Assessment of the Business Clock Synchronization Requirements of the Consolidated Audit Trail Pursuant to Section 6.6(a)(ii) of the CAT NMS Plan

Executive Summary

Pursuant to Section 6.6(a)(ii) of the National Market System Plan Governing the Consolidated Audit Trail (the "CAT NMS Plan" or "Plan"), on May 15, 2017, the Participants to the Plan filed with the Securities and Exchange Commission ("SEC") a written assessment of the clock synchronization standards set forth in the CAT NMS Plan. To prepare the written assessment, the Participants surveyed market participants regarding their current clock synchronization standards and practices, including their standards and practices based on the type of CAT Reporter, type of Industry Member and type of system. As described further in the enclosed written assessment, the Participants determined that it is not necessary or appropriate to amend the Business Clock synchronization requirements set forth in the Plan at this time.

May 15, 2017

Brent J. Fields
Secretary
Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549-1090

Re: File Number 4-698
National Market System Plan Governing the Consolidated Audit Trail
Clock Synchronization Assessment

Dear Mr. Fields:

In accordance with Section 6.6(a)(ii) of the National Market System Plan Governing the Consolidated Audit Trail (the "CAT NMS Plan" or "Plan"),[1] the Operating Committee[2] for CAT NMS, LLC respectfully provides the Securities and Exchange Commission ("SEC" or "Commission") with this assessment of the clock synchronization standard for the Consolidated Audit Trail ("CAT"), including consideration of industry standards based on the type of CAT Reporter, Industry Member and type of system, and recommendation for appropriate amendments based on this assessment.[3] This Assessment is divided into four sections: (1) executive summary; (2) description of current clock synchronization requirements under the CAT NMS Plan; (3) description of the CAT Clock Synchronization Survey (the "Survey"), including responses to the Survey; and (4) an assessment of the current clock synchronization requirements based on the analysis of the data collected in the Survey, including whether the current requirements should be amended.

I. Executive Summary

As previously noted, Section 6.6(a)(ii) of the CAT NMS Plan requires that the Participants provide the SEC with an assessment of the clock synchronization standard, including consideration of industry standards based on the type of CAT Reporter, Industry

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[1] The CAT NMS Plan is a national market system plan approved by the Commission pursuant to Section 11A of the Exchange Act and the rules and regulations thereunder. *See* Securities Exchange Act Release No. 79318 (Nov. 15, 2016), 81 Fed. Reg. 84696 (Nov. 23, 2016) (the "Adopting Release"). The full text of the CAT NMS Plan is available at www.catnmsplan.com.

[2] The Participants to the CAT NMS Plan are Bats BYX Exchange, Inc., Bats BZX Exchange, Inc., Bats EDGA Exchange, Inc., Bats EDGX Exchange, Inc., BOX Options Exchange LLC, C2 Options Exchange, Incorporated, Chicago Board Options Exchange, Incorporated, Chicago Stock Exchange, Inc., Financial Industry Regulatory Authority, Inc., Investors' Exchange LLC, Miami International Securities Exchange, LLC, MIAX PEARL, LLC, NASDAQ BX, Inc., Nasdaq GEMX, LLC, Nasdaq ISE, LLC, Nasdaq MRX, LLC, NASDAQ PHLX LLC, The NASDAQ Stock Market LLC, NYSE National, Inc., New York Stock Exchange LLC, NYSE MKT LLC, and NYSE Arca, Inc. Note that National Stock Exchange, Inc. has been renamed NYSE National, Inc. *See* Securities Exchange Act Rel. No. 79902 (Jan. 30, 2017), 82 Fed. Reg. 9258 (Feb. 3, 2017). Note further that ISE Gemini, LLC, ISE Mercury, LLC and International Securities Exchange, LLC have been renamed Nasdaq GEMX, LLC, Nasdaq MRX, LLC, and Nasdaq ISE, LLC, respectively. *See* Securities Exchange Act Rel. No. 80248 (Mar. 15, 2017), 82 Fed. Reg. 14547 (Mar. 21, 2017); Securities Exchange Act Rel. No. 80326 (Mar. 29, 2017), 82 Fed. Reg. 16460 (Apr. 4, 2017); and Securities Exchange Act Rel. No. 80325 (Mar. 29, 2017), 82 Fed. Reg. 16445 (Apr. 4, 2017).

[3] Unless otherwise defined herein, capitalized terms are defined as set forth in the CAT NMS Plan.

Member and type of system, and a recommendation for appropriate amendments based on this assessment. To prepare this assessment, the Participants sought information regarding Industry Members' clock synchronization practices through the Survey. This assessment provides a summary of the results of this Survey. Based on an analysis of the results of the Survey as well as information about Participant clock synchronization practices, the Participants do not believe that it is necessary or appropriate to amend the Business Clock synchronization requirements set forth in the Plan at this time. The Participants believe this assessment is consistent with the SEC's finding that the current 50 milliseconds standard for Industry Members "is acceptable for the initial phase of CAT reporting."[4] The Participants will reassess whether the Business Clock synchronization requirements remain consistent with industry standards – or whether it may be necessary to amend such requirements – in the future as part of the annual assessment required by Section 6.8(c) of the Plan; however, the Participants note that the first annual assessment will occur before the initial phase of Industry Member CAT reporting.

II. Current Clock Synchronization Requirements

Section 6.8 of the CAT NMS Plan sets forth the clock synchronization requirements related to the CAT for Participants and Industry Members. With regard to Participants, Section 6.8(a)(i) of the Plan requires each Participant to synchronize its Business Clocks at a minimum to within 100 microseconds of the time maintained by the National Institute of Standards and Technology ("NIST"), consistent with industry standards, except for Business Clocks used solely for Manual Order Events. Section 6.8(a)(iii) of the Plan requires each Participant to synchronize its Business Clocks used solely for Manual Order Events at a minimum to within one second of the time maintained by NIST, consistent with industry standards, and maintain such synchronization.

With regard to Industry Members, Section 6.8(a)(ii) of the Plan requires each Participant to require its Industry Members to synchronize their Business Clocks at a minimum to within 50 milliseconds of the time maintained by NIST, except for Business Clocks used solely for Manual Order Events or the time of allocation on Allocation Reports, and maintain such a synchronization. Section 6.8(a)(iii) of the Plan requires each Participant to require its Industry Members to synchronize their Business Clocks used solely for Manual Order Events at a minimum to within one second of the time maintained by NIST, consistent with industry standards, and maintain such synchronization. Section 6.8(a)(iv) of the Plan requires each Participant to require its Industry Members to synchronize their Business Clocks used solely for the time of allocation on Allocation Reports at a minimum to within one second of the time maintained by NIST, consistent with industry standards, and maintain such synchronization.

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[4] Adopting Release at 84785.

Each Participant has adopted rules requiring its Industry Members to comply with these clock synchronization requirements.[5]

In approving the Plan, the SEC noted that the 50 milliseconds standard was reasonable for the initial implementation of the CAT.[6] The SEC stated further that it "believes that a standard of 50 milliseconds for Industry Members will allow regulators to sequence orders and events with a level of accuracy that is acceptable for the initial phases of reporting."[7] Nevertheless, the SEC stated further that it:

> believes that it is appropriate for the Participants to consider the type of CAT Reporter (*e.g.*, Participant, Industry Member), the type of Industry Member (*e.g.*, ATS, small broker-dealer), and type of system (*e.g.*, order handling, post-execution) when establishing appropriate industry standards. The Commission does not believe that one industry standard should apply across all CAT Reporters and systems.[8]

Accordingly, the Commission amended Section 6.8(c) of the Plan to state that industry standards for purposes of clock synchronization should be determined based on the type of CAT Reporter, type of Industry Member and type of system. In recognition of the expectation that narrower clock synchronization thresholds may be appropriate for Industry Members, or certain categories or systems thereof, the Commission amended the Plan to require the Participants to provide this assessment of the clock synchronization standards set forth in the Plan.

III. CAT Clock Synchronization Survey

The Participants determined that the use of a survey was an appropriate method for gaining additional data on Industry Members' Business Clock synchronization practices to inform this assessment. On April 11, 2017, the Participants released the Survey, which was made available to the public on the CAT NMS Plan's public website.[9] Responses were collected through April 23, 2017. The Participants drafted the Survey in consultation with the Advisory Committee to help ensure that the Survey was designed to seek detailed and meaningful data regarding Business Clock synchronization practices and trends, and industry views regarding potential modifications to the Business Clock synchronization standards set forth in the Plan. When the Survey was posted, the Participants notified their respective members and the

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5 *See* Bats BYX Exchange, Inc. Rule 4.6; Bats BZX Exchange, Inc. Rule 4.6; Bats EDGA Exchange, Inc. Rule 4.6; Bats EDGX Exchange, Inc. Rule 4.6; BOX Options Exchange LLC Rule 16020; C2 Options Exchange, Incorporated Rulebook Chapter 6, Section F; Chicago Board Options Exchange, Incorporated Rule 6.86; Chicago Stock Exchange, Inc. Rulebook Article 23, Rule 2; Financial Industry Regulatory Authority, Inc. Rule 6820; Investors' Exchange LLC Rule 11.620; Miami International Securities Exchange, LLC Rule 1702; MIAX PEARL, LLC Rulebook Chapter XVII; NASDAQ BX, Inc. Equity Rule 6820, Option Rulebook Chapter IX, Section 8(b); Nasdaq GEMX, LLC Rule 901; Nasdaq ISE, LLC Rule 901; Nasdaq MRX, LLC Rule 901; NASDAQ PHLX LLC Rule 920A; The NASDAQ Stock Market LLC Equity Rule 6820, Option Rulebook Chapter IX, Section 8(b); NYSE National, Inc. Rule 14.2; New York Stock Exchange LLC Rule 6820; NYSE MKT LLC Rule 6820; and NYSE Arca, Inc. Equity Rule 6.6820, Option Rule 11.6820.

6 Adopting Release at 84785 ("For the initial implementation of the CAT, however, the Commission believes a 50 millisecond clock synchronization standard for Industry Members is reasonable at this time.").

7 Id.

8 Id.

9 The CAT NMS Plan's public website is available at www.catnmsplan.com.

Advisory Committee and industry trade associations,[10] to encourage a significant and diverse sample size.

A. Overview of CAT Clock Synchronization Survey

The Survey was divided into five main sections: (1) demographic questions; (2) general questions; (3) current clock synchronization practices; (4) changes to Business Clock synchronization practices; and (5) costs. Each of these sections is discussed in greater detail below.

1. Demographic Questions

The first section of the Survey asked that respondents provide their firm name and contact information. The section also asked that respondents, if applicable, identify themselves as a third-party vendor, technology services provider or other entity that is not subject to the CAT NMS Plan, but that provides services to CAT Reporters and maintains synchronized Business Clocks, and to explain their business and systems that contain Business Clocks. To the extent that a respondent was a small broker-dealer, as defined in Rule 613,[11] they were asked to identify themselves as such.

