



US Equity/Options Connectivity Manual

Version 6.0.0

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BATS US Equity/Options
Connectivity Manual (Version 6.0.0)

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1 Introduction

1.1 Overview

The BATS BZX Exchange, BYX Exchange and BATS Options trading platforms are housed in the SAVVIS data center in Weehawken, New Jersey. The BZX Exchange, BYX Exchange and BATS Options secondary data center is hosted by SAVVIS CH4 in Chicago, IL. BATS will additionally accept connections in the Equinix CH1 data center. Members are strongly encouraged to establish connectivity to both data centers to minimize service disruption in the event of an issue at either data center. Weehawken is the “primary” or “hot” site, with Chicago being “secondary” or “warm” – members may receive market data from Chicago, and they may connect and heartbeat with order entry systems in Chicago. Orders submitted to Chicago will be rejected until BATS declares Weehawken “down”.

Members are responsible for choosing their telecommunications provider and arranging for connections to both BATS data centers.

BATS supports the following network connectivity choices for access to both Equities and Options:

- **IPSec VPN** via the Internet (only for certification or test sessions);
- **Co-location Cross-connect** (i.e. for members co-located in the same data center);
- **Extranet** connectivity (e.g. BT Radianz, TNSi, SFTI, SAVVIS, 7Ticks, etc.); and
- **Private line ethernet.**

Other methods of connectivity may be possible, please contact BATS’ NOC for more information:

- **Phone:** 913-815-7005
- **Email:** noc@batstrading.com

2 Connectivity Choices

2.1 IPSec VPN

Members may connect via an IPSec Virtual Private Network (VPN) over the Internet. IPSec VPNs may only be used for:

- Access to order entry and unicast market data feeds for certification and test purposes.
- LAN-to-LAN IPSec VPNs supported. IP address of the host presented to BATS must be registered.
- VPN Connectivity is available in the Weehawken data center only.

Note: BATS does not offer market data feeds over VPN.

2.2 Co-location Cross-connect

Equities and Options members may co-locate within SAVVIS data centers and cross-connect to BATS.

- Equities members with their own space in either data center may request an in-house cross-connect from the member's Point of Presence (PoP) to the BATS network.
- Equities members not co-located can lease co-location space in either data center from the data center host (refer to the "Telecommunication Providers" section below for data center contact information).
- Options members with their own space in the SAVVIS data center may request an in-house cross-connect from the member's Point of Presence (PoP) to the BATS network.
- Options members not co-located can lease co-location space in the SAVVIS data center from SAVVIS (refer to the "Telecommunication Providers" section below for data center contact information).
- 1Gbps cross-connection is made with copper Ethernet cabling (e.g. Cat6). In the cases where distance is too great for copper cable, BATS can support optical fiber on a case-by-case basis.
- BATS will allow up to four physical ports (up to 1Gbps per port) per member/extranet at no cost for purposes of trading and/or receiving market data. Any ports of a size of up to 1Gbps beyond the four no cost physical ports will be subject to a monthly recurring charge. All 10Gbps physical ports will be subject to a monthly recurring charge. See the BATS Fee Schedule for more information.
- BATS reserves the right to charge for one-time setup and monthly recurring fees incurred connecting members or extranets. See the BATS Fee Schedule for more information.

With data center co-location, members can place equipment, terminate communications circuits, and establish a cross-connect to BATS (or other destinations) in that space. This gives the maximum amount of control to the member. This option is neutral for the member and provides the greatest flexibility for the member in determining when and to whom to connect. Members interested in co-location services should contact SAVVIS directly (refer to the “Telecommunication Providers” section below for data center contact information).

2.3 Extranet

Members may provision connectivity to BATS via an extranet.

- Extranets have provisioned redundant, high speed connections to BATS for use by multiple members.
- Contact information for a variety of Extranet providers is found below within the "Telecommunications Providers" section below.

This method is an attractive alternative when:

- the member would otherwise have to provision a long-haul private line;
- outsourcing of network services and network management is an option; or
- the ease and speed of turn-up are important (when both the member and BATS have an existing connection to the extranet).

