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SECURITIES AND EXCHANGE COMMISSION

[Release No. 34-97946; File No. SR-BX-2023-016]

Self-Regulatory Organizations; Nasdaq BX, Inc.; Notice of Filing and Immediate Effectiveness of Proposed Rule Change to Establish Fees for Field-Programmable Gate Array Technology as an Optional Delivery Mechanism for BX TotalView

July 19, 2023

Pursuant to Section 19(b)(1) of the Securities Exchange Act of 1934 ("Act")[1], and Rule 19b-4 thereunder,[2] notice is hereby given that on July 11, 2023, Nasdaq BX, Inc. ("BX" or "Exchange") filed with the Securities and Exchange Commission ("SEC" or "Commission") the proposed rule change as described in Items I, II, and III below, which Items have been prepared by the Exchange. The Commission is publishing this notice to solicit comments on the proposed rule change from interested persons.

I. Self-Regulatory Organization's Statement of the Terms of Substance of the Proposed Rule Change

The Exchange proposes to set fees for the purchase of field-programmable gate array ("FPGA") technology as an optional delivery mechanism for BX TotalView.

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1 15 U.S.C. 78s(b)(1).

2 17 CFR 240.19b-4.

The text of the proposed rule change is available on the Exchange's Website at https://listingcenter.nasdaq.com/rulebook/bx/rules, at the principal office of the Exchange, and at the Commission's Public Reference Room

II. Self-Regulatory Organization's Statement of the Purpose of, and Statutory Basis for, the Proposed Rule Change

In its filing with the Commission, the Exchange included statements concerning the purpose of and basis for the proposed rule change and discussed any comments it received on the proposed rule change. The text of these statements may be examined at the places specified in Item IV below. The Exchange has prepared summaries, set forth in sections A, B, and C below, of the most significant aspects of such statements.

A. Self-Regulatory Organization's Statement of the Purpose of, and Statutory Basis for, the Proposed Rule Change

1. Purpose

The purpose of the proposed rule change is to establish a fee schedule for the purchase of field-programmable gate array ("FPGA") technology as an optional delivery mechanism for BX TotalView.[3] This follows a recently-filed proposal to offer FPGA technology as an optional delivery mechanism for BX TotalView.[4]

FPGA

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[3] This Proposal was initially filed by the Exchange on May 23, 2023. See Securities Exchange Act Release No. 97627 (May 31, 2023), 88 FR 37112 (June 6, 2023) (SR-BX-2023-014). On July 7, 2023, that filing was withdrawn and replaced by the instant filing. The instant filing provides additional information regarding the Proposal, but does not change it in substance.

[4] See SR-BX-2023-011 ("A proposal to offer field-programmable gate array ('FPGA') technology as an optional delivery mechanism for BX TotalView."), available at https://listingcenter.nasdaq.com/rulebook/BX/rulefilings. A proposal to establish a fee schedule for the use of FPGA technology for the Phlx exchange is being filed concurrently with this proposal.

FPGA is a hardware-based delivery mechanism that utilizes an integrated circuit that is programmed to reduce "jitter"—a technical term of art referring to the deviation in amplitude, phase timing or width of a signal pulse in a digital signal—that will allow data to be processed in a more predictable, or "deterministic," fashion. Reducing jitter can be useful for certain customers due to the variability in the timing of market data packets transmitted by an exchange over the course of the trading day. Orders, and therefore market data packets, typically accumulate in larger numbers at the beginning and end of the trading day, as well as during the peaks of activity that occur at random intervals during the day. These bursts of activity may alter the time interval between the delivery of data packets because software processes information at variable rates depending on load to the system. Processing times may increase at higher loads, and decrease during periods of lesser activity. FPGA technology processes data packets at a constant time interval, without regard to the number of packets processed. Higher levels of determinism means less variable queuing, which improves the predictability of data transfer, particularly during times of peak market activity.

The benefits of determinism depend on the use case of the customer, as well as the customer's specific system architecture.