To help the Participants collect information from Industry Members that currently report to the Financial Industry Regulatory Authority's ("FINRA") Order Audit Trail System ("OATS"), the Survey asked respondents to identify whether they currently report to OATS and, if so, to identify approximately how many reportable order events they report each month. For firms that are not subject to OATS, the Survey asked that respondents provide a brief explanation of why they are excluded or exempt from OATS, as applicable. Respondents also were asked to provide estimates of the approximate number of orders for NMS Stocks and OTC Equity Securities, and listed options, that they handled in the past month (including orders given to, received by, or originated by, the respondent). Finally, respondents were asked to provide information concerning their business activities, including identifying the types of business activities in which they participate, identifying whether they are a market maker, identifying whether they are an alternative trading system ("ATS"), and identifying the instruments that they trade.

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[10] The Participants asked the following industry trade associations to notify their respective members about the Survey: Financial Information Forum, the Security Traders Association and the Securities Industry and Financial Markets Association.

[11] For purposes of this assessment, "small broker-dealer" has the meaning set forth in Rule 613. In particular, Rule 613(a)(3)(v) states that "small broker-dealer" has the meaning set forth in SEC Rule 0-10(c), which defines a "small broker-dealer" as a broker-dealer that:

> (1) Had total capital (net worth plus subordinated liabilities) of less than $500,000 on the date in the prior fiscal year as of which its audited financial statements were prepared pursuant to § 240.17a-5(d) or, if not required to file such statements, a broker or dealer that had total capital (net worth plus subordinated liabilities) of less than $500,000 on the last business day of the preceding fiscal year (or in the time that it has been in business, if shorter); and (2) Is not affiliated with any person (other than a natural person) that is not a small business or small organization as defined in this section[.]

2. General Questions

The next section of the Survey included general questions requesting views on whether the Business Clock synchronization requirements set forth in the Plan should vary depending on the type of CAT Reporter, the type of Industry Member and/or the type of system. To the extent that a respondent believed that the requirements should vary, the Survey asked that they explain how and why. Next, the Survey asked if respondents believed that firms voluntarily seek to improve Business Clock synchronization requirements, or if they believed that firms typically avoid changing such standards or practices absent a regulatory requirement to do so. Finally, this section asked that the respondents describe the factors that primarily affect costs related to complying with the Business Clock synchronization requirements and whether such factors vary by system or Industry Member.

3. Current Clock Synchronization Practices

The next section asked that respondents provide information regarding their current Business Clock synchronization practices. To the extent that respondents currently maintain synchronized Business Clocks, they were asked to identify the types of systems in which such Business Clocks are maintained.[12] To collect information on Business Clocks used in different systems, respondents also were asked to provide responses to various questions regarding the systems that they operate that contain Business Clocks. Respondents were asked whether they maintain different synchronization tolerances for Business Clocks used for different systems and, if so, for what types of systems the respondents maintain different tolerances and the tolerance of each respective system. The Survey requested information regarding the technologies that respondents use to maintain Business Clock synchronization, such as: PTP; NTP; PPS; GPS; CDMA; or other. Respondents also had the option of indicating that they "do not know" the technologies that they currently use to maintain Business Clock synchronization.

Respondents were then asked to provide information regarding their current Business Clock drift tolerances by choosing from the following responses: more than 1 second; 500 milliseconds to 1 second; 50 milliseconds to 499 milliseconds; 1 millisecond to 49 milliseconds; 500 microseconds to 999 microseconds; 1 microsecond to 499 microseconds; and "do not know." Respondents also were asked if tolerances vary by where a Business Clock is located (e.g., internal broker-dealer data center; third-party data center; exchange co-location). Next, respondents were asked to identify how often they check Business Clock synchronization by choosing from the following responses: once a day; more than once a day, but less than once an hour; once an hour or more, but less than once a minute; once a minute or more, but less than once a second; once a second or more, but less than once a hundredth of a second; more than once a hundredth of a second; or "do not know." Next, respondents were asked to identify what source they currently use as a "master" clock by identifying: GPS; CDMA; NIST atomic clock; data center-provided time; other vendor or hardware provided time; or "do not know." To the

[12] Specifically, the question listed the following options: order origination systems; order routing systems; order execution or matching systems; co-located systems; internalization systems; back-office systems; third-party systems (including vendor systems); and other (in which case a respondent was asked to identify such other system). Respondents also could indicate that they do not know the types of systems in which they currently maintain synchronized Business Clocks.

extent that respondents maintain Business Clock synchronization across geographically disparate systems, they were asked to identify this fact and explain any challenges encountered and costs incurred to maintain such synchronization.

4. Changes to Business Clock Synchronization Practices

Respondents were asked to provide information on how often they assess Business Clock synchronization tolerance and whether this practice varies by the type of Business Clock or system being considered. To collect information regarding changes to synchronization practices, respondents also were asked how often they assess their Business Clock synchronization tolerances and how often they have changed tolerances in the past year. Next, respondents were asked, to the best of their knowledge, how often their Business Clock tolerances are exceeded.

5. Costs

The final section of the Survey sought information regarding the costs to the industry of Business Clock synchronization. This section asked respondents to provide information regarding the initial costs that they incurred (or that they anticipate that they will incur) to comply with the Business Clock synchronization tolerance of 50 milliseconds or 1 second, as applicable. Respondents also were asked to explain any ongoing costs that they will incur to maintain applicable synchronization tolerance and to explain how this response varies by type of Business Clock or system. Respondents also were asked how long it took them (or how long they anticipate that it will take them) to comply with the Business Clock synchronization requirements, and to explain how this response varies by the type of Business Clock or system.

The next set of questions sought information on the projected costs of further reducing the Business Clock synchronization tolerance. Respondents were asked to describe the costs (initial and ongoing), if any, that they expect to incur if the Business Clock synchronization tolerance is reduced and how these costs vary by type of Business Clock or system. Respondents also were asked how long they anticipate that it will take them to comply with any new Business Clock synchronization tolerances.

B. Assessment of Participants' Business Clock Synchronization Standards

Although the Participants did not participate in the Survey, which was designed for Industry Members and other firms in the securities industry, the Participants previously assessed their operations and use of Business Clocks to determine an appropriate synchronization threshold to apply to themselves. These assessments occurred in 2015 and 2016.[13] Ultimately, the Participants determined that, collectively, they operate pursuant to a Business Clock synchronization of 100 microseconds or less with respect to their electronic systems. The Participants that are exchanges each measured average absolute matching engine clock drift across five business days. The average measured clock drift based on this analysis was approximately 36 microseconds. However, this result was an average and the Participants do not believe that it may be relied upon as a definitive statement that all Participants currently meet a

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[13] *See, e.g.*, Letter from CAT NMS Plan Participants to Brent J. Fields, dated Sept. 23, 2016.

threshold of 36 microseconds. In particular, Participants' practices vary with respect to the implementation, use and measurement of synchronization. Moreover, Participants' practices also vary with respect to the frequency with which they check the accuracy of synchronization, so it may be difficult to directly compare the synchronization of one Participant to another. Participants that operate non-electronic systems, such as manual systems operated on trading floors, manual order entry devices and certain other systems, found that they do not operate at a synchronization of 100 microseconds or less. Based on these findings, the Participants proposed, and the Commission adopted, that they be subject to a Business Clock synchronization standard of 100 microseconds of the time maintained by NIST, other than Business Clocks used solely for Manual Order Events (which must comply with a standard of 1 second of the time maintained by NIST). The Participants do not believe that their practices have changed materially since the Plan was adopted.

C. Analysis of Data from Clock Synchronization Survey[14]

1. Overview of Respondents and Demographics

The Participants received 143 substantially complete responses to the Survey.[15] The responses represent the views of a range of firms. Based on the responses, approximately 13% of respondents identified as small broker-dealers that expect to report to the CAT, approximately 60% of respondents identified as large broker-dealers that expect to be CAT reporters, and approximately 27% of respondents indicated that they do not expect to report to the CAT. Of the 143 responses, approximately 23% of respondents indicated that they are an equities market maker and approximately 13% of respondents indicated that they are an options market maker. Approximately 78% of respondents indicated that they currently report to OATS, and approximately 22% indicated that they currently do not report to OATS.[16]

With respect to types of business activities, respondents indicated the following: approximately 20% operate an institutional business; approximately 17% operate a retail business; approximately 17% are introducing brokers; approximately 12% engage in proprietary trading; approximately 8% engage in clearing activities; approximately 7% engage in asset management activities; approximately 8% engage in investment banking; approximately 5% provide prime brokerage services; and approximately 6% indicated that they engage in other activities. Approximately 8% of respondents stated that they operate an ATS. Approximately 18% of respondents indicated that they are a third-party vendor, technology services provider or other entity that is not subject to the CAT NMS Plan, but that provides services to CAT Reporters and maintains synchronized Business Clocks (a "Service Provider"). The

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[14] All figures and data discussed in this assessment are approximate and subject to potential minor rounding errors and assumptions. When discussing responses to specific questions regarding synchronization practices (i.e., the non-demographic questions), percentages focus on those respondents that provided information in response to the relevant questions.

[15] Survey responses were identified as "substantially complete" using a two-step process: (1) verification of whether a response was submitted as "complete" (even if some responses were blank); and (2) verification of whether a response was at least 50% complete (generally, responses with less than a 50% completion rate provided only demographic information and no meaningful data regarding Business Clock synchronization practices, costs or views).

[16] Specifically, approximately 12% of respondents stated that they were not FINRA members and approximately 10% stated that they are excluded or exempt from OATS reporting.

approximately 18% of respondents that identified as Service Providers indicated that they provide the following functions: back-office processing (approximately 3%); books and records (approximately 4%); clearing (approximately 1%); settlement (approximately 1%); trade order management systems (approximately 5%); trade reporting (approximately 3%); and other[17] (approximately 2%).

The approximately 78% of respondents that indicated that they currently report to OATS provided the following information regarding the approximate number of reportable events that they submit to OATS each month: 0 to 9,999 (approximately 30%); 10,000 to 99,999 (approximately 9%); 100,000 to 2,999,999 (approximately 15%); 3,000,000 to 99,999,999 (approximately 12%); and 100,000,000 or more (approximately 12%). As previously noted, approximately 12% of respondents reported that they are not FINRA members and approximately 10% of respondents indicated that they are excluded or exempt from OATS reporting.

