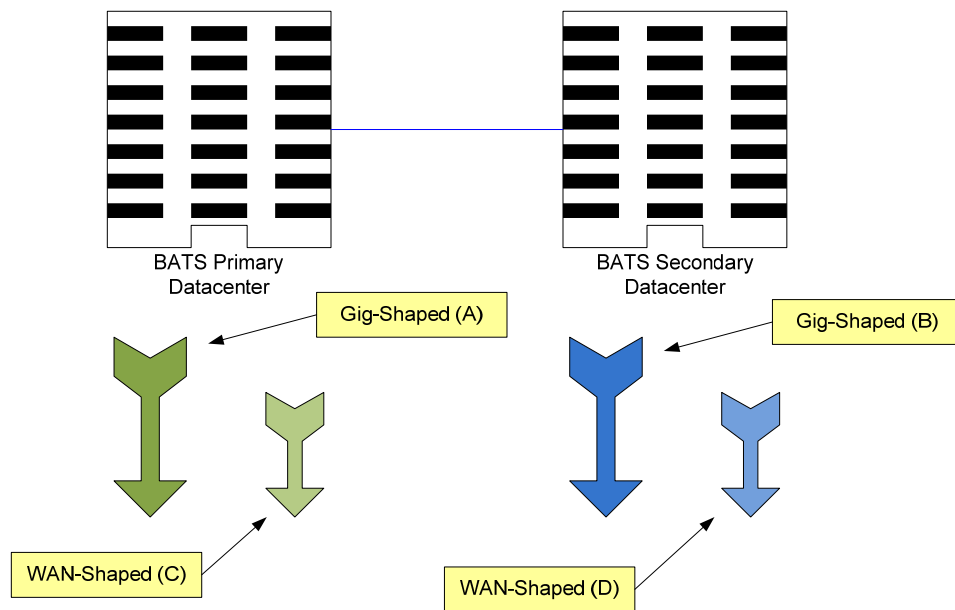
- *Gig-Shaped (A)* – Collection of multicast addresses and gap request infrastructure shaped for gigabit connectivity from BATS primary datacenter.
- *WAN-Shaped (C)* – Collection of multicast addresses and gap request infrastructure shaped for WAN connectivity from BATS primary datacenter.
- *Gig-Shaped (B)* – Collection of multicast addresses and gap request infrastructure shaped for gigabit connectivity from BATS secondary datacenter.
- *WAN-Shaped (D)* – Collection of multicast addresses and gap request infrastructure shaped for WAN connectivity from BATS secondary datacenter.

Feed Connectivity Requirements:

- Gig Shaped feeds are available to members with a minimum of 1 Gb/s of connectivity to BATS via cross connect or dedicated circuit.
- WAN-Shaped feeds are available to members who meet the minimum bandwidth requirements to BATS (see appendix) via cross connect, dedicated circuit, or a supported carrier.

Members with sufficient connectivity may choose to take both the Gig-Shaped and WAN-shaped feeds from one of BATS datacenters and arbitrate the feeds to recover lost data. Alternatively, members may choose to arbitrate feeds from both datacenters. It should be noted that feeds from the secondary datacenter will have additional latency for those co-located with BATS in the primary datacenter due to proximity and business continuity processing.

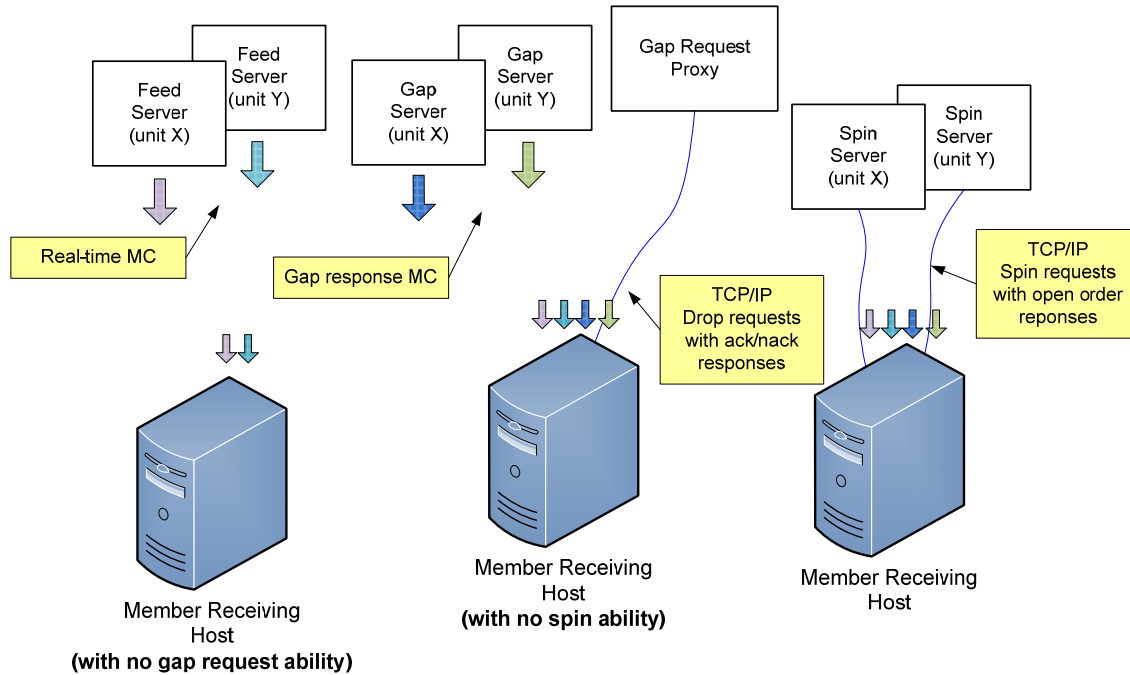
The following diagram describes the relationship between data centers and Multicast PITCH feeds.