Higher determinism does not necessarily mean lower latency. The concepts of determinism and latency are related, but distinct. Determinism refers to predictability in the rate of data transmission; latency refers to the time required to process data or transport it from one location to another. Low latency is not necessarily deterministic,

and higher determinism does not necessarily mean low latency. As such, use of FPGA technology will increase determinism, but does not guarantee lower latency at all times.[5]

Among customers that seek a higher degree of determinism, the benefits of FPGA technology varies, as FPGA technology is one possible solution, among a catalog of possible solutions, for increasing the consistency and predictability of message throughput over the course of the trading day. Some customers are able to adequately control jitter without using FPGA technology; other customers address jitter using specialized software, coding or other design solutions in conjunction with FPGA; still others use FPGA alone. The specific choice depends on a complex analysis of the customer's information technology systems in the context of their particular use cases.

FPGA is a broadly-available, commonly-used type of programmable circuit that can be modified to suit different use cases. It is used in a wide spectrum of industries, including the consumer electronics, automotive, and aerospace, as well as in a variety of industrial applications. It is not unique to the financial services industry,[6] or to Nasdaq.

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5 Because software can be impacted by workload, FPGA has lower latency during periods of peak activity.

6 See, e.g., Contrive Datum Insights, "Field-Programmable Gate Array (FPGA) Market is expected to reach around USD 22.10 Billion by 2030, Grow at a CAGR of 15.12% during Forecast Period 2023 to 2030," (February 21, 2023), available at https://www.globenewswire.com/en/news-release/2023/02/21/2612772/0/en/Field-Programmable-Gate-Array-FPGA-Market-Is-Expected-To-Reach-around-USD-22-10-Billion-by-2030-Grow-at-a-CAGR-Of-15-12-during-Forecast-Period-2023-To-2030-Data-By-Contrive-Datum-I.html (describing the general size and state of the FPGA market in 2023).

FPGA technology has been offered by the Nasdaq Stock Exchange for over a decade, and the Nasdaq Options Market for nearly as long,[7] and has been cited by the SEC as an example of a technology useful in the distribution of market data products.[8]

The Exchange proposes to offer FPGA technology in conjunction with the Exchange's depth of book feed, BX TotalView. BX TotalView is a real-time market data product that provides full order depth using a series of order messages to track the life of customer orders in the BX market, as well as trade data for BX executions and administrative messages such as Trading Action messages, Symbol Directory, and Event Control messages.[9]

Proposed Fees

BX proposes internal distribution fees of $3,500 per month and external distribution fees of $350 for FPGA hardware; customers that elect to use FPGA hardware for both internal and external distribution will pay both fees.[10] These fees are in addition

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7 See Securities Exchange Act Release No. 67297 (June 28, 2012), 77 FR 39752 (July 5, 2012) (SR-Nasdaq-2012-063) (introducing FPGA technology); see also Nasdaq Data News 2012-13, available at http://www.nasdaqtrader.com/TraderNews.aspx?id=dn2012-13 (introducing TotalView FPGA service as of August 1, 2012); Securities Exchange Act Release No. 74745 (April 16, 2015), 80 FR 22588 (April 22, 2015) (SR-Nasdaq-2015-035) (establishing FPGA for the Nasdaq Options Market); The Nasdaq Stock Market LLC Rules, Equity 7, Section 126(c) (Hardware-Based Delivery of Nasdaq Depth data).

8 See Securities Exchange Act Release No. 90610, 86 FR 18596, 18647 (April 9, 2021) (File No. S7-03-20) (listing field programmable gate array services as an example of a technological innovation that could be employed by competing consolidators as part of the Market Data Infrastructure rule).

9 See Nasdaq BX, Inc. Rules, Equity 7, Section 123 (BX TotalView); see also Securities Exchange Act Release No. 59307 (January 28, 2009), 74 FR 6069 (February 4, 2009) (establishing fees for BX TotalView).