2. Responses to General Questions

As discussed in greater detail in this section, generally, over half of respondents did not have a view on whether there should be different Business Clock synchronization requirements applicable to different types of businesses or systems. Focusing on the respondents that did have a view, approximately 64% did not believe that there should be different requirements for different types of businesses or systems, versus approximately 36% that believed that there should be different requirements for different types of businesses or systems. However, a majority of respondents that identified as small broker-dealers believed that there should be different Business Clock synchronization standards that apply to both (1) large broker-dealers vs. small broker-dealers (approximately 83% of small broker-dealer respondents), and (2) different types of systems (100% of small broker-dealer respondents). Large broker-dealers and small broker-dealers split on the question of whether firms voluntarily seek to improve their Business Clock synchronization standards or practices, or if firms only change such standards or practices when required to do so by regulation. Large broker-dealer respondents believed that they voluntarily seek to improve such standards or practices, while most small broker-dealer respondents indicated that they change such standards or practices when required to do so. Finally, there is no majority view with respect to how often respondents exceed applicable Business Clock synchronization thresholds, but most firms indicated that they did not know the answer to this question. These findings are discussed in greater detail below.

a. Execution Venues vs. Broker-Dealers

Approximately 50% of the respondents indicated that they did not have a view on whether there should be different Business Clock synchronization requirements applicable to Execution Venues and broker-dealers. Out of those respondents that did express a view, approximately 66% stated that they did not believe that there should be different Business Clock

[17] Some respondents provided comments with their responses regarding "other" activities. These respondents noted the following activities: execution services, network services and/or technology provider; market maker; ATS; national securities exchange routing facility; financial technology firm; private placement of securities and mutual fund retailer; and principal underwriter and distributor of affiliate insurers' registered annuity products.

synchronization requirements applicable to Execution Venues and broker-dealers and approximately 34% stated that they believe that Execution Venues and broker-dealers should be subject to different requirements. Notably, of the respondents that indicated that they operate an ATS, approximately 50% did not believe that different requirements should apply to Execution Venues. Approximately 33% of respondents operating ATSs believed that there should be different requirements that apply to Execution Venues, and approximately 17% of respondents that operate ATSs did not have a view.[18]

b. Small Broker-Dealers vs. Large Broker-Dealers

A majority of respondents (approximately 52%) indicated that they did not have a view on whether there should be different Business Clock synchronization requirements for CAT Reporters that are small broker-dealers and large broker-dealers. Focusing on those respondents who did express a view, the majority (approximately 68%) did not believe that there should be different requirements applicable to small broker-dealers and large broker-dealers, and approximately 32% of respondents believed that small broker-dealers and large broker-dealers should be subject to different standards. Notably, the respondents that provided a response to this question mostly identified as large broker-dealers (approximately 60%), while approximately 12% identified as small broker-dealers and approximately 28% identified as non-CAT Reporters.

c. Varying Standards by Type of System

A majority of the respondents (approximately 54%) indicated that they did not have a view on whether there should be different Business Clock synchronization requirements for different types of systems. Focusing on the respondents that did express a view, approximately 60% do not believe that there should be different Business Clock synchronization requirements applicable to different types of systems versus approximately 40% of respondents that believed that different requirements should apply to different types of systems. All small broker-dealer respondents that responded to this question, as well as approximately 60% of respondents that operate a retail business and responded to this question, support there being different Business Clock synchronization requirements applicable to different types of systems.

d. Improvements to Business Clock Synchronization Practices

Respondents split on whether firms voluntarily seek to improve their Business Clock synchronization standards or practices, or avoid changing such standards or practices absent a regulatory requirement to do so. Of the respondents that expressed a view, approximately 27%

[18] Some of the ATS respondents that believed that different requirements should apply to Execution Venues provided comments with their responses. One ATS respondent explained that Execution Venues currently maintain very tight clock synchronization standards, which is not always the case for non-ATS broker-dealer systems. Two respondents believed that Execution Venues should be subject to more stringent tolerances but they did not provide an explanation for this view. One ATS respondent explained that Execution Venues may adhere to tighter clock synchronization standards than broker-dealers and that requiring broker-dealers to meet the same standards as Execution Venues may impose significant costs and burdens on the broker-dealer community.

indicated that firms voluntarily[19] seek to improve their Business Clock synchronization standards or practices, approximately 23% indicated that firms did not change their standards or practices absent a regulatory requirement to do so,[20] and approximately 18% indicated that other factors cause them to update their Business Clock synchronization standards or practices.[21] Approximately 31% of respondents indicated that they did not have a view on whether firms voluntarily seek to improve their Business Clock synchronization standards or practices, or avoid changing such standards or practices absent a regulatory requirement to do so.

Of the respondents that identified as large broker-dealers, the largest number of responses (approximately 42%) indicated that respondents voluntarily seek to improve their Business Clock synchronization standards or practices. The opposite was true of small broker-dealer respondents, as the majority of such respondents (approximately 75%) indicated that they change their Business Clock synchronization standards or practices when a regulatory obligation requires them to do so.

e. Exceeding Required Synchronization Tolerances

Approximately 46% of respondents that expressed a view indicated that they did not know, on average, how often their Business Clock synchronization tolerances are exceeded. Approximately 3% of respondents stated that their response depends on the type of Business Clock or system being considered. Other respondents indicated that their Business Clock tolerances are exceeded: multiple times per day (approximately 5%); monthly (approximately 15%); semiannually (approximately 16%); and less than annually (approximately 15%).

Respondents that identified as large broker-dealers reported that, on average, their Business Clock synchronization tolerances are exceeded: multiple times per day (approximately 8%); monthly (approximately 14%); semiannually (approximately 13%); and less than annually (approximately 27%). Approximately 3% of large broker-dealer respondents indicated that their response depends on the type of Business Clock or system considered and approximately 35% of large broker-dealer respondents did not know how often their synchronization tolerances are exceeded. Small broker-dealer respondents indicated that, on average, their synchronization tolerances are exceeded: monthly (approximately 27%); semiannually (approximately 33%); and less than annually (approximately 7%). No small broker-dealer respondents reported exceeding thresholds multiple times per day or at different times depending on the type of Business Clock

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[19] Some respondents that indicated that firms voluntarily improve their synchronization tolerances provided additional comments with their responses. One respondent identified itself as a technology firm that can easily adjust its Business Clock synchronization tolerances, so it tries "to be ahead of the curve." Other respondents generally believe that firms voluntarily work on improving their synchronization tolerances to address customer comments and reduce system latencies (which may provide a competitive advantage).

[20] Some respondents that indicated that firms only improve their synchronization tolerances when required to do so provided additional comments with their responses. Respondents provided various views. Some respondents believed that firms only update synchronization tolerances when required to do so due to costs or limited resources. Others believed that firms only update tolerances when required to do so in the absence of some sort of business or competitive advantage that could be gained by updating tolerances. Some respondents expressed that they believe that regulators often drive changes to tolerances since the regulatory need for lower tolerances may exceed the business need.

[21] Respondents listed the following other factors: competitive advantage; efficient and effective client service; latency concerns; algorithmic high frequency trading; as technology and cost permits (i.e., no directing of scarce resources to unnecessary tasks); and reliance on vendors.

or system being considered. Approximately 33% of small broker-dealer respondents did not know how often their synchronization tolerances are exceeded.

3. Costs

Respondents generally identified software and/or hardware as the primary factors affecting costs for complying with the Business Clock synchronization requirements, with maintenance and compliance as the second and third greatest factors. The majority of respondents who expressed a view believed that such cost drivers vary by type of system. This view was generally consistent regardless of the type or size of respondents, except that small broker-dealer respondents were evenly split (i.e., 50% believed that cost drivers varied by system and 50% believed that cost drivers did not vary by system). Focusing on respondents who knew their initial costs of compliance (i.e., those that did not respond "do not know"), the majority (approximately 70%) stated that their initial costs of complying with the Business Clock synchronization requirements were less than $100,000. All small broker-dealer respondents who knew their initial compliance costs reported that such costs were below $100,000. Conversely, approximately 30% large broker-dealer respondents who knew their initial compliance costs indicated that such costs were over $100,000. Respondents provided a broad range of responses regarding the time it took to comply with the Business Clock synchronization requirements—responses ranged from less than one month to more than six months. These findings are discussed in greater detail below.

a. Factors Affecting Compliance Costs

Approximately 35% of respondents who expressed a view indicated that software and hardware primarily affect costs related to complying with the Business Clock synchronization requirements. Maintenance and compliance were the second and third largest cost drivers, with approximately 21% and 20% of respondents indicating that these reflected their greatest costs, respectively. When asked whether factors affecting costs of complying with the Business Clock synchronization requirements vary by system, approximately 46% of respondents stated that they did not have a view, 36% of respondents indicated that they thought that such factors did vary by type of system, and approximately 18% of respondents indicated that they thought that such factors did not vary by system.

b. Initial Compliance Costs

With respect to the costs incurred by respondents to comply with the initial Business Clock synchronization thresholds set forth in the Plan, approximately 35% of respondents did not know their initial compliance costs. Approximately 44% of respondents indicated that their initial compliance costs were less than $100,000, approximately 9% indicated that their initial compliance costs were between $100,000 and $500,000, and approximately 6% indicated that their initial compliance costs were more than $500,000. Approximately 5% of respondents

indicated that they incurred other costs[22] and approximately 1% indicated that costs depended on the type of Business Clock or system. Notably, no respondents that identified as small broker-dealers indicated that they incurred initial costs more than $100,000.

Respondents that identified as large broker-dealers indicated that they incurred the following initial compliance costs: no costs (approximately 5%); less than $100,000 (approximately 45%); $100,000 to $500,000 (approximately 12%); and more than $500,000 (approximately 9%). Approximately 29% of large broker-dealer respondents did not know what costs they incurred. Approximately 53% of respondents that identified as small broker-dealers indicated that they incurred initial compliance costs of less than $100,000. Approximately 6% of small broker-dealer respondents reported that their costs varied depending on the specific Business Clock or system, approximately 6% indicated that they incurred other costs beyond what was listed in the Survey, and approximately 35% did not know what initial compliance costs they incurred.

Respondents that identified themselves as Service Providers, OATS reporters and ATSs indicated that they incurred a range of different costs to comply with the initial Business Clock synchronization requirements. Respondents that identified as Service Providers indicated the following initial compliance costs: less than $100,000 (approximately 36%); $100,000 to $500,000 (approximately 9%); and more than $500,000 (approximately 9%). Approximately 45% of Service Providers did not know their initial compliance costs. Respondents that identified as OATS reporters indicated the following initial compliance costs: less than $100,000 (approximately 50%); $100,000 to $500,000 (approximately 10%); more than $500,000 (approximately 8%). Approximately 32% of respondents that identified as OATS reporters did not know what initial implementation costs they incurred (or would incur) to comply with the initial thresholds. Finally, respondents that indicated that they operate an ATS provided the following responses regarding initial implementation costs that they incurred (or would incur) to comply with the initial thresholds: less than $100,000 (approximately 25%); $100,000 to $500,000 (approximately 17%); and more than $500,000 (approximately 33%). Approximately 25% of respondents operating ATSs did not know their initial implementation costs.

c. Time to Comply with Initial Thresholds

Respondents that provided a time estimate indicated that it took (or would take) them the following amount of time to comply with the initial Business Clock synchronization thresholds set forth in the Plan: less than 1 month (approximately 30%); 1 to 2 months (approximately 5%); 2 to 6 months (approximately 12%); and more than 6 months (approximately 9%). Approximately 11% of respondents indicated it would take them some "other" amount of time,[23]

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[22] Some respondents provided comments with their responses. Some respondents indicated that they incurred no costs since they already complied with the Business Clock synchronization thresholds required by the Plan. One respondent stated that it achieved a 10 microseconds tolerance at a cost of $1 million to $2 million before the effective date of the Plan. Other respondents reported that they rely on a vendor so they do not incur direct costs or that they do not have any trading activity.