BATS Multicast PITCH Specification

BATS Multicast PITCH real-time events are delivered using a published range of multicast addresses divided by symbol range units. Dropped messages can be requested using a TCP/IP connection to one of BATS' Gap Request Proxy (GRP) servers with replayed messages being delivered on a separate set of multicast ranges reserved for packet retransmission. Intraday, a spin of all open orders may be requested from a Spin Server. This allows a client to become current without requesting a gap for all messages up to that point in the day.

The following diagram is a logical representation of a BATS Multicast PITCH feed for two units.



Symbol Ranges, Units, and Sequence Numbers

Symbols will be separated into units by a published alphabetical distribution. Symbol distribution will not change intra-day. BATS does, however, **reserve the right to add multicast addresses or change the symbol distribution** with prior notice to members. Care should be taken to ensure that address changes, address additions, and symbol distribution changes can be supported easily.

Message sequence numbers are incremented by one for every sequenced message within a particular symbol unit. It is important to understand that one *or more* units will be delivered on a single multicast address. As with symbol ranges, unit distribution across multicast addresses will not change intra-day, but may change after notice has been given.

Symbol distribution across units as well as unit distribution across multicast addresses are identical for real-time and gap response multicast addresses.

Gap Request Proxy and Message Retransmission

Requesting delivery of missed data is achieved by connecting to a BATS Gap Request Proxy (GRP). Members who do not wish to request missed messages do not need to connect to a GRP for any reason or listen to the multicast addresses reserved for message retransmission. Members choosing to request missed data will need to connect to their assigned GRP, log in, and request gap ranges as necessary. All gap requests will be responded to with a Gap Response Message. A Gap Response Status code of Accepted signals that the replayed messages will be delivered via the appropriate gap response multicast address. Any other Gap Response status code will indicate the reason that the request can not be serviced.

Gap requests are limited in message count, frequency, and age by the GRP. Gap requests will only be serviced if they are within a defined sequence range of the current multicast sequence number for the requested unit. Members will receive a total daily allowance of gap requested messages. In addition, each member is given renewable one second and one minute gap request limits.

If more than one gap request is received for a particular unit/sequence/count combination within a short timeframe, all requests will receive a successful Gap Response Message from the GRP, but only a single replayed message will be sent on the gap response multicast address.

If overlapping gap requests are received within a short period of time, the gap server will only send the union of the sequence ranges across grouped gap requests. Members will receive gap responses for their requested unit/sequence/count, but receivers should be prepared for the **gap responses to be delivered via multicast in non-contiguous blocks**.

Gap acknowledgements or rejects will be delivered to users for every gap request received by the GRP. Users should be prepared to see replayed multicast data before or after the receipt of the gap response acknowledgement from the GRP.

Spin Servers

A Spin Server is available for each unit. The server allows members to connect via TCP and receive a spin of all currently open orders on that unit. By using the spin, a member can get the current BATS book quickly in the middle of the trading session without worry of gap request limits. The spin server for each unit listens on its own address and/or TCP port.

Upon successful login and periodically thereafter, a Spin Image Available message is sent which contains a sequence number indicating the most recent message applied to the book. A member may then request the spin for the orders up to the sequence number using a Spin Request message with a sequence number from one of the *last ten* Spin Image Available messages.

The spin consists only of Add Order (long and/or short) and Time messages. Only open orders will be sent in the spin. Spins will not contain any message for an order which is no longer on the book. While receiving the spin, the member must buffer any multicast messages received whose sequence numbers are greater than the sequence number presented in the Spin Request message. When a Spin Finished message is received, the buffered messages must be applied to spun copy of the book to bring it current.

Appendix E shows an example flow of messages between a member and BATS' Multicast PITCH feed and spin server.

Protocol

BATS Multicast PITCH is delivered using PITCH 2.0 and the BATS Sequenced Unit Header. All messages delivered via multicast as well as to/from the Gap Request Proxy (GRP) will use the Sequenced Unit Header for handling message integrity.

All UDP delivered events will be self contained. Developers can assume that UDP delivered data will not cross frame boundaries and a single Ethernet frame will contain only one Sequenced Unit Header with associated data.

TCP/IP delivered events from the GRP may cross frames as the data will be delivered as a stream of data with the TCP/IP stack controlling Ethernet framing.

BATS reserves the right to add message types and grow the length of any message without notice. Members should develop their decoders to ignore unknown message types and messages that grow beyond the expected length. Messages will only be grown to add additional data to the end of a message.

Data Types

The following field types are used within the Sequenced Unit Header, GRP messages, and PITCH 2.0.

- **Alphanumeric** fields are left justified ASCII fields and space padded on the right.
- **Binary** fields are unsigned and sized to “Length” bytes and ordered using Little Endian convention. (least significant byte first)
- **Binary Short Price** fields are unsigned Little Endian encoded 2 byte binary fields with 2 implied decimal places. (denominator = 100)
- **Binary Long Price** fields are unsigned Little Endian encoded 8 byte binary fields with 4 implied decimal places. (denominator = 10,000)
- **Bit Field** fields are fixed width fields with each bit representing a boolean flag (the 0 bit is the lowest significant bit, the 7 bit is the highest significant bit)

Message Framing

Depth of book update messages will be combined into single UDP frame where possible to decrease message overhead and total bandwidth. The count of messages in a UDP frame will be communicated using the BATS Sequenced Unit Header. Framing will be determined by the server for each unit and site. The content of the multicast across feeds (A/B & Gig-Shaped/WAN-Shaped) will be identical, **but framing will not be consistent across feeds**. Receiving processes that receive and arbitrate multiple feeds can not use frame level arbitration to fill gaps.

BATS Sequenced Unit Header

The BATS Sequence Header is used for all BATS Multicast PITCH messages as well as messages to and from the Gap Request Proxy (GRP).

