Market Data Optimization Working Group

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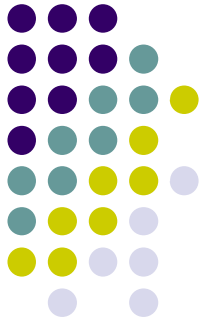
Standardising High Performance Market Data Flows

Scope & Workflows



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Business Case & Scope

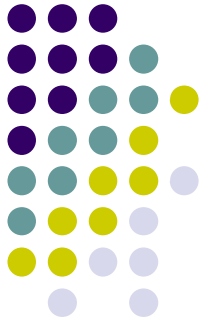
- **High Performance:** *An efficient and powerful market data protocol designed to work as fast as technically possible*
- **High Throughput:** *A protocol that efficiently and rapidly carries a large amount of market data updates, some of which are sent in bursts (i.e. many updates sent over a short period)*
- **Low Latency:** *A protocol that enables all clients to maintain an up-to-date state of the market data as soon as technologically practicable*
- **Non-Bandwidth Constrained:** *A protocol which is not constrained by the network bandwidth*

Layers In Scope	Details	Working group
Transport layer	• UDP multicast • TCP unicast	
Session Layer	• FIXT1.1 – (TBD) • FIXP	HPWG
Presentation layer	• FIX ASCII (FIXtv) - (TBD) • SBE (Simple Binary Encoding) • CBE (Compressed Binary Encoding)	SBE - HPWG CBE – (TBD)
Application layer	• 'ITCH-like' new messages • Existing FIX messages – (TBD)	MDOWG

Market Data Protocols Analysis

ITCH®, PITCH®, and likewise

March 2014



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Sources

	Execution Venue	Asset class	Source
NASDAQ group:			
	NASDAQ	Equities	http://www.nasdaqtrader.com/content/technicalsupport/specifications/dataproducts/nqtv-itch-v4_1.pdf
	ASE	Equities	https://www.asxonline.com/marketinfo/Doco/Glimpse%20-%20ITCH%20Message%20Specification%20v1.0.pdf
	OMEGA ATS	Equities	http://omegaats.com/wp/wp-content/uploads/2012/04/Omega%20ITCH%203.0%20v2.04.pdf
	Japannext PTS	Equities	http://en.japannext.co.jp/pub_data/pub_onboarding/Japannext_PTS_ITCH_v1.3.pdf
LSE Group (PITCH):			
	LSE	Equities	http://www.londonstockexchange.com/products-and-services/millennium-exchange/millennium-exchange-migration/mit303-issue93final.pdf
	Borsa Italiana	Equities	http://www.borsaitaliana.it/borsaitaliana/gestione-mercati/migrazionemillenniumit-mit/mit303-bit-marketdatafeed-itch-specification-bit-issue61.en_pdf.htm
	Turquoise	Equities	http://www.lseg.com/sites/default/files/content/documents/TQ401_Level2_ITCH_Market_Data.pdf
	Oslo Børs	Equities	http://www.oslobors.no/ob_eng/obnewsletter/download/fde4e9687e0b137b2c44fd3f7fc2a4a8/file/file/OSLMIT%20303%20ITCH%20Gateway%20-%20issue%202.0.pdf

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Sources

	Execution Venue	Asset class	Source
BATS group (PITCH):			
	BATS US	Equities & Options	http://cdn.batstrading.com/resources/membership/BATS_MC_PITCH_Specification.pdf
	BATS Chi-X Europe	Equities	http://cdn.batstrading.com/resources/participant_resources/BATS_Europe_MC_PITCH_Specification.pdf
Knight Capital Group:			
	HOTSPOT	FX	https://www.hotspotfx.com/pdfs/Itch_Protocol.pdf
	Equiduct	Equities	http://www.equiduct.com/downloads/itchmd-specification-v1.8.pdf
Independents:			
	Quote MTF	Equities	Available through: https://fixspec.com

Diversities Identified

- Transport layer (UDP & TCP)
- Session layer
- Presentation Layer
- Application layer – some diversities