10 The difference in amount for external and external distribution reflects Nasdaq's experience that the Exchange's FPGA hardware is best employed at the point of ingestion, as the utility of FPGA technology falls as the data moves farther from the source.

to Market Data Distributor Fees,[11] fees for BX TotalView,[12] and other fees for Distribution Models.[13] Customers that elect to receive BX depth of book data without using FPGA technology will pay no fee in addition to the underlying fees listed above.

The proposed fees are substantially lower than FPGA fees for the Nasdaq exchange, which are set at $25,000 per Distributor for internal only distribution, $2,500 for external only, and $27,500 for internal and external distribution.[14] The difference is based, in part, on a comparison of peak activity at the two exchanges. As noted above, high levels of determinism are particularly valuable during periods of peak activity.

Although there is considerable variation in the number of messages at various peaks, as well as the duration of peak activity, the proposed fees are roughly comparable to the differences in average peak activity at the BX exchange relative to the Nasdaq exchange. Exchange staff have also discussed the proposed fees with customers, and believe, based on those discussions and their own business judgment, that the proposed fees fairly reflect the value of FPGA technology for the BX exchange. A number of customers provisionally agree with this assessment, and have indicated that they are interested in testing it.

No other exchange currently offers FPGA technology as a separate service in conjunction with the delivery of a proprietary data feed, and therefore there are no other fees for comparison.

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11 See Nasdaq BX, Inc. Rules, Equity 7, Section 119.

12 See Id., Section 123.

13 See Id., Section 126.

14 See The Nasdaq Stock Market LLC Rules, Equity 7 (Pricing Schedule), Section 126(c) (Hardware-based delivery of Nasdaq depth data).

If BX is incorrect in its determination that the proposed fees reflect the underlying value of FPGA technology, customers will not purchase the product. FPGA technology is not necessary for a customer to ingest and process depth of book information, and those customers that seek a higher degree of determinism have a number of options at their disposal to reduce jitter without using FPGA.

2. Statutory Basis

The Exchange believes that its proposal is consistent with Section 6(b) of the Act,[15] in general, and furthers the objectives of Sections 6(b)(4) and 6(b)(5) of the Act,[16] in particular, in that it provides for the equitable allocation of reasonable dues, fees and other charges among members and issuers and other persons using any facility, and is not designed to permit unfair discrimination between customers, issuers, brokers, or dealers.

The Proposal is reasonable and unlikely to burden the market because the purchase of FPGA technology is optional for all categories of customers. No customer and no category of customers (such as, for example, vendors, proprietary trading firms, banks, hedge funds, market makers, or high frequency trading firms) are required to purchase FPGA technology for either legal or technological reasons—even a customer that seeks to reduce jitter.[17]

The Nasdaq exchange has over ten years of experience in selling FPGA technology. That experience has shown that the vast majority of Nasdaq depth customers do not find value in FPGA. The Exchange expects such customers to continue to ingest

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15 15 U.S.C. 78f(b).

16 15 U.S.C. 78f(b)(4) and (5).

17 Not all customers of depth of book information process at sufficiently high speeds for jitter to become a concern. Neither FPGA hardware nor its substitutes are required to ingest depth of book information.

BX TotalView as they do now.

For those customers that may seek to increase determinism, the purchase of FPGA technology from the BX exchange will be only one of several options available. FPGA technology is not unique to the Exchange or even the financial services industry. Third-party data vendors offer FPGA technology services. Customers may also install their own FPGA hardware for internal use. All of these are viable options; the benefits of any particular option will depend on the particular customer's systems and use cases.

Customers may also choose not to address jitter using FPGA at all. As noted above, FPGA technology processes the data at a consistently predictable rate relative to software. This predictability in the rate of processing may not be advantageous or optimal for all systems receiving the exchange data feed.