Sequenced and un-sequenced data may be delivered using the Sequenced Unit Header. Un-sequenced data will have 0 values for unit and sequence fields. All messages sent to and from the GRP are un-sequenced while multicast may contain sequenced and un-sequenced messages.

Sequenced messages have implied sequences with the first message having the sequence number contained in the header. Each subsequent message will have an implied sequence one greater than the previous message up to a maximum of count messages. Multiple messages can follow a Sequenced Unit Header, but a combination of sequenced and un-sequenced messages can not be sent with one header.

The sequence number for the first message in the next frame can be calculated by adding the Hdr Count field to the Hdr Sequence. This technique will work for sequenced messages and heartbeats.

Sequenced Unit Header				
Field	Offset	Length	Value/Type	Description
Hdr Length	0	2	Binary	Length of entire block of messages. Includes this header and “Hdr Count” messages to follow.
Hdr Count	2	1	Binary	Number of messages to follow this header.
Hdr Unit	3	1	Binary	Unit that applies to messages included in this header.
Hdr Sequence	4	4	Binary	Sequence of first message to follow this header.
Total Length = 8 bytes				

Heartbeat Messages

The BATS Sequenced Unit Header with a count field set to “0” will be used for heartbeat messages. During trading hours heartbeat messages will be sent from the GRP and all multicast addresses if no data has been delivered within 1 second. Heartbeat messages never increment the sequence number for a unit, but can be used to detect gaps on the real-time multicast channels during low update rate periods.

Heartbeats on the real-time multicast addresses during trading hours will have a Hdr Sequence value equal to the sequence of the next sequenced message to be sent for the unit. Heartbeats on gap multicast addresses will always have the Hdr Sequence field set to 0. All heartbeat messages sent to and from the GRP are considered un-sequenced and should have sequence and unit fields set to 0.

Outside of trading hours BATS sends heartbeat messages on all real-time and gap channels with a sequence of “0” to help users validate multicast connectivity. Heartbeat messages may not be sent from 12:00 am – 1:00 am ET or during maintenance windows.

BATS expects heartbeat messages to be sent to the GRP on live connections no less than every 5 seconds. Failure to receive 2 consecutive heartbeat messages will result in the GRP terminating the client connection.

Gap Request Proxy Messages

The following messages are used for initializing a TCP/IP connection to the Gap Request Proxy (GRP) and to request message retransmissions. Members only need to implement the following messages if gap requests will be made. The following messages will not be delivered using multicast.

Login Message

The Login Message is the first message sent to the GRP by a user's process after the connection to the GRP is established. Failure to login before sending any other message type will result in the connection being dropped by the GRP.

Login Message				
Field	Offset	Length	Value/Type	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x01	Login Message
SessionSubId	2	4	Alphanumeric	SessionSubId supplied by BATS
Username	6	4	Alphanumeric	Username supplied by BATS
Filler	10	2	Alphanumeric	(space filled)
Password	12	10	Alphanumeric	Password supplied by BATS
Total Length = 22 bytes				

Login Response Message

The Login Response Message is sent by the GRP to a user's process in response to a Login Message. The status field is used to reflect an accepted login or the reason the session was not accepted. If login fails, the connection will be dropped after the Login Response Message is sent.

Login Response				
Field	Offset	Length	Value/Type	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x02	Login Response
Status	2	1	Alphanumeric	Accepted or reason for reject
Total Length = 3 bytes				

Login Response - Status Codes	
'A'	Login Accepted
'N'	Not authorized (Invalid Username/Password)
'B'	Session in use
'S'	Invalid Session

Gap Request Message

The Gap Request Message is used by a user's process to request retransmission of a sequenced message (or messages) by one of BATS' gap servers.

Gap Request				
Field	Offset	Length	Value/Type	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x03	Gap Request Message
Unit	2	1	Binary	Unit that the gap is requested for
Sequence	3	4	Binary	Sequence of first message (lowest sequence in range)
Count	7	2	Binary	Count of messages requested
Total Length = 9 bytes				

Gap Response Message

The Gap Response Message is sent by the GRP in response to a Gap Request Message. The Unit and Sequence fields will match the values supplied in the Gap Request Message. A Gap Response Message, with a Status of Accepted or reason for failure, will be sent for each Gap Request Message received by the GRP.

Gap Response				
Field	Offset	Length	Value/Type	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x04	Gap Response Message
Unit	2	1	Binary	Unit the gap was requested for
Sequence	3	4	Binary	Sequence of first message in request
Count	7	2	Binary	Count of messages requested
Status	9	1	Alphanumeric	Accepted or reason for reject
Total Length = 10 bytes				

Gap Response - Status Codes	
'A'	Accepted
'O'	Out of range (ahead of sequence or too far behind)
'D'	Daily gap request allocation exhausted
'M'	Minute gap request allocation exhausted
'S'	Second gap request allocation exhausted
'C'	Count request limit for one gap request exceeded
'I'	Invalid Unit specified in request
'U'	Unit is currently unavailable

* - All non-'A' status codes should be interpreted as a reject.

PITCH 2.0

BATS users may use the PITCH 2.0 protocol over multicast to receive real-time full depth of book quotations and execution information direct from BATS.

The messages that make up the PITCH 2.0 protocol are delivered using BATS Sequenced Unit Header which handles sequencing and delivery integrity.

PITCH 2.0 cannot be used to enter orders. For order entry, refer to the BATS FIX Specification.

All visible orders and executions are reflected via the PITCH 2.0 feed. All orders and executions are anonymous, and do not contain any member identity.

The PITCH data feed is comprised of a series of dynamic length sequenced messages. Each message begins with Length and Message Type fields. BATS reserves the right to add message types and grow the length of any message without notice. Members should develop their decoders to deal with unknown message types and messages that grow beyond the expected length.

With the exception of time messages, each PITCH message reflects the order addition, order deletion, order modification or execution of an order in the system.