Connectivity to Extranet providers not listed in the “Telecommunications Providers” section below is possible. BATS is willing to connect via any open and available Extranet provider, based on member demand and cooperation from the Extranet provider (certain considerations apply – please contact the BATS NOC for information).

2.4 Directly Connected via Private Line Ethernet

Members may connect to BATS via Private Line Ethernet.

- No co-location space is required. Cross-connect from Telco demarcation point to BATS network via a Gigabit Ethernet interface.
- BATS will allow up to four physical ports (up to 1Gbps per port) per member/extranet at no cost for purposes of trading and/or receiving market data. Any ports of a size of up to 1Gbps beyond the four no cost physical ports will be subject to a monthly recurring charge. All 10Gbps physical ports will be subject to a monthly reoccurring charge. See the BATS Fee Schedule for more information.
- BATS reserves the right to charge for one-time setup and monthly recurring fees incurred connecting members or extranets. See the BATS Fee Schedule for more information.
- Contact your carrier of choice to arrange connectivity to BATS, see the “Telecommunications Providers” section below.

2.5 Directly Connected via Member Terminated Routers

Members may terminate circuits MetroE, OC-3, etc. on a member-provided and owned router or switch in the BATS controlled space.

- Communications equipment is owned and maintained by the member.
- For each BATS market a member is connected to, BATS will provide physical space, 110VAC power, and adequate environment in the Weehawken data center for up to four Rack Units of member-owned communications equipment (i.e. router, switch) necessary to connect to BATS. Servers cannot be supported.
- In the Chicago data center, BATS will provide physical space, 110VAC power, and adequate environment for up to four Rack Units of member-owned communications equipment (i.e. router, switch) necessary to connect to BATS. Servers cannot be supported.
- All member equipment is placed into 2-post open relay-type racks, and BATS requires the use of routers/switches that are rack-mountable (mid-device rack ears are required for Weehawken).
- All equipment must be clearly labeled front and rear with the member (abbreviation such as MPID is acceptable) and a member-determined unique device name.
- To minimize the number of power circuits and rack space requirements, BATS requires that when a member router/switch solution necessitates a DSU/CSU that the DSU/CSU be incorporated within the router/switch.
- The demarcation point between the member and BATS would be Ethernet interface of the member's router/switch. Patches are made with copper Ethernet cabling (e.g. Cat6). For each site (Weehawken and Chicago), BATS will allow up to four physical ports (up to 1Gbps per port) per member/extranet at no cost for purposes of trading and/or receiving market data. Any ports of a size of up to 1Gbps beyond the four no cost physical ports will be subject to a monthly recurring charge. All 10Gbps physical ports will be subject to a monthly reoccurring charge. See the BATS Fee Schedule for more information.
- Connections to third parties (market centers or other broker/dealers) from the member-provided equipment will not be permitted.
- BATS will not control or manage the member-owned router/switch, nor perform maintenance or other actions on behalf of the member. BATS can assist, when requested, in arranging hands-on access by data center personnel to the member-owned network devices in the BATS space. Activity that may be accomplished is limited to, generally, power cycling, and console access to perform very basic configuration steps that will enable the device to be manageable via a network or dial connection.
- Physical access by member representatives to the member's equipment is not possible at any time for any reason.

- BATS will pass to the member any charges by SAVVIS to BATS related to troubleshooting and/or maintaining the member's equipment (after initial install).

Do not order a circuit into either data center without first contacting BATS – doing so will delay your implementation. Contact BATS for information about circuit ordering details (e.g. NPA-NXX, LOA/CFA requirements, demarcation information, media and connector types, etc.). BATS will supply the in-house cross-connect of the circuit from the building's node-room / Meet-Me-room to the BATS space.

Members are strongly urged to order from the LEC a standard business telephone line to be brought to a member-supplied dial modem that is connected to the member's router(s)/switch(es) for remote access to the equipment. BATS will supply the dial line extension from the building's node room to the BATS space.