[23] Generally, these respondents provided comments that indicated that they already comply with the thresholds, rely on vendors or do not have trading activities.

and approximately 33% of respondents reported that they did not know how long it took (or would take) them to comply with the initial synchronization thresholds.

Respondents that identified as large broker-dealers indicated that it took (or would take) them the following amount of time to comply with the initial thresholds: less than 1 month (approximately 34%); 1 to 2 months (approximately 6%); 2 to 6 months (approximately 18%); and more than 6 months (approximately 12%).[24] Approximately 18% of large broker-dealer respondents could not provide a time estimate and approximately 11% stated it would take them some other amount of time. Respondents identifying as small broker-dealers provided the following time estimates: less than 1 month (approximately 29%); and 2 to 6 months (approximately 6%). Approximately 6% of small broker-dealer respondents indicated that it would take them some other amount of time. Most small broker-dealer respondents (approximately 59%) could not provide a time estimate.

4. Changes to Business Clock Synchronization Threshold

Respondents generally indicated that implementation time, initial costs and ongoing costs, all increased as the Business Clock synchronization threshold became narrower. Responses also indicated that the implementation time, initial costs and ongoing costs to comply with any new threshold would vary greatly across different types or sizes of firms, as well as within firms of the same size or type. These findings are discussed in greater detail below.

a. General Findings

i. Implementation Time

Approximately 30% of respondents stated that they could not determine how much time it would take for them to comply with any new Business Clock synchronization requirement (e.g., 5 milliseconds, 1 millisecond, 100 microseconds or 500 microseconds). Approximately 20% of respondents indicated that it would take no time to comply with new thresholds of 5 milliseconds or 1 millisecond, and 13.5% of respondents indicated that it would take them no time to comply with new thresholds of 100 microseconds or 500 microseconds. However, approximately 35% of respondents stated that it would take them between 1 and 11 months to comply with any of the new tolerances noted in the Survey.

Notably, the data did not reflect a substantial difference in implementation times if the Business Clock synchronization threshold was changed to 5 milliseconds or 1 millisecond. With respect to a threshold of 5 milliseconds, approximately 92% of respondents indicated that it would take them 1 year or less to implement the change, and approximately 7% indicated that it would take them 1 to 2 years to implement the change. With respect to a threshold of 1 millisecond, approximately 95% of respondents indicated that it would take them 1 year or less to implement the change, and approximately 5% indicated that it would take them 1 to 2 years to implement the change. Approximately 70% of respondents indicated that it would take them 1 year or less to implement a change to a threshold of 100 microseconds, approximately 25%

[24] One large broker-dealer respondent indicated that it took (or would take) it one year to comply with the initial requirements.

indicated it would take them 1-2 years to implement such change, and approximately 5% indicated it would take them more than 2 years to implement such change.

ii. Initial Costs

The survey sought information concerning the initial costs that respondents would incur should they be required to comply with new Business Clock synchronization thresholds. Approximately 20% of respondents indicated that they would not incur any initial costs to comply with potential new thresholds of 5 milliseconds or 1 millisecond, and approximately 10% of respondents indicated that they would not incur any initial costs to comply with new thresholds of 100 microseconds or 500 microseconds. Approximately 20% of respondents stated that they would incur initial costs between $1,000 and $499,999 to comply with any new threshold (i.e., 5 milliseconds, 1 millisecond, 100 microseconds or 500 microseconds). Many respondents (approximately 35%) did not know what initial costs they would incur to comply with any new threshold.

iii. Ongoing Costs

With respect to estimated ongoing costs incurred by respondents to maintain new Business Clock synchronization thresholds (i.e., 5 milliseconds, 1 millisecond, 100 microseconds or 500 microseconds), respondents provided the following information. Approximately 15% of respondents stated that they would not incur any ongoing costs to comply with any new tolerance. Approximately 25% of respondents indicated that they would incur ongoing annual costs between $1,000 and $99,000 to comply with the new tolerances. Only approximately 2% of respondents indicated that their ongoing annual costs to comply with any of the new tolerances would be prohibitive. Approximately 40% of respondents did not know what ongoing annual costs they would incur to comply with any new tolerances.

iv. Voluntary Assessments and Changes to Tolerances

Nearly half of respondents (approximately 49%) reported that they assess their Business Clock synchronization practices daily. Other respondents indicated that they assess their synchronization practices: monthly (approximately 1%); weekly (approximately 4%); quarterly (approximately 4%); and yearly (approximately 6%). Approximately 16% of respondents indicated that they assess their synchronization practices at other intervals, and approximately 3% stated that the frequency of their assessments depends on the type of Business Clock or system being considered. Approximately 17% of respondents did not know how often they assess their synchronization practices.

Respondents that identified as large broker-dealers stated that they assess their synchronization practices: daily (approximately 53%); weekly (approximately 4%); quarterly (approximately 6%); and annually (approximately 7%). No large broker-dealer respondents reported assessing their practices monthly. Approximately 18% of large broker-dealer respondents stated that they assess their synchronization practices at other intervals, and approximately 1% indicated that their practices depend on the Business Clock or system being considered. Approximately 11% of large broker-dealer respondents did not know how often they

assess their synchronization practices. Respondents that identified as small broker-dealers reported that they assess their synchronization practices: daily (approximately 53%); monthly (approximately 12%); and annually (approximately 6%). No small broker-dealer respondents indicated that they assess their practices weekly, quarterly or at different intervals depending on the type of Business Clock or system considered. Approximately 12% of small broker-dealer respondents indicated that they assess their synchronization practices at other intervals. Approximately 18% of small broker-dealer respondents did not know how often they assess their synchronization practices.

The Survey also asked respondents how often they changed their Business Clock synchronization tolerances in the past year. Overall, in the past year, approximately 38% of respondents changed their synchronization tolerances 1 time, approximately 7% changed their synchronization tolerances 2 to 5 times, and approximately 1% changed their synchronization tolerances 6 to 10 times. Approximately 19% of respondents stated that they changed their tolerances a different number of times not indicated in the Survey and approximately 1% stated that changes depended on the type of Business Clock or system being considered. Approximately 35% of respondents did not know how often they changed their tolerances in the past year.

Trends with respect to changing synchronization tolerances were not consistent across large and small broker-dealers. Large broker-dealer respondents indicated that in the past year they changed tolerances: 1 time (approximately 49%); 2 to 5 times (approximately 6%); and 6 to 10 times (approximately 1%). Approximately 18% of large broker-dealers changed their tolerances a number of times not indicated in the Survey. No large broker-dealer respondents stated that changes to tolerances in the past year depended on the type of Business Clock or system being considered. Approximately 26% of large broker-dealer respondents did not know how often they changed their tolerances in the past year. Small broker-dealer respondents reported that in the past year they changed tolerances: 1 time (approximately 18%); and 2 to 5 times (approximately 18%). No small broker-dealer respondents reported changing their tolerances 6 to 10 times in the past year. Approximately 18% of small broker-dealer respondents stated that changes to tolerances in the past year depended on the type of Business Clock or system, and approximately 18% changed their tolerances a number of times not indicated in the survey. Approximately 41% of small broker-dealer respondents did not know how often they changed their tolerances in the past year.

b. Findings Related to Specific Thresholds

This section provides a more detailed discussion of the results described above in Section III.C.4.a. In particular, this section discusses the implementation time, initial cost and ongoing cost of each potential new threshold noted in the Survey (i.e., 5 milliseconds, 1 millisecond, 100 microseconds or 500 microseconds).

i. 5 milliseconds

With respect to a possible 5 milliseconds Business Clock synchronization threshold, respondents provided the following information. In terms of the potential time to comply with a

5 milliseconds threshold, approximately 21% of respondents stated that it would take no time for them to comply with such threshold and approximately 5% of respondents stated it would take less than 1 month. Approximately 14% of respondents indicated that it would take between 1 and 2 months, approximately 4% of respondents indicated it would take between 3 and 5 months and approximately 21% of respondents indicated that it would take between 6 and 11 months, to comply with the lower threshold. Approximately 4% of respondents stated that it would take 1 to 1.5 years to comply with the lower threshold. Approximately 30% of respondents stated that they did not know how long it would take to comply with the threshold.

Approximately 29% of large broker-dealers providing a response to this question stated that it would take them 6 to 11 months to comply with the lower threshold and approximately 23% stated that they could comply in no time. Approximately 23% of large broker-dealer respondents did not know how long it would take them to comply. Other large broker-dealer respondents provided responses that were spread across different time periods. With respect to small broker-dealer respondents, approximately 43% could not estimate how long it would take them to comply with a lower threshold. Approximately 29% of small broker-dealer respondents indicated that they could comply in no time, approximately 14% stated that they could comply in 1 to 2 months, and approximately 14% stated that they could comply in 6 to 11 months. Respondents that operate ATSs reported the following estimated initial implementation times: no time (approximately 18%); 3 to 5 months (approximately 17%); and 6 to 11 months (approximately 67%).

In terms of initial costs to comply with a 5 milliseconds threshold, approximately 25% of respondents stated that they would incur no initial costs to comply with the threshold; however, the majority of these responses (approximately 71%) were from large broker-dealers. Another approximately 36% of respondents indicated that they did not know what initial costs they would incur to comply with a 5 milliseconds threshold. Other respondents indicated the following estimated initial compliance costs: $1 to $999 (approximately 4%); $1,000 to $9,999 (approximately 5%); $10,000 and $99,999 (approximately 9%); $100,000 and $499,999 (approximately 9%); $500,000 and $999,999 (approximately 5% of respondents—all large broker-dealers); and $1 million to $1.99 million (approximately 5% of respondents—all large broker-dealers). Approximately 2% of respondents indicated that a 5 milliseconds threshold would be cost prohibitive from an initial costs standpoint.

The majority of respondents providing information on initial implementation costs identified as large broker-dealers (approximately 63%). Large broker-dealer respondents reported the following costs to comply with the lower threshold: $0 (approximately 29%); $1 to $999 (approximately 3%); $1,000 to $9,999 (approximately 3%); $10,000 to $99,999 (approximately 9%); $100,000 to $499,999 (approximately 6%); $500,000 to $999,999 (approximately 9%); and $1 million to $1.99 million (approximately 9%). One large broker-dealer respondent said that the initial costs of compliance would be prohibitive. Approximately 31% of large broker-dealer respondents could not estimate their initial costs to comply with a 5 milliseconds threshold. Small broker-dealer respondents reported the following initial costs to comply with the lower threshold: $0 (approximately 14%); $1,000 to $9,999 (approximately 14%); $10,000 to $99,999 (approximately 14%); and $100,000 to $499,999 (approximately

14%). Approximately 43% of small broker-dealer respondents could not estimate their initial costs to comply with the lower threshold. Respondents that operate ATSs estimated the following initial implementation costs: $0 (approximately 17%); $100,000 to $499,999 (approximately 17%); $500,000 to $999,999 (approximately 33%); and $1 million to $1.99 million (approximately 17%). Approximately 17% of respondents operating ATSs did not know their initial costs.