Time Message

A Time Message is sent whenever the source time for a unit passes over a second boundary. All subsequent time offset fields for the same unit will use the new Time value as the base until another Time Message is received for the same unit.

Time				
Field Name	Offset	Length	Type/(Value)	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x20	Time Message
Time	2	4	Binary	Number of whole seconds from midnight Eastern Time
Total Length = 6 bytes				

Add Order Message

An Add Order Message represents a newly accepted visible order on the BATS book. It includes a day-specific Order Id assigned by BATS to the order.

Add Order (long)				
Field Name	Offset	Length	Type/(Value)	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x21	Add Order Message (long)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Day-specific identifier assigned to this order
Side Indicator	14	1	Alphanumeric	"B" = Buy Order "S" = Sell Order
Shares	15	4	Binary	Number of shares being added to the book (may be less than the number of shares entered).
Stock Symbol	19	6	Alphanumeric	Stock symbol right padded with spaces.
Price	25	8	Binary Long Price	The limit order price
Add Flags	33	1	Bit Field	Bit 0 - Display 0 - Not displayed in SIP 1 - Displayed in SIP
Total Length = 34 bytes				

Add Order (short)				
Field Name	Offset	Length	Type/(Value)	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x22	Add Order Message (short)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Day-specific identifier assigned to this order
Side Indicator	14	1	Alphanumeric	"B" = Buy Order "S" = Sell Order
Shares	15	2	Binary	Number of shares being added to the book (may be less than the number of shares entered).
Stock Symbol	17	6	Alphanumeric	Stock symbol right padded with spaces.
Price	23	2	Binary Short Price	The limit order price
Add Flags	25	1	Bit Field	Bit 0 - Display 0 - Not displayed in SIP 1 - Displayed in SIP
Total Length = 26 bytes				

Order Modification Messages

A Modify Order Message refers to an Order Id previously sent with an Add Order Message. Multiple Modify Order Messages may modify a single order and the effects are cumulative. Modify messages may update the size and/or the price of an order on the book. When the remaining shares for an order reach zero, the order is dead and should be removed from the book.

Order Executed Message

Order Execution Messages are sent when a visible order on the BATS book is executed in whole or in part. The execution price equals the limit order price found in the original Add Order Message or the limit order price in the latest Modify Order Message referencing the Order Id.

Order Executed				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x23	Order Executed Message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that was executed
Executed Shares	14	4	Binary	Number of shares executed
Execution Id	18	8	Binary	BATS generated day-unique execution identifier of this execution. Execution Id is also referenced in the Trade Break Message
Total Length = 26 bytes				

Order Executed at Price/Size Message

Order Execution at Price/Size Messages are sent when a visible order on the BATS book is executed in whole or in part at a different price than the limit price on the original Add Order Message or the limit order price in the latest Modify Order Message referencing the Order Id. If the Remaining Shares field contains a 0 the order should be completely removed from the book.

If the existing size for Order Id is not equal to Executed Shares + Remaining Shares then this event models the reload of a reserve order. In this case the order should be prioritized the same as a new order.

Order Executed at Price/Size				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x24	Order Executed at Price/Size
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that was executed
Executed Shares	14	4	Binary	Number of shares executed
Remaining Shares	18	4	Binary	Number of shares remaining after the execution
Execution Id	22	8	Binary	BATS generated day-unique execution identifier of this execution. Execution Id is also referenced in the Trade Break Message
Price	30	8	Binary Long Price	The execution price of the order
Total Length = 38 bytes				

Reduce Size Message

Reduce Size Messages are sent when a visible order on the BATS book is partially reduced.

Reduce Size (long)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x25	Reduce Size Message (long)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that has been reduced
Canceled Shares	14	4	Binary	Number of shares canceled
Total Length = 18 bytes				

Reduce Size (short)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x26	Reduce Size Message (short)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that has been reduced
Canceled Shares	14	2	Binary	Number of shares canceled
Total Length = 16 bytes				

Modify Order Message

The Modify Order Message is sent whenever an open order is visibly modified. The Order Id refers to the Order Id of the original Add Order Message.

Modify (long)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x27	Modify Order Message (long)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that has been modified
Shares	14	4	Binary	Number of shares associated with this order after this modify (may be less than the number of shares entered)
Price	18	8	Binary Long Price	The limit order price after this modify
Modify Flags	26	1	Bit Field	Bit 0 - Display 0 - Not displayed in SIP 1 - Displayed in SIP Bit 1 - Maintain Priority 0 - Reset Priority 1 - Maintain Priority
Total Length = 27 bytes				

Modify (short)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x28	Modify Order Message (short)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that has been modified
Shares	14	2	Binary	Number of shares associated with this order after this modify (may be less than the number of shares entered)
Price	16	2	Binary Short Price	The limit order price after this modify
Modify Flags	18	1	Bit Field	Bit 0 - Display 0 - Not displayed in SIP 1 - Displayed in SIP Bit 1 - Maintain Priority 0 - Reset Priority 1 - Maintain Priority
Total Length = 19 bytes				

Delete Order Message

The Delete Order Message is sent whenever an open order is completely canceled. The Order Id refers to the Order Id of the original Add Order Message.

Delete				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x29	Delete Order Message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of a previously sent Add Order Message that has completely cancelled
Total Length = 14 bytes				

Trade Message

The Trade Message provides information about executions of hidden orders on the BATS book and routed executions to other trading centers. Trade Messages are necessary to calculate BATS execution based data. Trade Messages do not alter the book and can be ignored if you are just building a book.

No Add Order Message is sent for hidden orders, and thus, no modify order messages may be sent when hidden orders are executed. Instead, a Trade Message is sent whenever a hidden order is executed in whole or in part. As with visible orders, hidden orders may be executed in parts. The effects of multiple Trade Messages on the same order are cumulative.

A complete view of all BATS executions can be built by combining all Order Executed Messages and Trade Messages.