BATS requires members using this connectivity choice to ensure that their router(s)/switch(es) in this space are secured with strong passwords, and that those passwords are unique to the member's network devices at this location.

BATS may, now and/or in the future, pass through some or all of the associated costs of circuit extension, power, space allocation, and co-location of the member's equipment to the member.

2.6 Physical Interfaces

The following standard physical interface specifications are supported. For other interface specifications contact noc@batstrading.com.

10G	SR (multi-mode) , LR (single-mode) & ER (single-mode)
1G	SX (multi-mode), LX (single-mode), 1000BaseT
<1G	100BaseT, 10BaseT

3 Bandwidth

3.1 Market Data Feeds

BATS offers four different types of market data feeds:

- Multicast PITCH
- TCP PITCH
- TOP
- Last Sale

BATS requires that members allocate a **minimum** of 1 Gb/s per Multicast PITCH Gig-Shaped feed and 100 Mb/s per Multicast PITCH WAN-Shaped feed. With respect to TCP PITCH and TOP feeds (not available in options), BATS understands that firms will have varying levels of sensitivity with respect to latency and as such encourages members to use the statistics provided below to make a well informed decision regarding the bandwidth they will require based on their organization's latency sensitivity.

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The table below shows the bandwidth statistics for historical highs for BATS market data feeds. The table shows the bandwidth peaks for 1, 5, 10, 30, and 60-second intervals. 1 and 10 millisecond interval peaks are also included. The TCP statistics include 11 bytes for TCP/IP overhead per packet and do not include the data link layer overhead.

BATS Market	Interval Seconds	Multicast PITCH		TOP		TCP PITCH	
		MPS	Mb/s	MPS	Mb/s	MPS	Mb/s
BZX Exchange	.001	5,363,000	601	405,000	115	970,000	450
	.010	4,854,900	544	344,100	95	857,300	397
	1	361,739	124	145,285	38	332,412	154
	5	192,815	66	85,237	22	249,388	116
	10	176,739	61	79,303	21	229,095	107
	30	159,833	55	70,997	19	207,030	96
	60	140,200	48	64,124	17	180,114	84
BYX Exchange	.001	3,569,000	400	477,000	128	984,000	456
	.010	781,600	123	449,500	119	836,400	388
	1	176,215	60	108,395	28	257,021	119
	5	94,199	32	59,984	16	137,535	64
	10	78,679	27	50,868	13	116,207	54
	30	56,761	19	37,546	10	83,490	39
	60	49,807	17	33,190	8.5	74,411	35
BATS Options	.001	8,222,000	921	N/A	N/A	N/A	N/A
	.010	7,827,200	877	N/A	N/A	N/A	N/A
	1	683,011	204	N/A	N/A	N/A	N/A
	5	443,315	151	N/A	N/A	N/A	N/A
	10	436,716	149	N/A	N/A	N/A	N/A
	30	429,654	146	N/A	N/A	N/A	N/A
	60	423,799	144	N/A	N/A	N/A	N/A

*Statistics as of 12/01/11.

It should be noted that BATS data will have microbursts within the one-second interval above, and that these microbursts will exceed the peak rates at the one-second interval. This is demonstrated within the 1 and 10 millisecond interval statistics. The extent to which the network connection to the member will cope with the microbursts exceeding the available bandwidth without packet loss will depend heavily on the buffers in the end to end path.

During spikes in quote updates, members using less than sufficient bandwidth will experience queuing of their market data. Members using the same bandwidth to both receive quotes and transmit orders may expect their orders to be slightly delayed if they have less than sufficient bandwidth. Many members will find these delays unacceptable and should provision their bandwidth to reduce these delays. The following table demonstrates statistics regarding latency incurred as a result of queuing on Gig-Shaped and WAN-Shaped Multicast PITCH feeds.

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BATS Market	Measurement	Gig-Shaped Multicast PITCH Serialization Delay (ms)	WAN-Shaped Multicast PITCH Serialization Delay (ms)
BZX Exchange	Average	.002	.528
	Standard Deviation	.290	3.701
	Historical High	8.2	552
BYX Exchange	Average	0	.020
	Standard Deviation	.002	.341
	Historical High	0	98.3
BATS Options	Average	.160	8.031
	Standard Deviation	2.887	54.418
	Historical High	36.371	55,583

* Statistics as of 12/01/11.