In terms of ongoing costs to comply with a 5 milliseconds threshold, approximately 17% of respondents reported an estimated cost of $0 and approximately 38% of respondents could not estimate ongoing costs. Other respondents reported the following costs: $1 to $999 (approximately 4%); $1,000 to $9,999 (approximately 10%); $10,000 to $99,999 (approximately 19%); $100,000 to $499,999 (approximately 4%); $500,000 to $999,999 (approximately 4%); and $1 million to $1.99 million (approximately 2%). Approximately 2% of respondents stated that ongoing costs would be prohibitive.

The majority of responses regarding estimated ongoing costs (approximately 63%) were from large broker-dealers. Large broker-dealers indicated the following ongoing costs: $0 (approximately 18%); $1,000 to $9,999 (approximately 9%); $10,000 to $99,999 (approximately 24%); $100,000 to $499,999 (approximately 3%); $500,000 to $999,999 (approximately 6%); and $1 million to $1.99 million (approximately 3%). Approximately 3% of large broker-dealer respondents stated that ongoing costs to comply with the lower threshold would be prohibitive. Half of the small broker-dealers that responded to this question could not estimate ongoing costs of compliance. Other small broker-dealer responses were split as follows: $0 (approximately 17%); $1,000 to $9,999 (approximately 17%); and $10,000 to $99,999 (approximately 17%). Respondents that operate ATSs reported the following estimated ongoing costs: $10,000 to $99,999 (approximately 50%); $100,000 to $499,999 (approximately 17%); and $500,000 to $999,999 (approximately 17%). Approximately 17% of respondents operating ATSs could not estimate ongoing costs of compliance.

ii. 1 millisecond

Approximately 28% of respondents reported that they did not know how long it would take them to comply with a 1 millisecond threshold. Other respondents reported the following time estimates: no time (approximately 21%); less than 1 month (approximately 8%); 1 to 2 months (approximately 6%); 3 to 5 months (approximately 11%); 6 to 11 months (approximately 21%); 1 to 1.5 years (approximately 4%); and 1.5 to 1.99 years (approximately 2%).

Most of the respondents providing implementation time estimates identified as large broker-dealers (approximately 66% of the respondents). The large broker-dealer respondents provided the following implementation times: no time (approximately 23%); less than 1 month (approximately 8%); 1 to 2 months (approximately 3%); 3 to 5 months (approximately 14%); 6 to 11 months (approximately 23%); 1 to 1.5 years (approximately 6%); and 1.5 to 1.99 years (approximately 3%). Approximately 20% of large broker-dealer respondents could not estimate an implementation time to comply with the lower threshold. Approximately 33% of small broker-dealer respondents could not estimate an implementation time to comply with the lower threshold and approximately 16% stated that implementation time was unknown. Other small

broker-dealer respondents provided the following implementation time estimates: no time (approximately 17%); 1 to 2 months (approximately 17%); and 6 to 11 months (approximately 17%). Respondents operating ATSs indicated the following implementation time estimates: no time (approximately 29%); 3 to 5 months (approximately 14%); and 6 to 11 months (approximately 57%).

With respect to initial costs to comply with a 1 millisecond threshold, approximately 20% of respondents stated that they would incur no initial costs. Other respondents indicated the following estimated initial compliance costs: $1 to $999 (approximately 4%); $1,000 to $9,999 (approximately 4%); $10,000 and $99,999 (approximately 11%); $100,000 and $499,999 (approximately 9%); $500,000 and $999,999 (approximately 11%); and $1 million to $1.99 million (approximately 4%). Approximately 2% of respondents indicated that the initial costs of complying with a 1 millisecond threshold would be prohibitive. Approximately 35% of respondents could not estimate their initial compliance costs.

Most of the respondents providing initial cost estimates were large broker-dealers (approximately 67%). Large broker-dealer respondents indicated the following initial costs of compliance: $0 (approximately 25%); $1,000 to $9,999 (approximately 3%); $10,000 to $99,999 (approximately 14%); $100,000 to $499,999 (approximately 6%); $500,000 to $999,999 (approximately 14%); and $1 million to $1.99 million (approximately 6%). One large broker-dealer said that the initial costs of compliance would be prohibitive. Approximately 31% of large broker-dealer respondents could not estimate their initial costs to comply with a 1 millisecond threshold. Small broker-dealer respondents reported the following initial costs to comply with the lower threshold: $0 (approximately 17%); $1 to $999 (approximately 17%); $10,000 to $99,999 (approximately 17%); and $100,000 to $499,999 (approximately 17%). Approximately 33% of small broker-dealer respondents could not estimate their initial costs to comply with the lower threshold. Respondents operating ATSs estimated the following initial implementation costs: $0 (approximately 17%); $100,000 to $499,999 (approximately 17%); $500,000 to $999,999 (approximately 33%); and $1 million to $1.99 million (approximately 17%). Approximately 17% of respondents operating ATSs did not know their initial costs.

With respect to estimated ongoing costs to comply with a 1 millisecond threshold, approximately 17% of respondents reported an estimated cost of $0 and approximately 38% of respondents could not estimate ongoing costs. Other respondents reported the following costs: $1 to $999 (approximately 4%); $1,000 to $9,999 (approximately 10%); $10,000 to $99,999 (approximately 17%); $100,000 to $499,999 (approximately 6%); $500,000 to $999,999 (approximately 4%); and $2 million to $4.99 million (approximately 2%). Approximately 2% of respondents stated that ongoing costs would be prohibitive.

The majority of responses regarding estimated ongoing costs (approximately 67%) were from large broker-dealers. Large broker-dealers indicated the following ongoing costs: $0 (approximately 17%); $1,000 to $9,999 (approximately 9%); $10,000 to $99,999 (approximately 23%); $100,000 to $499,999 (approximately 6%); $500,000 to $999,999 (approximately 6%); and $2 million to $4.99 million (approximately 2%). Approximately 3% of large broker-dealer respondents stated that ongoing costs to comply with the lower threshold would be prohibitive. Approximately 40% of small broker-dealer respondents could not estimate ongoing costs of

compliance. Other responses were as follows: $0 (approximately 20%); $1,000 to $9,999 (approximately 20%); and $10,000 to $99,999 (approximately 20%). Respondents operating ATSs reported the following estimated ongoing costs: $10,000 to $99,999 (approximately 50%); $100,000 to $499,999 (approximately 17%); and $500,000 to $999,999 (approximately 17%). Approximately 17% of respondents operating ATSs could not estimate ongoing costs of compliance.

iii. 500 microseconds

Approximately 30% of respondents reported that they did not know how long it would take them to comply with a 500 microseconds threshold. Other respondents reported the following time estimates: no time (approximately 15%); less than 1 month (approximately 2%); 1 to 2 months (approximately 11%); 3 to 5 months (approximately 8%); 6 to 11 months (approximately 13%); 1 to 1.5 years (approximately 8%); and 1.5 to 1.99 years (approximately 4%).

Most of the respondents providing implementation time estimates identified as large broker-dealers (approximately 66% of the respondents). The large broker-dealers provided the following implementation times: no time (approximately 14%); 1 to 2 months (approximately 11%); 3 to 5 months (approximately 11%); 6 to 11 months (approximately 17%); 1 to 1.5 years (approximately 9%); and 1.5 to 1.99 years (approximately 6%). Approximately 20% of large broker-dealer respondents could not estimate an implementation time to comply with the lower threshold. Small broker-dealer respondents provided the following implementation time estimates: no time (approximately 33%); 1 to 2 months (approximately 17%); and 6 to 11 months (approximately 17%). Approximately 33% of small broker-dealer respondents could not estimate an implementation time to comply with the lower threshold. Respondents operating ATSs reported the following estimated initial implementation times: no time (approximately 17%); 3 to 5 months (approximately 17%); and 6 to 11 months (approximately 50%). Approximately 17% of respondents that operate ATSs could not estimate their initial implementation costs.

With respect to initial costs to comply with a 500 microseconds threshold, approximately 15% of respondents stated that they would incur no initial costs. Other respondents indicated the following estimated initial compliance costs: $1,000 to $9,999 (approximately 5%); $10,000 and $99,999 (approximately 7%); $100,000 and $499,999 (approximately 13%); $500,000 and $999,999 (approximately 2%); $1 million to $1.99 million (approximately 9%); $2 million to $4.99 million (approximately 5%); and $5 million or more (approximately 4%). Approximately 2% of respondents indicated that the initial costs of complying with a 500 microseconds threshold would be prohibitive. Approximately 38% of respondents could not estimate their initial compliance costs.

Most of the respondents providing initial cost estimates were large broker-dealers (approximately 67%). Large broker-dealer respondents indicated the following initial costs of compliance: $0 (approximately 16%); $10,000 to $99,999 (approximately 8%); $100,000 to $499,999 (approximately 16%); $500,000 to $999,999 (approximately 3%); $1 million to $1.99 million (approximately 14%); $2 million to $4.99 million (approximately 5%); and $5 million or

more (approximately 5%). One large broker-dealer said that the initial costs of compliance would be prohibitive. Approximately 27% of large broker-dealer respondents could not estimate their initial costs to comply with a 500 microseconds threshold. Small broker-dealer respondents reported the following initial costs to comply with the lower threshold: $0 (approximately 17%); $1,000 to $9,999 (approximately 17%); $10,000 to $99,999 (approximately 17%); and $100,000 to $499,999 (approximately 17%). Approximately 33% of small broker-dealer respondents could not estimate their initial costs to comply with the lower threshold. Respondents operating ATSs estimated the following initial implementation costs: $0 (approximately 14%); $100,000 to $499,999 (approximately 14%); $1 million to $1.99 million (approximately 43%); and $10 million to $20 million (approximately 14%). Approximately 14% of respondents operating ATSs did not know their initial costs.

With respect to estimated ongoing costs to comply with a 500 microseconds threshold, approximately 12% of respondents reported an estimated cost of $0 and approximately 45% of respondents could not estimate ongoing costs. Other respondents reported the following costs: $1 to $999 (approximately 4%); $1,000 to $9,999 (approximately 2%); $10,000 to $99,999 (approximately 24%); $100,000 to $499,999 (approximately 4%); $500,000 to $999,999 (approximately 4%); $1 million to $1.99 million (approximately 2%); and $2 million to $4.99 million (approximately 2%). Approximately 2% of respondents stated that ongoing costs would be prohibitive.