The design of data processing architecture is complex. The ingestion of data from an exchange is just one step in the life-cycle of trading. Customers must also generate and submit orders, evaluate trades, and then generate new orders while interacting with multiple exchanges. All of these steps are part of a single trading system. Changing any one step in the process—by, for example, purchasing FPGA technology services from one exchange (when other exchanges may not offer FPGA)—often results in the need for changes to other aspects of the process. As such, the decision to buy FPGA services will be based on whether the service is compatible with their trading system as a whole, not just on whether it may facilitate the processing of data from a single exchange. The appropriateness of any particular solution will depend on the customer's system architecture, and the specific use cases for the market data consumed.

To illustrate the choice faced by exchange customers, consider the decisions made

by the two consolidated data processors, the UTP and CTA Plans, two different systems that use dissimilar means to achieve an optimal solution. Both perform the same task—combining quotes and trades from all US exchanges into a consolidated data feed with relatively low jitter. Yet only one processor—the CTA Plan—uses FPGA hardware, while the other—the UTP Plan—does not.

This is because the UTP Plan's design, coding and hardware achieve the desired level of determinism without FPGA technology. The CTA Plan, by contrast, elected to incorporate FPGA technology into its system design. Notwithstanding these different design decisions, both plans achieve broadly similar levels of performance. FPGA technology is therefore not essential to addressing jitter, but rather is one option among many to address the issue.

Market data customers face an array of choices to optimize determinism, much like the UTP and CTA Plans. For example, a customer may purchase and deploy its own FPGA hardware, without purchasing the proposed FPGA technology service from the Exchange, *after* receiving data from the Exchange. Another customer may find use of the Exchange's FPGA technology, which lowers the level of jitter prior to the customer's receipt of the data, to be a better fit for its system architecture. The solution chosen will vary based on the needs and design choices of the customer.

The experience of the Nasdaq exchange in offering FPGA technology shows that customers sensitive to jitter often avail themselves of substitutes for FPGA technology, a decision that can change over time. Over the past decade, a total of 21 current or potential users of FPGA technology—all of which sought a higher degree of determinism—substituted FPGA with an alternative solution. Six of these customers

were in the process of developing and testing FPGA hardware but ultimately decided not to purchase it before completing this process. The remaining 15 customers purchased FPGA technology, only to cancel it after using it. Because all of these customers continued to utilize the underlying data, these cancelations demonstrate that FPGA technology is an optional service, even for those customers that seek to reduce jitter.

Moreover, as noted above, no other exchange currently offers FPGA technology in conjunction with their proprietary data feeds as a separate service, notwithstanding the fact that it is a widely available technology, providing further evidence that customers have multiple options at their disposal to address jitter.

In the experience of the Nasdaq exchange, FPGA services are purchased by vendors, proprietary trading firms, banks, high-frequency trading firms, hedge funds, and market makers. The Nasdaq exchange is aware of no systematic differences within any of these categories among market participants that choose to use or not to use FPGA technology.

Few customers of Nasdaq TotalView purchase FPGA services from Nasdaq. This is because the bulk of customers consume Nasdaq TotalView for display (i.e., human) usage. FPGA technology impacts performance at a speed that a human cannot process, and there is no need for FPGA technology for such usage.

Of the customers that receive Nasdaq TotalView from Nasdaq (either through a direct feed or an extranet connection), and are in a position to utilize FPGA technology, only about 15 percent purchase it.

Most strikingly, only approximately 3% of market makers at Nasdaq purchase FPGA technology. This may seem a surprising result, given that market makers, by

definition, trade throughout the day and during periods of peak activity, but, as noted above, customers have several options: purchase FPGA services from a third-party vendor, implement FPGA technology on their own, or configure their systems to process data during peaks without the use of FPGA. The fact that only about 3% of market makers at the Nasdaq exchange purchase FPGA demonstrates that most customers make use of alternative solutions. As such, the determining factor in whether to purchase FPGA is not the category of customer, but rather the compatibility of FPGA technology with the customer's specific systems architecture and technical requirements, which can and do change over time as systems are modified, replaced or updated.

For all of these reasons, customers can discontinue the use of FPGA technology at any time, or decide not to purchase it, for any reason, including the level of fees.