As the volume on the BATS Exchange increases, the market data feed bandwidth required to accommodate peaks will also grow. Members can obtain the latest published market data bandwidth and serialization statistics within this Connectivity Manual. Additionally, monthly statistical updates are presented through the FIF Market Data Capacity working group.

3.1.1 Multicast PITCH

Key features include:

- Low latency, up to 50% latency reduction vs. TCP based PITCH.
- Two bandwidth versions:
 - Gig-Shaped, requires gigabit cross-connect. Only available in the Weehawken data center.
 - WAN-Shaped, available via cross-connect, direct connect and via certain Extranets. Contact the BATS NOC for a current list of Extranets that have been certified for Multicast PITCH redistribution.
- Gap Response Proxy to recover small data gaps.
- Spin Server to efficiently recover from intra-day disconnects.
- Efficient binary messaging and new modify order message.

The US Equities/Options Multicast PITCH specification is published at:
http://www.batstrading.com/resources/membership/BATS_MC_PITCH_Specification.pdf

3.1.2 TCP PITCH

For the TCP PITCH specification, refer to:
http://www.batstrading.com/resources/membership/BATS_PITCH_Specification.pdf

3.1.3 TOP

The BATS TOP feed offers up to 66% reduction in events and 84% reduction in bandwidth compared to the BATS PITCH market data feed. For the TOP specification, see:
http://www.batstrading.com/resources/membership/BATS_TOP_Specification.pdf

3.1.4 Last Sale

The Last Sale feed is ideal for market data distributors. It is a real-time, intraday TCP feed that disseminates matched trade price, volume, and execution time from the BATS Exchange order book. Users only need 2Mb of bandwidth to take this extremely efficient feed in real-time. For the Last Sale Specification, refer to:

http://www.batstrading.com/resources/membership/BATS_US_Equities_Last_Sale_Specification.pdf

3.2 FIX Order Entry

Bandwidth recommended for submitting orders via FIX depends on expected member order volume. If a member intends to submit orders to BATS and will not receive market data, then it is possible that the member can connect with less than a T1 equivalent connection. The following table shows the maximum number of inbound orders (and/or cancels) per second that can be handled, with no buffering or delay, with different capacity connections.

Example Connection Rates

Order Protocol	256Kb	512Kb	1.5Mb
FIX Capacity	75/sec.	150/sec.	450/sec.

4 Telecommunications Providers

Some telecommunications providers available within the Weehawken and/or Chicago data centers are listed below. This list is a summary and is not indicative of BATS preference or recommendation. For Telecom's not included on the list, please contact the BATS NOC to discuss.

4.1 Extranet Providers

BATS Exchange partners with several extranet providers to aggregate member connectivity and provide low cost, value-added B2B services such as multicast market data feeds. Extranet providers are required to sign Telecommunications Service Provider Agreement after meeting the following requirements:

4.1.1 Network Connectivity and Redundancy requirements

In order to be accepted as and to maintain one's status as an extranet, all extranet providers are required to sign the Telecommunications Service Provider Agreement and meet the following requirements:

- Provider must provide a Network Design Diagram to the Exchange that must be approved with the Exchange Network Operations Center.
- Third Party network Data presented to BATS network must be presented in either contiguous public address subnets, by contiguous private (RFC 1918) IP address subnets assigned from the Exchange, or must be presented on separate VLANs.
- Each Third Party must be presented within its own IP address subnet range.
- Provider will only redistribute Gig multicast feeds to Third Parties with 1 Gigabit of bandwidth or greater for each Gig-Shaped feed they are receiving.
- Providers will be billed for each individual physical network connection according to the BZX Exchange Fee Schedule http://www.batstrading.com/resources/regulation/rule_book/BZX_Fee_Schedule.pdf and/or the BYX Exchange Fee Schedule http://www.batstrading.com/resources/regulation/rule_book/BYX_Fee_Schedule.pdf, as applicable.
- Providers will be responsible for providing a standard operating procedure for trouble shooting network issues including multicast quality issues to Third Parties that must be approved with the Exchange Network Operations Center.
- Provider must maintain a staffed network support phone number between the hours of 7:30 AM and 7:00 PM Eastern time.