Trade (long)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x2A	Trade Message (long)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of the non-displayed executed order.
Side Indicator	14	1	Alphanumeric	"B" = Buy Order "S" = Sell Order
Shares	15	4	Binary	Incremental Number of shares executed
Stock Symbol	19	6	Alphanumeric	Stock symbol right padded with spaces.
Price	25	8	Binary Long Price	The execution price of the order
Execution Id	33	8	Binary	BATS generated day-unique execution identifier of this trade. Execution Id is also referenced in the Trade Break Message.
Total Length = 41 bytes				

Trade (short)				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x2B	Trade Message (short)
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Order Id	6	8	Binary	Order Id of the non-displayed executed order.
Side Indicator	14	1	Alphanumeric	"B" = Buy Order "S" = Sell Order
Shares	15	2	Binary	Incremental Number of shares executed
Stock Symbol	17	6	Alphanumeric	Stock symbol right padded with spaces.
Price	23	2	Binary Short Price	The execution price of the order
Execution Id	25	8	Binary	BATS generated day-unique execution identifier of this trade. Execution Id is also referenced in the Trade Break Message.
Total Length = 33 bytes				

Trade Break Message

The Trade Break message is sent whenever an execution on BATS is broken. Trade breaks are rare and only affect applications that rely upon BATS execution based data. Applications that simply build a BATS book can ignore Trade Break messages.

Trade Break				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x2C	Trade Break Message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Execution Id	6	8	Binary	BATS execution identifier of the execution that was broken. Execution Id refers to previously sent Order Execution or Trade Message.
Total Length = 14 bytes				

End of Session Message

The End of Session Message is sent for each unit when the unit shuts down. No more sequenced messages will be delivered for this unit, but heartbeats from the unit may be received.

End of Session				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x2D	End of Session Message
Timestamp	2	4	Binary	Nanosecond offset from last unit timestamp
Total Length = 6 bytes				

Spin Messages

Login Message

The Login Message is the first message sent to the Spin Server by a user’s process after the connection to the Spin Server is established. Failure to login before sending any other message type will result in the connection being dropped by the Spin Server.

The format of the Login Message for the Spin Server is identical to that of the GRP.

Login Response Message

The Login Response Message is sent by the Spin Server to a user’s process in response to a Login Message. The status field is used to reflect an accepted login or the reason the session was not accepted. If login fails, the connection will be dropped after the Login Response Message is sent.

The format of the Login Message for the Spin Server is identical to that of the GRP.

Spin Image Available Message

The Spin Image Available message is sent once per second and indicates through what sequence number a spin is available.

Spin Image Available				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x80	Spin Image Available Message
Sequence	2	4	Binary	Spin is available which is current through this sequence number
Total Length = 6 bytes				

Spin Request Message

The Spin Request Message is used by a user’s process to request transmission of a spin of the unit’s order book. The sequence number presented in the Spin Request message must match the sequence sent in one of the last ten Spin Image Available messages. The member must buffer all multicast messages for the unit with a sequence number greater than the sequence number requested so that when the spin is finished, the buffered messages can be applied to bring the book current.

Spin Request				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x81	Spin Request Message
Sequence	2	4	Binary	Sequence number from a Spin Image Available Message received by the member
Total Length = 6 bytes				

Spin Response Message

The Spin Response Message is sent in response to a user's Spin Request message indicating whether a spin will be sent.

Spin Response				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x82	Spin Response Message
Sequence	2	4	Binary	Sequence number from a Spin Image Available Message received by the member
Order Count	6	4	Binary	Number of Add Order messages which will be contained in this spin; 0 if spin cannot be satisfied
Status	10	1	Alphanumeric	Accepted or reason for reject
Total Length = 11 bytes				

Spin Response - Status Codes	
'A'	Accepted
'O'	Out of range (spin no longer available)
'S'	Spin already in progress (only one spin can be running at a time)

* - All non-'A' status codes should be interpreted as a reject.

Spin Finished Message

The Spin Finished Message is sent to indicate that all Add Order messages for the spin requested have been sent. A Spin Finished message is only sent if a Spin Request was not rejected. Upon receipt of a Spin Finished message, any buffered multicast messages should be applied to the member's copy of the book to make it current.

Spin Finished				
Field Name	Offset	Length	Value	Description
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x83	Spin Heartbeat Message
Sequence	2	4	Binary	Sequence number from the Spin Request message
Total Length = 6 bytes				

Appendix

Supported Carriers

The WAN-Shaped feed will be made available to members through extranet carriers that have completed their multicast implementation with BATS. Please contact your respective carrier for more information on using their services to connect to BATS Multicast PITCH. Carrier contact information can be found within the BATS Connectivity Manual.

Bandwidth Recommendation

The Gig-shaped feeds require 1Gbps of bandwidth while the WAN-shaped feeds require 100Mbps of bandwidth. BATS will use 90% of these respective bandwidths for Multicast PITCH to allow members to use the same physical connection for FIX order entry if desired. .

Symbology

For more information on BATS Symbology, please refer to the BATS Symbology Reference document at http://www.batstrading.com/subscriber_resources/BATS_Symbology.pdf.

Multicast Test Program

The ZIP file located at http://www.batstrading.com/subscriber_resources/mcast_pitch.zip contains a sample program that may be used to test Multicast PITCH feed connections and to troubleshoot Multicast issues. Refer to the included README file for build and usage information.

Support

Please e-mail questions or comments regarding this specification to tradedesk@batstrading.com.

Appendix A: Production Environment Configuration

Limitations/Configurations

The following table defines BATS current configuration for network and gap request limitations. BATS reserves the right to adjust the gap request limitations to improve the effectiveness of the gap request infrastructure.