The majority of responses regarding estimated ongoing costs (approximately 67%) were from large broker-dealers. Large broker-dealers indicated the following ongoing costs: $0 (approximately 12%); $1,000 to $9,999 (approximately 3%); $10,000 to $99,999 (approximately 29%); $100,000 to $499,999 (approximately 6%); $500,000 to $999,999 (approximately 6%); $1 million to $1.99 million (approximately 3%); and $2 million to $4.99 million (approximately 3%). Approximately 3% of large broker-dealer respondents stated that ongoing costs to comply with the lower threshold would be prohibitive and approximately 36% of large broker-dealer respondents stated that ongoing costs were unknown. Small broker-dealer respondents reported the following ongoing costs: $0 (approximately 20%); $1 to $999 (approximately 20%); and $10,000 to $99,999 (approximately 20%). Approximately 40% of small broker-dealer respondents could not estimate ongoing costs of compliance. Respondents operating ATSs indicated the following estimated ongoing costs: $10,000 to $99,999 (approximately 33%); $100,000 to $499,999 (approximately 17%); and $500,000 to $999,999 (approximately 33%). Approximately 17% of respondents operating ATSs could not estimate ongoing costs of compliance.

iv. 100 microseconds

Approximately 32% of respondents reported that they did not know how long it would take them to comply with a 100 microseconds threshold. Other respondents reported the following time estimates: no time (approximately 12%); less than 1 month (approximately 2%); 1 to 2 months (approximately 11%); 3 to 5 months (approximately 9%); 6 to 11 months (approximately 11%); 1 to 1.5 years (approximately 18%); 1.5 to 1.99 years (approximately 4%); and 2 years or more (approximately 2%).

Most of the respondents providing implementation time estimates identified as large broker-dealers (approximately 68% of the respondents). The large broker-dealers provided the following implementation times: no time (approximately 13%); 1 to 2 months (approximately 8%); 3 to 5 months (approximately 13%); 6 to 11 months (approximately 13%); 1 to 1.5 years (approximately 23%); and 1.5 to 1.99 years (approximately 5%). Approximately 23% of large broker-dealer respondents could not estimate an implementation time to comply with the lower threshold. Small broker-dealer respondents provided the following implementation time estimates: no time (approximately 33%); 1 to 2 months (approximately 17%); and 6 to 11 months (approximately 17%). Approximately 33% of small broker-dealer respondents could not estimate an implementation time to comply with the lower threshold. Respondents operating ATSs reported the following estimated initial implementation times: 3 to 5 months (approximately 17%); 6 to 11 months (approximately 50%); and 1 to 1.5 years (approximately 33%).

With respect to initial costs to comply with a 100 microseconds threshold, approximately 9% of respondents stated that they would incur no initial costs. Other respondents indicated the following estimated initial compliance costs: $1 to $999 (approximately 7%); $1,000 to $9,999 (approximately 10%); $10,000 and $99,999 (approximately 10%); $100,000 and $499,999 (approximately 9%); $500,000 and $999,999 (approximately 7%); $2 million to $4.99 million (approximately 7%); and $5 million or more (approximately 2%). Approximately 2% of respondents indicated that the initial costs of complying with a 100 microseconds threshold would be prohibitive. Approximately 42% of respondents could not estimate their initial compliance costs.

Most of the respondents providing initial cost estimates were large broker-dealers (approximately 69%). Large broker-dealer respondents indicated the following initial costs of compliance: $0 (approximately 10%); $1 to $999 (approximately 3%); $1,000 to $9,999 (approximately 13%); $10,000 to $99,999 (approximately 13%); $100,000 to $499,999 (approximately 13%); $500,000 to $999,999 (approximately 10%); $2 million to $4.99 million (approximately 8%); and $5 million or more (approximately 3%). One large broker-dealer said that the initial costs of compliance would be prohibitive. Approximately 28% of large broker-dealer respondents could not estimate their initial costs to comply with a 100 microseconds threshold. Small broker-dealer respondents reported the following initial costs to comply with the lower threshold: $0 (approximately 17%); $1 to $999 (approximately 17%); $1,000 to $9,999 (approximately 17%); and $10,000 to $99,999 (approximately 17%). Approximately 33% of small broker-dealer respondents could not estimate their initial costs to comply with the lower threshold. Respondents operating ATSs estimated the following initial implementation costs: $100,000 to $499,999 (approximately 14%); $500,000 to $999,999 (approximately 14%); $1 million to $1.99 million (approximately 43%); $10 million to $20 million (approximately 14%). Approximately 14% of respondents operating ATSs did not know their initial costs.

With respect to estimated ongoing costs to comply with a 100 microseconds threshold, approximately 13% of respondents reported an estimated cost of $0 and approximately 42% of respondents could not estimate ongoing costs. Other respondents reported the following costs: $1 to $999 (approximately 2%); $1,000 to $9,999 (approximately 4%); $10,000 to $99,999

(approximately 20%); $100,000 to $499,999 (approximately 11%); $500,000 to $999,999 (approximately 4%); $1 million to $1.99 million (approximately 2%); and $2 million to $4.99 million (approximately 2%). Approximately 2% of respondents stated that ongoing costs would be prohibitive.

The majority of responses regarding estimated ongoing costs (approximately 69%) were from large broker-dealers. Large broker-dealer respondents indicated the following ongoing costs: $0 (approximately 13%); $1,000 to $9,999 (approximately 3%); $10,000 to $99,999 (approximately 24%); $100,000 to $499,999 (approximately 16%); $500,000 to $999,999 (approximately 5%); $1 million to $1.99 million (approximately 3%); and $2 million to $4.99 million (approximately 3%). Approximately 3% of large broker-dealer respondents stated that ongoing costs to comply with the lower threshold would be prohibitive. Small broker-dealer respondents reported the following ongoing costs: $0 (approximately 20%); $1,000 to $9,999 (approximately 20%); and $10,000 to $99,999 (approximately 20%). Approximately 40% of small broker-dealer respondents could not estimate ongoing costs of compliance. Respondents operating ATSs reported the following estimated ongoing costs: $10,000 to $99,999 (approximately 33%); $100,000 to $499,999 (approximately 17%); and $500,000 to $999,999 (approximately 33%). Approximately 17% of respondents operating ATSs could not estimate ongoing costs of compliance.

5. Current Business Clock Synchronization Practices

A majority of respondents (approximately 64%) indicated that their current Business Clock synchronization threshold is less than 50 milliseconds; however, these responses were skewed toward large broker-dealers, which made up approximately 80% of the responses. Respondents varied as to the particular thresholds that they currently use. In particular, respondents reported the following current thresholds: 1 microsecond to 499 microseconds (approximately 9%); 500 microseconds to 999 microseconds (approximately 8%); 1 millisecond to 49 milliseconds (approximately 47%); 50 milliseconds to 499 milliseconds (approximately 13%); 500 milliseconds to 1 second (approximately 4%) and more than one second (approximately 1%). Approximately 19% of respondents did not know their firm's current Business Clock synchronization thresholds.

Focusing on type of respondent, large broker-dealer respondents indicated that they have current thresholds of: 1 microsecond to 499 microseconds (approximately 12%); 500 microseconds to 999 microseconds (approximately 6%); 1 millisecond to 49 milliseconds (approximately 51%); 50 milliseconds to 499 milliseconds (approximately 12%); and 500 milliseconds to 1 second (approximately 3%). Approximately 17% of large broker-dealer respondents did not know their firm's current threshold. Small broker-dealer respondents reported the following current thresholds: 500 microseconds to 999 microseconds (approximately 19%); 1 millisecond to 49 milliseconds (approximately 11%); 50 milliseconds to 499 milliseconds (approximately 26%); 500 milliseconds to 1 second (approximately 11%) and more than one second (approximately 7%). Approximately 26% of small broker-dealer respondents did not know their firm's current threshold.

Approximately 55% of respondents indicated that their Business Clock synchronization tolerances did not vary based on whether Business Clocks were located in particular systems. Respondents did not express a clear majority view on the frequency with which they check the synchronization of Business Clocks. Focusing on large and small broker-dealers, the majority of large broker-dealer respondents (approximately 57%) and small broker-dealer respondents (approximately 65%) stated that their synchronization tolerances do not vary based on where a Business Clock is located. Approximately 19% of large broker-dealer respondents indicated that their synchronization tolerances vary based on where Business Clocks are located; by comparison, no small broker-dealer respondents indicated that their tolerances vary based on the location of Business Clocks. Approximately 25% of large broker-dealer respondents and approximately 35% of small broker-dealer respondents did not know if their tolerances vary based on where Business Clocks are located.

Generally, respondents reported that NTP was the most common technology used to maintain Business Clock synchronization, although, with respect to co-located systems in particular, PTP was the most common technology used. The most common response among large broker-dealer respondents (approximately 40%) was that they employ multiple technologies to maintain synchronization. Small broker-dealer respondents most commonly (approximately 30%) indicated that they use NTP to maintain synchronization; however, approximately 41% of small broker-dealer respondents did not know what technology they use to maintain synchronization. Overall, the NIST atomic clock was the most common master clock used by respondents.

These findings are discussed further below.

a. Maintaining Business Clock Synchronization

Approximately 15% of respondents did not know what technology their firms use to maintain Business Clock synchronization. Focusing on the respondents that did know what technology their firms use, the most common response (approximately 50% of respondents) was that firms used a combination of different technologies to maintain synchronization—typically, these respondents use a combination of PTP, NTP and GPS. In terms of a single solution, NTP was the most common technology used by respondents with approximately 46% reporting that they use this solution. GPS and PTP were the next most common solutions, with each being used by approximately 22% of respondents.[25]

Large broker-dealer respondents reported using the following solutions to maintain synchronization: multiple technologies (approximately 40%); NTP (approximately 27%); PTP (approximately 6%); GPS (approximately 6%); CDMA (approximately 2%); and other technologies (approximately 3%). Approximately 16% of large broker-dealer respondents did not know what technology they use to maintain synchronization. Small broker-dealer respondents reported using the following solutions to maintain synchronization: NTP (approximately 30%); other technologies (approximately 15%); GPS (approximately 7%); and

[25] As described in the sections that follow, some respondents provided comments with their responses indicating that they use other solutions. These respondents listed the following as "other" solutions: NIST US time; third-party software/solution; Nagios; and STP.

multiple technologies (approximately 7%). Approximately 41% of small broker-dealer respondents did not know what technology they use to maintain synchronization.

Results also varied when analyzed by type of system, as described further below.

i. Origination Systems

Respondents operating origination systems indicated that their firms use the following technologies to maintain Business Clock synchronization: PTP was the primary technology used (approximately 46% of respondents) followed by GPS and PTP (each used by approximately 22% of respondents), other technology (approximately 7% of respondents) and CDMA (approximately 3% of respondents). Approximately 25% of respondents did not know what technology their firms use to maintain synchronization.

ii. Routing Systems

Respondents operating routing systems stated that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 43%); GPS (approximately 25%); PTP (approximately 24%); CDMA (approximately 4%); and other solutions (approximately 4%). Approximately 20% of respondents did not know what technology their firms use to maintain synchronization. Based on the Survey results, routing systems appear to have the highest use of CDMA technology of any system based on the number of responses.

iii. Execution Systems

Respondents operating execution systems reported that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 44%); PTP (approximately 25%); GPS (approximately 21%); other solutions (approximately 8%); and CDMA (approximately 1%). Approximately 13% of respondents did not know what technology their firms use to maintain synchronization.

iv. Co-located Systems

Respondents operating co-located systems indicated that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 35%); PTP (approximately 33%); GPS (approximately 25%); CDMA (approximately 5%); and other solutions (approximately 2%). Approximately 10% of respondents did not know what technology their firms use to maintain Business Clock synchronization. Based on information provided by the respondents, co-located systems have the lowest use of NTP and the highest use of PTP across any systems addressed in the Survey.

v. Internalization Systems

Respondents operating internalization systems stated that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 42%); GPS (approximately 31%); PTP (approximately 23%); and other technology (approximately 4%).