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Company	Contact	Phone	Multicast Feeds *	Data Center
Atrium Networks www.atriumnetwork.com	Des Peck pellede.peck@tmxatrium.com	+44 203 194 2510	Z, Y, O	Weehawken
BT Radianz www.btradianz.com	Pam Friedberg pam.friedberg@bt.com	(212) 205-1895	Z	Weehawken Chicago
Fixnetix www.fixnetix.com	Rayan Rowe rayan.rowe@fixnetix.com	+44 203 008 8999		Weehawken
GuavaTech Inc www.guavatech.com	Michael Pappas mikep@guavatech.com	(312) 604-4581	Z, Y, O	Weehawken Chicago
Interactive Data 7ticks www.7ticks.com	Jason Bunyea sales@7ticks.com	(312) 896-0300	Z, Y, O	Weehawken Chicago
IPC www.ipc.com	Paul Zatek paul.zatek@ipc.com	(212) 709-1146		Weehawken
NexGen Networks www.nexgen-net.com	Jeffrey Barth jeffrey.barth@nexgen-net.com	(800) 310-2501	Z, Y, O	Weehawken
NYSE Technologies (SFTI) www.nyse.com/technologies	NYSE Technologies Sales nyse-technologies-sales@nyx.com	(212) 510-3600	Z, Y, O	Weehawken Chicago
QuantHouse www.quanthouse.com	BATS US Technical bats-technical@quanthouse.com	(646) 837-8774		Weehawken
Reliance Globalcom www.relianceglobalcom.com	Dominick Soesman dsoesman@relianceglobalcom.com	(212) 455-4853	Z, Y, O	Weehawken
SAVVIS, Inc. www.savvis.net	Danielle Durkin teambats@savvis.net	(201) 472-2823	Z, Y, O	Weehawken Chicago
Telx www.telx.com	Julie Hutchinson jhutchinson@telx.com	(917) 284-6487		Weehawken Chicago
TNSi www.tnsi.com	John Owens jowens@tnsi.com	+44 2073 361 526	Z	Weehawken
Universal E-Business Solutions www.uebiz.com	Beth Wiesner bwiesner@uebiz.com	(646) 706-4098		Weehawken
Verizon Financial Network www.verizonbusiness.com/us	Verizon Financial Network Sales VFNSales@lists.verizonbusiness.com	(800) 825- 9196	Z, Y, O	Weehawken

* Z = BZX Exchange, Y = BYX Exchange, O = BATS Options

4.2 Carriers

Telecom carriers provide a dedicated circuit between members in different data centers to a demarcation point in either the Weehawken or Chicago data centers. The circuit is extended from the demarc to either member-owned equipment collocated with BATS or a BATS' network device.

Company	Contact	Phone	Data Center
AboveNet www.abovenet.com	Travis Brown tbrown@above.net	(212) 803-5597	Weehawken
Anova Technologies http://www.anova-tech.com	Terry Quinn tquinn@anova-tech.com	(973) 401-0009	Weehawken Chicago
A T & T www.business.att.com	Dale Rife wr7024@att.com	(816) 275-2335	Weehawken
Hibernia Atlantic www.hiberniaatlantic.com	Tom Kennedy Tom.kennedy@hiberniaatlantic.com	(347) 757-4520	Weehawken
Hudson Fiber www.hudsonfiber.com	Michael Fizulich mfizulich@hudsonfiber.com	(201) 289-5219	Weehawken
Level(3) Communications www.level3.com	Daniel Hann daniel.hann@level3.com	(212) 487-0198	Weehawken Chicago
Lighttower Fiber Networks www.lighttower.com	Christopher J. Schook cschook@lighttower.com Jeffrey Mollica jmollica@lighttower.com	(631) 974-4307 (516) 375-6808	Weehawken
Optimum LightPath www.optimumlightpath.com	Colleen M. Capen ccapen@optimumlightpath.com	(201) 644-9610	Weehawken
Sidera Networks www.sidera.net	Stephen Papa stephen.papa@sidera.net	(212) 324-5033	Weehawken Chicago
Verizon Financial Network www.verizonbusiness.com/us/	Verizon Financial Network Sales VFNSales@lists.verizonbusiness.com	(800) 825- 9196	Weehawken
XO Communications www.xo.com	Bob Miskiewicz robert.m.miskiewicz@xo.com	(212) 651-8362	Weehawken