Period/Type	Limit/Setting	Notes
MTU	1500	BATS will send UDP messages up to 1500 bytes. Members should ensure that their infrastructure is configured accordingly.
Gig-Shaped Throttle	1 Gb/s	The real-time and gap multicast head ends are configured to shape their output to this level to minimize packet loss.
WAN-Shaped Throttle	TBD	
Gap Response Delay	2 ms	The Gap Server will delay resending sequenced messages via multicast for the specified limit in order to satisfy multiple GRP gap requests with one multicast response.
Count	100	Any single gap request may not be for more than this number of dropped messages.
1 Second	50 Requests	Users' retransmission requests are limited to this many requests per second. This is renewed every clock second.
1 Minute	1500 Requests	Users' retransmission requests are limited to this many requests per minute. This is renewed every clock minute.
Day	100,000 Requests	Users' retransmission requests are limited to this many requests per day.
Within Range	1,000,000 Messages	Users' retransmission requests must be within this many messages of the most recent sequence sent by the real-time feed.

Unit/Symbol Distribution

The following table describes BATS symbol distribution across units.

Symbol Range Start	Unit
A	1
BG	2
CT	3
EG	4
GE	5
IW	6
KS	7
NN	8
QJ	9
SL	10
TM	11
VU	12

Note - BATS reserves the right to add units and/or change symbol distribution with 48 hours notice and no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

Multicast Routing Parameters

Data Center	Rendezvous Point
Primary Data Center	208.90.208.253
Secondary Data Center	208.90.208.252

BATS Multicast PITCH Specification

Address/Unit Distribution

The following tables describe the current unit distribution across the BATS Multicast PITCH feeds.

Primary Datacenter		Gig-Shaped (A)		WAN-Shaped (C)	
Unit	IP Port	Real-time MC & (Src) IP Addr	Gap Response MC & (Src) IP Addr	Real-time MC & (Src) IP Addr	Gap Response MC & (Src) IP Addr
1	30001	224.0.62.2	224.0.62.3	224.0.62.14	224.0.62.15
2	30002	(208.90.209.241)	(208.90.209.241)	(208.90.209.217)	(208.90.209.217)
3	30003	224.0.62.4	224.0.62.5	224.0.62.16	224.0.62.17
4	30004	(208.90.209.242)	(208.90.209.242)	(208.90.209.217)	(208.90.209.217)
5	30005	224.0.62.6	224.0.62.7	224.0.62.18	224.0.62.19
6	30006	(208.90.209.243)	(208.90.209.243)	(208.90.209.217)	(208.90.209.217)
7	30007	224.0.62.8	224.0.62.9	224.0.62.20	224.0.62.21
8	30008	(208.90.209.244)	(208.90.209.244)	(208.90.209.218)	(208.90.209.218)
9	30009	224.0.62.10	224.0.62.11	224.0.62.22	224.0.62.23
10	30010	(208.90.209.245)	(208.90.209.245)	(208.90.209.218)	(208.90.209.218)
11	30011	224.0.62.12	224.0.62.13	224.0.62.24	224.0.62.25
12	30012	(208.90.209.246)	(208.90.209.246)	(208.90.209.218)	(208.90.209.218)

Secondary Datacenter		Gig-Shaped (B)		WAN-Shaped (D)	
Unit	IP Port	Real-time MC & (Src) IP Addr	Gap Response MC & (Src) IP Addr	Real-time MC & (Src) IP Addr	Gap Response MC & (Src) IP Addr
1	31001	224.0.62.64	224.0.62.65	224.0.62.76	224.0.62.77
2	31002	(208.90.209.113)	(208.90.209.113)	(208.90.209.89)	(208.90.209.89)
3	31003	224.0.62.66	224.0.62.67	224.0.62.78	224.0.62.79
4	31004	(208.90.209.114)	(208.90.209.114)	(208.90.209.89)	(208.90.209.89)
5	31005	224.0.62.68	224.0.62.69	224.0.62.80	224.0.62.81
6	31006	(208.90.209.115)	(208.90.209.115)	(208.90.209.89)	(208.90.209.89)
7	31007	224.0.62.70	224.0.62.71	224.0.62.82	224.0.62.83
8	31008	(208.90.209.116)	(208.90.209.116)	(208.90.209.90)	(208.90.209.90)
9	31009	224.0.62.72	224.0.62.73	224.0.62.84	224.0.62.85
10	31010	(208.90.209.117)	(208.90.209.117)	(208.90.209.90)	(208.90.209.90)
11	31011	224.0.62.74	224.0.62.75	224.0.62.86	224.0.62.87
12	31012	(208.90.209.118)	(208.90.209.118)	(208.90.209.90)	(208.90.209.90)

Note - BATS reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

Appendix B: Certification Environment Configuration

Unit/Symbol Distribution

The following table describes BATS symbol distribution across units.

Symbol Range Start	Unit
A	1
N	2

Note - BATS reserves the right to add units and/or change symbol distribution with 48 hours notice and no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

Multicast Routing Parameters

Data Center	Rendezvous Point
Certification Data Center	208.90.208.253

Address/Unit Distribution across Feeds

The following tables describe the current unit distribution across the BATS Multicast PITCH feeds.

Certification

Unit	IP Port	Real-time MC & (Src) IP Addr	Gap Response MC & (Src) IP Addr
1	32001	224.0.62.190	224.0.62.191
2	32002	(208.90.208.245)	(208.90.208.245)

Note - BATS reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

Appendix C: Message Types

Gap Request Proxy Messages

0x01	Login
0x02	Login Response
0x03	Gap Request
0x04	Gap Response

Spin Server Messages

0x01	Login
0x02	Login Response
0x80	Spin Image Available
0x81	Spin Request
0x82	Spin Response
0x83	Spin Finished

PITCH 2.0 Messages

0x20	Time
0x21	Add Order - Long
0x22	Add Order - Short
0x23	Order Executed
0x24	Order Executed at Price/Size
0x25	Reduce Size - Long
0x26	Reduce Size - Short
0x27	Modify Order - Long
0x28	Modify Order - Short
0x29	Delete Order
0x2A	Trade - Long
0x2B	Trade - Short
0x2C	Trade Break
0x2D	End of Session

Appendix D: Example Messages

In the following examples, each byte is represented by two hexadecimal digits.