Approximately 17% of respondents indicated that they did not know what technology their firms use to maintain Business Clock synchronization. Based on information provided by respondents, internalization systems have the highest use of GPS technology across any system addressed in the Survey and, along with third-party systems (discussed below) the lowest use of CDMA technology (no respondents reported using GPS technology to maintain synchronization of internalization systems).

vi. Back-Office Systems

Respondents operating back-office systems reported that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 56%); GPS (approximately 19%); PTP (approximately 19%); CDMA (approximately 3%); and other technology (approximately 3%). Approximately 15% of respondents did not know what technology their firms use to maintain Business Clock synchronization. Based on the information provided by respondents, back-office systems have the highest use of NTP and the lowest use of GPS across any of the systems addressed in the Survey.

vii. Third-Party Systems

Respondents that use third-party systems indicated that their firms use the following technologies to maintain Business Clock synchronization: NTP (approximately 49%); GPS (approximately 26%); PTP (approximately 17%); and other technology (approximately 9%). No respondents reported using CDMA to maintain Business Clock synchronization in third-party systems. Approximately 15% of respondents indicated that they did not know what technology they use to maintain Business Clock synchronization.

b. Current Business Clock Synchronization Tolerances

As previously noted, a majority of respondents (approximately 60%) indicated that their current Business Clock synchronization tolerance is better than the standard currently set forth in the Plan. However, this result is not necessarily representative of the industry as a whole since the vast majority of these responses (approximately 80%) were provided by large broker-dealer respondents. Conversely, approximately 20% of respondents stated that their current synchronization tolerance is at or above the current standard set forth in the Plan, and the approximately 20% of respondents indicated that they did not know their current synchronization tolerance.

Respondents that identified as large broker-dealers reported that they currently maintain the following Business Clock synchronization tolerances: 1 microsecond to 499 microseconds (approximately 12%); 500 microseconds to 999 microseconds (approximately 6%); 1 millisecond to 49 milliseconds (approximately 51%); 50 milliseconds to 499 milliseconds (approximately 12%); and 500 milliseconds to 1 second (approximately 3%). Approximately 17% of large broker-dealer respondents did not know their current synchronization tolerances. Small broker-dealer respondents reported that they currently maintain the following synchronization tolerances: 500 microseconds to 999 microseconds (approximately 19%); 1 millisecond to 49 milliseconds (approximately 11%); 50 milliseconds to 499 milliseconds

(approximately 26%); and 500 milliseconds to 1 second (approximately 11%); and more than 1 second (approximately 7%). Approximately 26% of small broker-dealer respondents did not know their current synchronization tolerances.

These findings are discussed further below, focusing on the types of systems used by respondents.

i. Origination Systems

Approximately 60% of respondents operating origination systems reported that they currently use a synchronization tolerance that is better than the standard set forth in the Plan. Specifically, respondents reported the following current tolerances: 1 microsecond to 499 microseconds (approximately 10%); 500 microseconds to 999 microseconds (approximately 7%); 1 millisecond to 49 milliseconds (approximately 44%); 50 milliseconds to 499 milliseconds (approximately 13%); and 500 milliseconds to 1 second (approximately 3%). Approximately 24% of respondents indicated that they did not know their current synchronization tolerances.

ii. Routing Systems

Approximately 70% of respondents operating routing systems reported that they currently use a tolerance that is better than the standard set forth in the Plan. Specifically, respondents reported the following tolerances: 1 microsecond to 499 microseconds (approximately 10%); 500 microseconds to 999 microseconds (approximately 8%); 1 millisecond to 49 milliseconds (approximately 53%); 50 milliseconds to 499 milliseconds (approximately 10%); and more than 1 second (approximately 1%). Approximately 18% of respondents did not know their current synchronization tolerances.

iii. Execution Systems

Approximately 57% of respondents operating execution systems reported that they currently use a synchronization tolerance that is better than the standard set forth in the Plan. Specifically, respondents reported the following current tolerances: 1 microsecond to 499 microseconds (approximately 9%); 500 microseconds to 999 microseconds (approximately 4%); 1 millisecond to 49 milliseconds (approximately 44%); 50 milliseconds to 499 milliseconds (approximately 16%); 500 milliseconds to 1 second (approximately 7%); and more than 1 second (approximately 2%). Approximately 19% of respondents did not know their current synchronization tolerances.

iv. Co-located Systems

Approximately 82% of respondents operating co-located systems reported that they currently use a tolerance that is better than the standard set forth in the Plan. In particular, respondents reported that they currently use the following tolerances: 1 microsecond to 499 microseconds (approximately 22%); 500 microseconds to 999 microseconds (approximately 19%); 1 millisecond to 49 milliseconds (approximately 41%); and 50 milliseconds to 499

milliseconds (approximately 14%). Approximately 5% of respondents indicated that they did not know their current synchronization tolerances.

v. Internalization Systems

Approximately 73% of respondents operating internalization systems reported that they currently use a synchronization tolerance that is better than the standard set forth in the Plan. Specifically, respondents reported the following current tolerances: 1 microsecond to 499 microseconds (approximately 6%); 500 microseconds to 999 microseconds (approximately 11%); 1 millisecond to 49 milliseconds (approximately 56%); 50 milliseconds to 499 milliseconds (approximately 11%); and 500 milliseconds to 1 second (approximately 6%). Approximately 11% of respondents did not know their current synchronization tolerances.

vi. Back-Office Systems

Approximately 63% of respondents operating back-office systems reported that they currently use a tolerance that is better than the standard set forth in the Plan. Specifically, respondents reported the following tolerances: 1 microsecond to 499 microseconds (approximately 4%); 500 microseconds to 999 microseconds (approximately 8%); 1 millisecond to 49 milliseconds (approximately 51%); 50 milliseconds to 499 milliseconds (approximately 15%); and 500 milliseconds to 1 second (approximately 9%). Approximately 13% of respondents did not know their current synchronization tolerances.

vii. Third-Party Systems

Approximately 44% of respondents using third-party systems stated that they currently use a tolerance that is better than the standard set forth in the Plan. In particular, respondents reported the following tolerances: 1 microsecond to 499 microseconds (approximately 3%); 1 millisecond to 49 milliseconds (approximately 41%); and 50 milliseconds to 499 milliseconds (approximately 16%). Approximately 41% of respondents did not know their current synchronization tolerances.

c. Business Clock Location

A majority of respondents (approximately 55%) stated that their Business Clock synchronization tolerances did not vary based on where a Business Clock was located. Conversely, approximately 15% of respondents indicated that their tolerances did vary based on where a Business Clocks was located. Approximately 30% of respondents did not know if their tolerances vary based on the location of a Business Clock.

The majority of large broker-dealer respondents (approximately 57%) stated that their synchronization tolerances did not vary based on the location of Business Clocks, while approximately 19% reported that tolerances did vary based on location. Approximately 25% of large broker-dealer respondents did not know if tolerances varied by the location of Business Clocks. Similarly, the majority of small broker-dealer respondents (approximately 65%) indicated that their synchronization tolerances did not vary based on the location of Business

Clocks, however, no small broker-dealer respondents reported that tolerances varied based on location of Business Clocks. Approximately 35% of small broker-dealer respondents did not know if their synchronization tolerances varied by the location of Business Clocks.

These results are described below, focusing on type of system.

i. Origination Systems

Approximately 56% of respondents operating origination systems indicated that their Business Clock synchronization tolerances did not vary based on where Business Clocks were located. Approximately 14% of respondents stated that their tolerances did vary based on where Business Clocks were located. Approximately 30% did not know if their synchronization tolerances varied based on the location of Business Clocks.

ii. Routing Systems

Approximately 55% of respondents operating routing systems stated that their synchronization tolerances did not vary based on where Business Clocks were located, while approximately 15% of respondents stated that their tolerances did vary based on where Business Clocks were located. Approximately 30% of respondents did not know if their tolerances varied based on the system in which Business Clocks were located.

iii. Execution Systems

Approximately 56% of respondents operating execution indicated that their Business Clock tolerances did not vary based on where Business Clocks were located, and approximately 15% of respondents indicated that their tolerances did vary based on where Business Clocks were located. Approximately 29% of respondents did not know if their tolerances varied based on the system in which Business Clocks were located.

iv. Co-located Systems

The majority of respondents operating co-located systems (approximately 67%) indicated that their synchronization tolerances did not vary based on where Business Clocks were located, while approximately 19% of respondents indicated that their tolerances did vary based on where Business Clocks were located. Approximately 14% of respondents did not know if their synchronization tolerances varied based on where Business Clocks were located.

v. Internalization Systems

Respondents operating internalization systems were roughly split, with approximately 39% reporting that their synchronization tolerances did not vary based on where Business Clocks were located and 39% reporting that their tolerances did vary based on where Business Clocks were located. Approximately 22% of respondents did not know if their Business Clock synchronization tolerances varied based on where Business Clocks were located.

vi. Back-Office Systems

Approximately 68% of respondents operating back-office systems reported that their tolerances did not vary based on the location of Business Clocks. Approximately 10% of respondents stated that their tolerances did vary based on where Business Clocks were located. Approximately 22% of respondents did not know if their tolerances varied based on where Business Clocks were located.

vii. Third-Party Systems

Approximately 41% of respondents using third-party systems indicated that their tolerances did not vary based on where Business Clocks were located, and approximately 18% of respondents stated that their tolerances did vary based on where Business Clocks were located. Approximately 41% of respondents did not know if Business Clock synchronization tolerances varied based on where Business Clocks were located.

d. Business Clock Synchronization Frequency

With respect to the frequency with which respondents check their Business Clock synchronization accuracy, the most common response (approximately 23%) was that respondents check synchronization accuracy once a minute or more but less than once a second. Other respondents indicated checking synchronization accuracy with the following frequencies: once an hour or more but less than once a minute (approximately 20%); once a second or more but less than once a hundredth of a second (approximately 14%); more than once a day but less than once an hour (approximately 14%); once a day (approximately 12%); and more than once a hundredth of a second (approximately 3%). Only approximately 15% of respondents reported that they did not know how often their firms checked Business Clock synchronization accuracy.

Large broker-dealer respondents reported that they check synchronization accuracy at the following frequencies: once a day (approximately 9%); more than once a day but less than once an hour (approximately 15%); once an hour or more but less than once a minute (approximately 23%); once a minute or more but less than once a second (approximately 18%); once a second or more but less than once a hundredth of a second (approximately 17%); and more than once a hundredth of a second (approximately 4%). Approximately 14% of large broker-dealer respondents did not know how often they check the accuracy of Business Clock synchronization. Small broker-dealer respondents indicated that they check synchronization accuracy at the following frequencies: once a day (approximately 47%); more than once a day but less than once an hour (approximately 10%); and once a minute or more but less than once a second (approximately 20%). Approximately 23% of small broker-dealer respondents did not know how often they check the accuracy of Business Clock synchronization.