It is recommended that members use redundant connectivity via multiple telecommunications providers to each of the BATS data centers.

Contact BATS Network Support for information about circuit ordering details (e.g. NPA-NXX, LOA/CFA requirements, demarcation information, etc.).

5 Data Center Contact Information

5.1 SAVVIS NJ2 – Weehawken, New Jersey

Bob Luparello

Sr. Sales Manager

(201) 472-2869

Robert.Luparello@savvis.net

5.2 SAVVIS CH4 – Chicago, Illinois

Bob Luparello

Sr. Sales Manager

(201) 472-2869

Robert.Luparello@savvis.net

5.3 Equinix CH1 – Chicago, Illinois

Monica Datta

Account Executive, Financial Services

(646) 430-6819

mdatta@equinix.com

6 Support

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

Revision History

Document Version	Date	Description
5.0.0	12/04/09	Converted former document to new spec template. SAVVIS contact information update. Physical port policy update.
5.0.1	12/10/09	BT Radianz contact information update.
5.0.2	12/29/09	Various updates to Bandwidth - Market Data Feed section.
5.0.3	02/10/10	RGC and IPC contact information update. Added Interactive Data 7ticks as a Telco Provider. Various updates to Bandwidth - Market Data Feed section.
5.0.4	02/22/10	Added allowance for member's of multiple BATS markets to utilize 4U of BATS rack space for connectivity per market.
5.0.5	04/14/10	RCN contact information update.
5.1.0	04/15/10	Added BYX Equities references.
5.1.1	06/01/10	Various updates to Bandwidth – Market Data Feed section. Added Nutley as supported site for Interactive Data 7ticks.
5.1.2	07/29/10	Removed FAT Networks LLC as an extranet. Amended Verizon Financial Network contact information. Added provision for VPN order entry ports.
5.1.3	09/30/10	Changed RCN Metro to Sidera Networks.
5.2.0	12/27/10	Added 10G connectivity. Changed IPC Networks contact information.
5.2.1	01/10/11	Added Lighttower Fiber Networks contact information.
5.2.2	02/02/11	Amended copyright information. Removed VPN connectivity for production.
5.2.3	02/15/11	Provide separate table for extranet and carrier contacts. Added Multicast Feed column for extranets. Updated contact information for Hibernia Atlantic.
5.2.4	03/03/11	Added QuantHouse as an extranet. Amended contact information for Atrium Networks, AT&T, and RGC.
5.3.0	03/14/11	Bandwidth statistics updated and now include metrics for BZX Exchange, BYX Exchange and BATS Options.
5.3.1	04/14/11	Remove references to TCP FAST PITCH protocol.
5.3.2	04/27/11	Amended Extranet Provider table.
5.3.3	06/23/11	Amended Carrier table contact information.
5.3.4	07/01/11	Amended Extranet table and data center contact information.

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5.3.5	07/29/11	Amended contact information for Optimum LightPath and SFTI, added Anova Technologies.
5.3.6	09/01/11	Bandwidth statistics updated. Amended contact information for Atrium Networks.
5.4.0	09/12/11	Added requirements for extranets. Amended contact information for AT&T, Level3, removed Qwest.
5.4.1	12/16/11	Bandwidth statistics updated. Added Universal E-Business Solutions as an extranet.
6.0.0	01/18/12	Removed Nutley, NJ references and added Chicago, IL data center information.