Login Message

Length	16	22 bytes
Type	01	Login
SessionSubId	30 30 30 31	"0001"
Username	46 49 52 4D	"FIRM"
Filler	20 20	" "
Password	41 42 43 44 30 30 20 20 20 20 20	"ABCD00 "

Login Response Message

Length	03	3 bytes
Type	02	Login Response
Status	41	Login accepted

Gap Request Message

Length	09	9 bytes
Type	03	Gap Request
Unit	01	Unit 1
Sequence	3B 10 00 00	First message: 4155
Count	32 00	50 messages

Gap Response Message

Length	08	8 bytes
Type	04	Gap Response
Unit	01	Unit 1
Sequence	3B 10 00 00	First message: 4155
Status	41	Accepted

Spin Image Available Message

Length	06	6 bytes
Type	80	Spin Image Available
Sequence	3B 10 00 00	Sequence: 4155

Spin Request Message

Length	06	6 bytes
Type	81	Spin Request
Sequence	3B 10 00 00	Sequence: 4155

Spin Response Message

Length	0B	6 bytes
Type	82	Spin Request
Sequence	3B 10 00 00	Sequence: 4155
Order Count	42 00 00 00	66 orders

Spin Finished Message

Length	06	6 bytes
Type	83	Spin Finished
Sequence	3B 10 00 00	Sequence: 4155

Time Message

Length	06	6 bytes
Type	20	Time
Time	98 85 00 00	34,200 seconds = 09:30 AM Eastern

Add Order – Long

Length	22	34 bytes
Type	21	Add Order - Long
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Side Indicator	42	Buy
Shares	20 4E 00 00	20,000 shares
Stock Symbol	5A 56 5A 5A 54 20	ZVZZT
Price	5A 23 00 00 00 00 00 00	\$0.9050
AddBitField1	01	Displayed

Add Order – Short

Length	1A	26 bytes
Type	22	Add Order - Short
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Side Indicator	42	Buy
Shares	20 4E	20,000 shares
Stock Symbol	5A 56 5A 5A 54 20	ZVZZT
Price	0A 28	\$102.50
AddBitField1	01	Displayed

Order Executed

Length	1A	26 bytes
Type	23	Order Executed
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Executed Shares	64 00 00 00	100 shares
Execution Id	C8 00 00 00 01 40 57 3A	

Order Executed at Price/Size

Length	26	38 bytes
Type	24	Order Executed at Price/Size
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Executed Shares	64 00 00 00	100 shares
Remaining	BC 4D 00 00	19,900 shares
Execution Id	C8 00 00 00 01 40 57 3A	
Price	E8 A3 0F 00 00 00 00 00	\$102.50

Reduce Size – Long

Length	12	18 bytes
Type	25	Reduce Size - Long
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Canceled Shares	F8 24 01 00	75,000 shares

Reduce Size – Short

Length	10	16 bytes
Type	26	Reduce Size - Short
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Canceled Shares	64 00	100 shares

Modify Order – Long

Length	1B	27 bytes
Type	27	Modify Order – Long
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Shares	F8 24 01 00	75,000 shares
Price	E8 A3 0F 00 00 00 00 00	\$102.50
ModifyBitField1	03	Displayed & Maintains Priority

Modify Order – Short

Length	13	19 bytes
Type	28	Modify Order – Short
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Shares	64 00	100 shares
Price	0A 28	\$102.50
ModifyBitField1	03	Displayed & Maintains Priority

Delete Order

Length	0E	14 bytes
Type	29	Delete Order
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	

Trade – Long

Length	29	41 bytes
Type	2A	Trade - Long
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Side	42	Buy
Shares	F8 24 01 00	75,000 shares
Stock Symbol	5A 56 5A 5A 54 20	ZVZZT
Price	E8 A3 0F 00 00 00 00 00	\$102.50
Execution Id	C8 00 00 00 01 40 57 3A	

Trade – Short

Length	21	33 bytes
Type	2B	Trade - Long
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	
Side	42	Buy
Shares	64 00	100 shares
Stock Symbol	5A 56 5A 5A 54 20	ZVZZT
Price	0A 28	\$102.50
Execution Id	C8 00 00 00 01 40 57 3A	

Trade Break

Length	0E	14 bytes
Type	2C	Trade Break
Time offset	18 D2 06 00	447,000 ns since last Time Message
Execution Id	C8 00 00 00 01 40 57 3A	

End of Session

Length	06	6 bytes
Type	2D	End of Session
Time offset	18 D2 06 00	447,000 ns since last Time Message

Sequenced Unit Header with 2 Messages

Sequenced Unit Header:

Hdr Length	31 00	49 bytes, including header
Hdr Count	02	2 messages to follow
Hdr Unit	01	Unit 1
Hdr Sequence	01 00 00 00	First message has sequence number 1

Message 1: Add Order (Short)

Length	1A	26 bytes
Message format	22	Add Order – Short
Time offset	18 D2 06 00	447,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	631WC4000005
Side Indicator	42	Buy
Shares	E1 02	737 shares
Stock Symbol	5A 56 5A 5A 54 20	ZVZZT
Price	01 00	0.01
Flags	01	Display

Message 2: Reduce Size (Short)

Length	10	16 bytes
Message format	26	Reduce Size – Short
Time offset	E8 D9 06 00	449,000 ns since last Time Message
Order Id	05 40 5B 77 8F 56 1D 0B	631WC4000005
Canceled Shares	E1 02	737 shares

Appendix E: Spin Server Usage Example

The following diagram (see next page) shows the exchange of messages over time between a member and BATS' Multicast PITCH feed and spin server.

At time 1, the member has no state of the book and desires to become current. The member caches the received Multicast PITCH messages (sequences 310172 and 310173) for later use. Since the member has no book, they cannot yet be applied.