Session Layer

Execution Venue	BinSoupTCP	MoldUDP	Others
NASDAQ group: NASDAQ ASE OMEGA ATS Japannext PTS	✓	✓	
LSE group: LSE Borsa Italiana Turquoise Oslo Børs			Proprietary session layer – UDP based
BATS: US Chi-X Europe			Proprietary session layer – UDP based
Knight Capital group: HOTSPOT Equiduct			Proprietary sequencing mechanism – TCP based
Independents: Quote MTF	✓		And MTF QTP64 (Quick Transaction ProtocolTCP based protocol)

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Session & Application Layers, Header Lengths

Execution Venue	Session Layer Header Length (bytes)	Application Layer Header Length (Bytes)
NASDAQ group: NASDAQ ASE OMEGA ATS Japannext PTS	20 (for MoldUDP64)	3
LSE group: LSE Borsa Italiana Turquoise Oslo Børs	8	2
BATS: US Chi-X Europe	8	2
Knight Capital Group: HOTSPOT Equiduct	(no common header)	1
Independent: Quote MTF	(Depends on session layer)	1

Presentation Layer: Message Length

Execution Venue	Message length determined by template	Variable Length
NASDAQ group: NASDAQ ASE OMEGA ATS Japannext PTS	✓	
LSE group: LSE Borsa Italiana Turquoise Oslo Børs	✓	
BATS: US Chi-X Europe	✓	
Knight Capital Group: HOTSPOT	✗	Messages are terminated with ASCII LF [0x0A]
Equiduct	?	Messages are fixed length based except a 'debug message' Messages are terminated with ASCII LF [0x0A]
Independent: Quote MTF	✓	

Presentation Layer: Endianess

Execution Venue	Big Endian	Little Endian	Notes
NASDAQ group: NASDAQ ASE Japannext PTS	✓		BinSoupTCP may be compressed using ZLIB
OMEGA ATS	✘	✘	ASCII encoded integers
LSE group: LSE Borsa Italiana Turquoise Oslo Børs		✓	
BATS: US Chi-X Europe		✓	
Knight Capital Group: HOTSPOT Equiduct	✘	✘	ASCII encoded integers
Independent: Quote MTF	✓		

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Presentation Layer: Data Formats

Execution Venue	Date	Time	Price
NASDAQ group: NASDAQ ASE Japannext PTS OMEGA ATS	n/a	Seconds – int[4] - since midnight Nanoseconds – int[4] – since last time message	Int[4] Signed int[4] ASCII format 6.4 Int[4]
LSE group: LSE Borsa Italiana Turquoise Oslo Børs	YYYYMMDD	HH:MM:SS Int[5] // number of seconds since midnight (local time)	Unsigned int[4] Turquoise: String[6]
BATS: US Chi-X Europe	n/a	Nanoseconds – int[4]	String[6]
Knight Capital Group: HOTSPOT	YYYYMMDD	HHMMSSmmmm HHMMSS	String[7] (Currency pairs) String[6]
Equiduct	n/a	Milliseconds since midnight –string[8] (int)	
Independent: Quote MTF	Int[4]	Seconds – int[4] Milliseconds – int[4]	2 bytes

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Identifiers

Execution Venue	Order identifier [bytes]	Instrument Identifier [bytes]
NASDAQ group: NASDAQ ASE Japannext PTS OMEGA ATS	Int[8]	AlphaNumeric[8] Int[4] AlphaNumeric[10] Int[4]
LSE group: LSE Borsa Italiana Turquoise Oslo Børs	Unsigned int[8]	Unsigned int[4] Turquoise: String[6]
BATS: US Chi-X Europe	Int[8]	String[6]
Knight Capital Group: HOTSPOT Equiduct	String[15] String[12]	String[7] (Currency pairs) String[6]
Independent: Quote MTF	Int[4]	2 bytes

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Application Layer: Message Types