Customers that choose not to purchase FPGA technology are not impacted by the proposal.

The proposed fees will be available to all customers on a non-discriminatory basis, and therefore are not designed to permit unfair discrimination between customers, issuers, brokers, or dealers.

B. Self-Regulatory Organization's Statement on Burden on Competition

The Exchange does not believe that the proposed rule change will impose any burden on competition not necessary or appropriate in furtherance of the purposes of the Act.

This Proposal, a response to customer demand, is a product of a competitive marketplace. To date, lower levels of peak activity at the BX Exchange relative to the Nasdaq exchange have been associated with low levels of customer interest in this product. Recently, however, BX has heard from customers interested in using FPGA

technology for BX TotalView. To address this customer demand, and to drive liquidity to the BX Exchange by making it a more attractive trading venue, BX has decided to offer this product.

Approval of this Proposal will further promote competition by providing market participants additional choices in the transmission of depth of book data.

Nothing in the Proposal burdens inter-market competition (the competition among self-regulatory organizations) because approval of the Proposal does not impose any burden on the ability of other exchanges to compete. As noted above, FPGA technology is generally available and any exchange has the ability to offer it if it so chooses.

Nothing in the Proposal burdens intra-market competition (the competition among consumers of exchange data) because FPGA technology is available to any customer under the same fee schedule as any other customer, and any market participant that wishes to purchase FPGA technology can do so on a non-discriminatory basis.

C. Self-Regulatory Organization's Statement on Comments on the Proposed Rule Change Received from Members, Participants, or Others

No written comments were either solicited or received.

III. Date of Effectiveness of the Proposed Rule Change and Timing for Commission Action

The foregoing rule change has become effective pursuant to Section 19(b)(3)(A)(ii) of the Act.[18]

At any time within 60 days of the filing of the proposed rule change, the Commission summarily may temporarily suspend such rule change if it appears to the Commission that such action is: (i) necessary or appropriate in the public interest; (ii) for

[18] 15 U.S.C. 78s(b)(3)(A)(ii).

the protection of investors; or (iii) otherwise in furtherance of the purposes of the Act. If the Commission takes such action, the Commission shall institute proceedings to determine whether the proposed rule should be approved or disapproved.

IV. Solicitation of Comments

Interested persons are invited to submit written data, views and arguments concerning the foregoing, including whether the proposed rule change is consistent with the Act. Comments may be submitted by any of the following methods:

Electronic Comments:

- Use the Commission's internet comment form (https://www.sec.gov/rules/sro.shtml); or
- Send an email to rule-comments@sec.gov. Please include file number SR-BX-2023-016 on the subject line.

Paper Comments:

- Send paper comments in triplicate to Secretary, Securities and Exchange Commission, 100 F Street NE, Washington, DC 20549-1090.

All submissions should refer to file number SR-BX-2023-016. This file number should be included on the subject line if email is used. To help the Commission process and review your comments more efficiently, please use only one method. The Commission will post all comments on the Commission's internet website (https://www.sec.gov/rules/sro.shtml). Copies of the submission, all subsequent amendments, all written statements with respect to the proposed rule change that are filed with the Commission, and all written communications relating to the proposed rule change between the Commission and any person, other than those that may be withheld

from the public in accordance with the provisions of 5 U.S.C. 552, will be available for website viewing and printing in the Commission's Public Reference Room, 100 F Street NE, Washington, DC 20549, on official business days between the hours of 10 a.m. and 3 p.m. Copies of the filing also will be available for inspection and copying at the principal office of the Exchange. Do not include personal identifiable information in submissions; you should submit only information that you wish to make available publicly. We may redact in part or withhold entirely from publication submitted material that is obscene or subject to copyright protection. All submissions should refer to file number SR-BX-2023-016 and should be submitted on or before **[INSERT DATE 21 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

For the Commission, by the Division of Trading and Markets, pursuant to delegated authority.[19]

Sherry R. Haywood,

Assistant Secretary.

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[19] 17 CFR 200.30-3(a)(12).