At time 5, the member has successfully logged into the Spin Server and has cached another message, sequence 310174.

At time 7, the member receives a Spin Image Available message which indicates that the spin server is capable of giving them a spin of all open orders as of sequence 310169. The member does not have all messages cached after 310169 (they are missing 310170 and 310171), so this spin is not useful to the member.

At time 10, the member receives a Spin Image Available message which is useful since it would be a spin of all orders up to and including sequence 310175 and the member has all messages after 310175 cached.

At time 11, the member sends a Spin Request for all messages up to and including 310175 and continues to cache Multicast PITCH messages received.

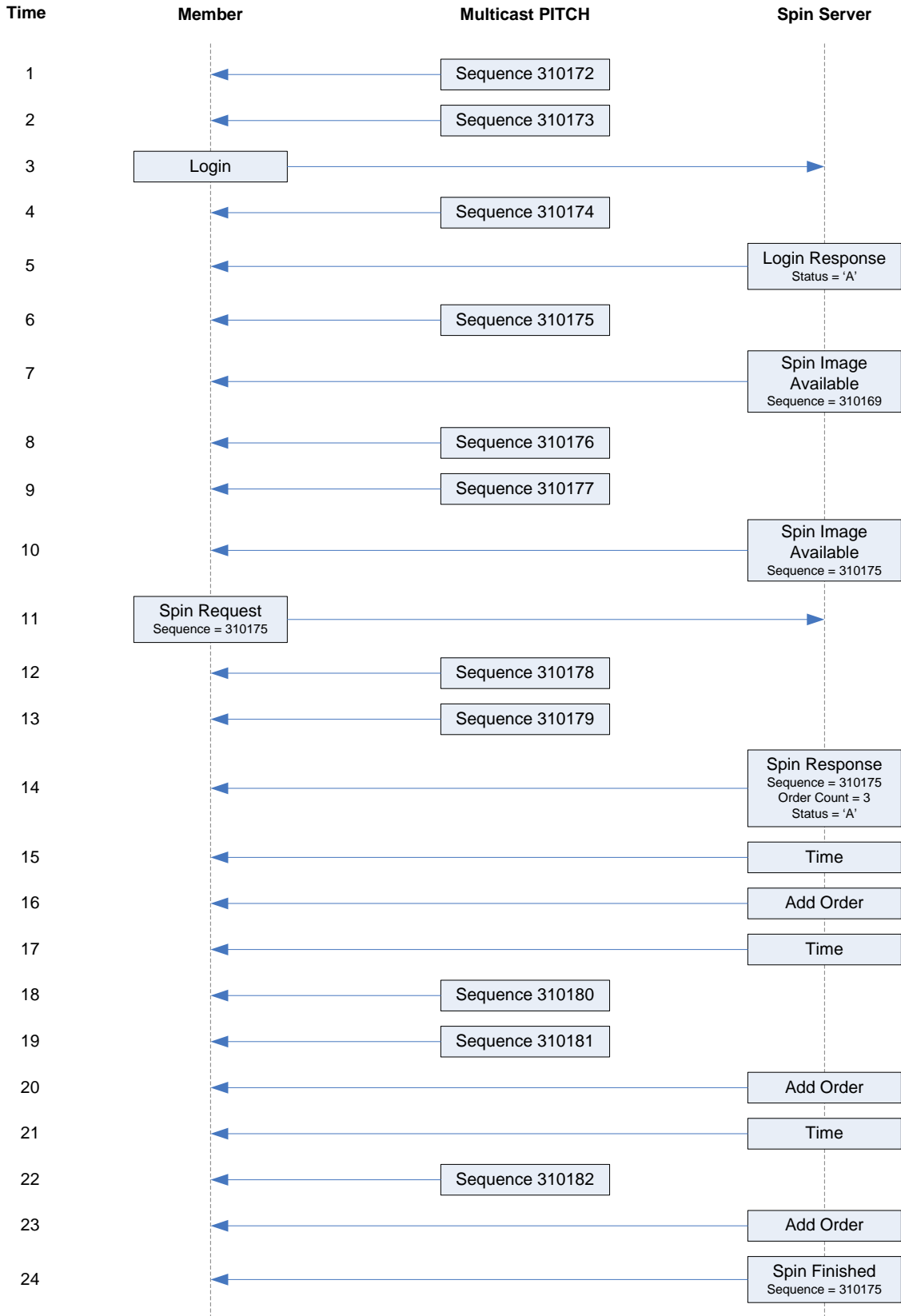
At time 14, the spin server acknowledges the spin request and indicates that three open orders will be sent.

At time 24, the spin server indicates that it has finished sending all open orders. The member must then apply the cached messages from sequence number 310176 through current.

Notes:

- A Spin Request may only be sent for a sequence number which was present in a Spin Image Available message. Arbitrary sequence numbers cannot be sent.
- Spin Servers are available for each unit. Members may need to employ multiple Spin Servers depending upon their architecture.
- As a rule of thumb, BATS typically has 200,000 open orders across *all* units, or an average of about 16,000 orders per unit. The actual number per unit varies depending upon activity in individual symbols. Expect this number to increase and plan accordingly.

BATS Multicast PITCH Specification



Revision History

Dec 19, 2008	Initial Version 1.0
Dec 26, 2008	Correction to Hdr Sequence example
Jan 6, 2009	Symbol distribution update, IP information added
Jan 8, 2009	Symbol distribution update
Jan 12, 2009	Added Source IP and RP information
Jan 16, 2009	Reference added for Multicast PITCH test program
Jan 21, 2009	Length on Trade – Short example corrected
Jan 29, 2009	Added information on Spin Servers & WAN Source IPs
May 27, 2009	Added FLAG fields to the Add and Modify messages
Jun 3, 2009	Added Certification Environment details
Aug 11, 2009	Removed BOLT references