Execution Venue	Add Order	Modify Order	Delete / Cancel Order
NASDAQ group: NASDAQ	A	E	D, C
ASE	A	U	D
Japannext PTS	F, f	E, e	D, X, x
OMEGA ATS	A, F	E, U	D
LSE group: LSE, Borsa Italiana, Turquoise, Oslo Børs	A	U	D
BATS: US, Chi-X Europe	0x21, 0x22, 0x2F	0x27, 0x28	0x29
Knight Capital Group: HOTSPOT	N	M	X
Equiduct	A, a	E, e,	X, x
Independent: Quote MTF	A	E, U	D, X

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Commonalities Identified

- Market By Order
- Presentation Layer – ‘Compact Messages’ i.e.: no repeating groups
- Application Layer – Event Driven Workflows

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Scope & Workflows

Draft version 0.9, 28th July 2014

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Timelines

Tentative Date	Working Group	Topic
✓ 7th May 2014	MDOWG	Introduce scope and workflows
✓ 21st May 2014	MDOWG	Introduce scope and workflows – Order book management
✓ 4th June 2014	MDOWG	Introduce scope and workflows – Additional workflows
✓ 11th June 2014	MDOWG	Introduce scope and workflows – Initialization & recovery workflows
✓ 18th June 2014	MDOWG	Introduce scope and workflows – Initialization & recovery workflows (part II)
✓ 25th June 2014	MDOWG	Introduce scope and workflows – Initialization & recovery workflows (part III)
✓ 9th July 2014	MDOWG	Introduce scope and workflows – Reference Data; Message Design – Add Order
✓ 16th July 2014	MDOWG	Message Design– Add Order
✓ 24th July 2014	MDOWG	Message Design– Add Order
▶ 31st July 2014	MDOWG	Message Design – Fill Order, Amend Order
7th August 2014	MDOWG	Message Design – Clear Order Book, Trade, Cancel Trade
14th August 2014	MDOWG	Message Design – Trading Session Status, Security Status, Mass Security Status
21st August 2014	MDOWG	Message Design – Market statistic and Indicative Price
28th August 2014	MDOWG	Message Design – Market Initialization & recovery messages
4th September 2014	MDOWG	Review gap analysis
11th September 2014	MDOWG	Review gap analysis (part II)
18th September 2014	MDOWG	Review Best Practices document
25th September 2014	MDOWG	Review Best Practices document

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Proposed Workflows Summary

	#	Discussed	Workflow
Order book management Workflows	1	7/May	Add Order
	2	21/May	Fill Order - partially filled
	3	21/May	Fill Order – fully filled
	4	7/May	Amend Order – unchanged / lost priority
	5	7/May	Cancel Order (order expired, or other reasons that an order may leave the order book)
	7	21/May	Clear an order book
	8	21/May	Clear all order books
	9	21/May	Example Fill Order – Iceberg order filled with a quantity greater than originally displayed
Additional Workflows	10	7/May	Trade (with no order referenced)
	11	7/May	Cancelled Trade (busted trade)
	12	4/June	Trading Session Status
	13	4/June	Instrument Status & Instrument Mass Status
	14	11/June	Indicative price
	15	4/June	Market Data Light-Weight Statistics
	16	4/June	Example – Auction events

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Proposed Workflows Summary – cont.

	#	Discussed	Workflow
Initialization & Recovery Workflows *(with emphasis on UDP multi-cast)*	17	18/June	System events (Introduced & discussed with MDOWG, 11th June, 2014)
	18	11/June	Start of Day (or week) Procedures
	19	11/June	Exchange non-transient Outage
	20	18/June	Exchange transient Outage
	21	18/June	Intraday initialize Single Order Book
	22	25/June	Late Joiner (Introduced & discussed with MDOWG, 23rd April, 2014)
	23	25/June	Recover loss datagram(s) - by arbitrate feed(s)
	24	25/June	Recover loss datagram(s) - by request or snapshot channel
Reference Data Workflows	25	9/July	Snapshot of instruments reference data (i.e. Instrument Directory)
	26	9/July	Updates – intraday addition to the instruments reference data
	27	9/July	Late joiner instruments reference data