These results are discussed further below, focusing on the types of systems that respondents operate.

i. Origination Systems

Respondents operating origination systems indicated that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 18%); more than once a day but less than once an hour (approximately 14%); once an hour or more but less than once a minute (approximately 26%); once a minute or more but less than once a second (approximately 14%); once a second or more but less than once a hundredth of a second (approximately 10%); and more than once a hundredth of a second (approximately 1%). Approximately 17% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

ii. Routing Systems

Respondents operating routing systems reported that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 9%); more than once a day but less than once an hour (approximately 13%); once an hour or more but less than once a minute (approximately 26%); once a minute or more but less than once a second (approximately 19%); once a second or more but less than once a hundredth of a second (approximately 16%); and more than once a hundredth of a second (approximately 3%). Approximately 16% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

iii. Execution Systems

Respondents operating execution systems stated that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 16%); more than once a day but less than once an hour (approximately 15%); once an hour or more but less than once a minute (approximately 16%); once a minute or more but less than once a second (approximately 18%); once a second or more but less than once a hundredth of a second (approximately 18%); and more than once a hundredth of a second (approximately 4%). Approximately 13% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

iv. Co-located Systems

Respondents operating co-located systems indicated that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 3%); more than once a day but less than once an hour (approximately 8%); once an hour or more but less than once a minute (approximately 22%); once a minute or more but less than once a second (approximately 22%); once a second or more but less than once a hundredth of a second (approximately 31%); and more than once a hundredth of a second (approximately 3%). Approximately 11% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

v. Internalization Systems

Respondents operating internalization systems reported that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 11%); more than once a day but less than once an hour (approximately 17%); once a minute or more but less than once a second (approximately 44%); once a second or more but less than once a hundredth of a second (approximately 11%); and more than once a hundredth of a second (approximately 6%). Approximately 11% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

vi. Back-Office Systems

Respondents operating back-office systems indicated that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 13%); more than once a day but less than once an hour (approximately 15%); once an hour or more but less than once a minute (approximately 25%); once a minute or more but less than once a second (approximately 21%); once a second or more but less than once a hundredth of a second (approximately 6%); and more than once a hundredth of a second (approximately 4%). Approximately 17% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

vii. Third-Party Systems

Respondents using third-party systems reported that they check Business Clock synchronization accuracy at the following frequencies: once a day (approximately 13%); more than once a day but less than once an hour (approximately 15%); once an hour or more but less than once a minute (approximately 26%); once a minute or more but less than once a second (approximately 20%); once a second or more but less than once a hundredth of a second (approximately 6%); and more than once a hundredth of a second (approximately 4%). Approximately 17% of respondents did not know how often they check the accuracy of their Business Clock synchronization.

e. Master Clocks

Respondents that provided information regarding the type of master clock that they use for purposes of maintaining Business Clock synchronization most commonly reported using the NIST atomic clock (approximately 45%). The next most popular solutions were: GPS (approximately 20%); other vendor or hardware-provided time (approximately 10%); data center-provided time (approximately 4%); and CDMA (approximately 1%). Approximately 15% of respondents did not know what their firms use as a master clock.

Large broker-dealer respondents reported using the following as a master clock: NIST atomic clock (approximately 43%); GPS (approximately 27%); other vendor or hardware-provided time (approximately 11%); data center-provided time (approximately 3%); and CDMA (approximately 3%). Approximately 13% of large broker-dealers did not know what they use as a master clock. The responses from small broker-dealer respondents differed somewhat as they

indicated using the following: NIST atomic clock (approximately 37%); other vendor or hardware-provided time (approximately 19%); and data center-provided time (approximately 7%). Approximately 37% of small broker-dealer respondents did not know what they use as a master clock.

These results are described further below, based on the types of systems that respondents operate.

i. Origination Systems

Respondents operating origination systems reported that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 50%); GPS (approximately 20%); other vendor or hardware-provided time (approximately 10%); data center-provided time (approximately 4%); and CDMA (approximately 1%). Approximately 15% of respondents did not know what they use as a master clock.

ii. Routing Systems

Respondents operating routing systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 40%); GPS (approximately 25%); other vendor or hardware-provided time (approximately 10%); data center-provided time (approximately 5%); and CDMA (approximately 5%). Approximately 15% of respondents did not know what they use as a master clock.

iii. Execution Systems

Respondents operating execution systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 50%); GPS (approximately 20%); other vendor or hardware-provided time (approximately 15%); data center-provided time (approximately 5%); and CDMA (approximately 2%). Approximately 10% of respondents did not know what they use as a master clock.

iv. Co-located Systems

Respondents operating co-located systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 40%); GPS (approximately 30%); other vendor or hardware-provided time (approximately 10%); CDMA (approximately 5%); and data center-provided time (approximately 3%). Approximately 15% of respondents did not know what they use as a master clock.

v. Internalization Systems

Respondents operating internalization systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: GPS (approximately 40%); NIST atomic clock (approximately 35%); and other vendor or hardware-provided time (approximately 10%). No respondents reported using data center-provided time or CDMA as their master clocks. Approximately 10% of respondents did not know what they use as a master clock.

vi. Back-Office Systems

Respondents operating back-office systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 50%); GPS (approximately 20%); other vendor or hardware-provided time (approximately 15%). No respondents indicated that they used data center-provided time or CDMA as their master clocks. Approximately 15% of respondents did not know what they use as a master clock.

vii. Third-Party Systems

Respondents using third-party systems stated that they use the following as a master clock for purposes of complying with the Business Clock synchronization requirement: NIST atomic clock (approximately 50%); GPS (approximately 20%); and other vendor or hardware-provided time (approximately 15%). No respondents reported using data center-provided time or CDMA as their master clocks. Approximately 15% of respondents did not know what they use as a master clock.

f. Synchronization Across Geographically Disparate Systems

Approximately 40% of respondents responding to the question on maintaining Business Clock synchronization across geographically disparate systems indicated that they do maintain synchronization across systems that are geographically disparate.[26] Approximately 30% of respondents reported that they do not synchronize Business Clocks across geographically disparate systems. Approximately 30% of respondents indicated that this question was not applicable.

The most common response from large broker-dealer respondents was that they did maintain Business Clock synchronization across geographically disparate systems (approximately 44%). Approximately 29% of large broker-dealer respondents reported that they did not maintain synchronization across geographically disparate systems, and approximately 27% indicated that this question was not applicable to them. Approximately 38% of small

[26] These respondents indicated that key challenges with respect to synchronizing Business Clocks in geographically disparate systems generally relate to time, monetary costs and resources. One respondent also indicated that challenges include signal quality (e.g., GPS line of site and GPS jamming), network congestion, protocol and software selection and configuration, and real-time monitoring and alerting. Another respondent indicated that traceability across multiple systems is its primary challenge.

broker-dealer respondents stated that they maintain synchronization across geographically disparate systems, and approximately 28% reported that they do not. Approximately 34% of small broker-dealer respondents indicated that this question was not applicable to them.

These results are discussed further below, based on the types of systems that respondents operate.

i. Origination Systems

Approximately 30% of respondents operating origination systems indicated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 35% of respondents stated that they did not maintain synchronization across geographically disparate systems. Approximately 30% of respondents indicated that this question did not apply to their operations.

ii. Routing Systems

Approximately 35% of respondents operating routing systems reported that they maintained Business Clock synchronization across geographically disparate systems. Approximately 40% of respondents indicated that they did not maintain synchronization across geographically disparate systems. Approximately 25% of respondents indicated that this question did not apply to their operations.

iii. Execution Systems

Approximately 40% of respondents operating execution systems stated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 20% of respondents indicated that they did not maintain synchronization across geographically disparate systems. Approximately 40% of respondents indicated that this question did not apply to their operations.

iv. Co-located Systems

Approximately 50% of respondents operating co-located systems stated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 20% of respondents stated that they did not maintain synchronization across geographically disparate systems. Approximately 30% of respondents indicated that this question did not apply to their operations.

v. Internalization Systems

Approximately 50% of respondents operating internalization systems indicated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 15% of respondents stated that they did not maintain synchronization across geographically disparate systems. Approximately 30% of respondents indicated that this question did not apply to their operations.

vi. Back-Office Systems

Approximately 40% of respondents operating back-office systems indicated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 40% of respondents stated that they did not maintain synchronization across geographically disparate systems. Approximately 20% of respondents indicated that this question did not apply to their operations.

vii. Third-Party Systems

Approximately 35% of respondents stated that they maintained Business Clock synchronization across geographically disparate systems. Approximately 40% of respondents indicated that they did not maintain synchronization across geographically disparate systems. Approximately 25% of respondents indicated that this question did not apply to their operations.

VI. Recommendations: Current Clock Synchronization Requirements

As required by Section 6.6(a)(ii) of the CAT NMS Plan, the Participants provide these recommendations with respect to the current Business Clock synchronization requirements based on their analysis of the data collected in the Survey. As discussed further below, the Participants do not believe that it is appropriate to amend the current Business Clock synchronization requirements set forth in the Plan at this time based on the results of the Survey.

The Participants note that data collected in the survey is limited in certain ways for general applicability.[27] For instance, the data is heavily skewed towards larger broker-dealers (approximately 60% of all respondents), thus making its applicability to small broker-dealers (approximately 13% of all respondents) more questionable. In addition, many respondents indicated in their responses to various questions that they did not know their firm's current practices and did not know, or cannot estimate, potential costs (i.e., with respect to implementation times and initial and ongoing monetary costs).

Moreover, the Participants note that the current Business Clock synchronization standards were only recently implemented, and the Participants believe that the Participants and Industry Members should gain experience with those new standards prior to implementing more stringent or granular standards. In particular, the Participants desire to evaluate the effectiveness of current Business Clock synchronization requirements on the linkage and sequencing of independent events in the CAT, or whether more granular synchronization requirements are important to the accurate linkage and sequencing of the events. After gaining experience with

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[27] In connection with future assessments of the Business Clock synchronization standards set forth in the Plan, the Participants will consider how to improve the efficiency and effectiveness of collecting data from CAT Reporters and the securities industry generally. For instance, the Participants may elect to, without limitation: use targeted studies/surveys or small group discussions with particular types of Industry Members; collect data regarding synchronization practices and thresholds from certain types of Industry Members (e.g., those with the lowest synchronization thresholds) and compare the data to the Participants' practices and thresholds; analyze data recorded in Industry Members' synchronization logs; or recommend the implementation of pilot programs where certain CAT Reporters would comply with a narrower synchronization threshold for a period of time to give the Participants an opportunity to assess the costs, benefits and general utility of a narrower threshold.

the synchronization standards and their effect on the accuracy of the CAT, the Participants believe that they will be able to analyze whether narrower clock synchronization requirements are necessary to obtain the intended regulatory goals of the CAT and whether any narrower requirements should be applied to certain groups or types of Industry Members consistent with industry standard practices. The Participants also anticipate that Industry Members, Small Industry Members and Service Providers that maintain synchronized Business Clocks will be able to provide more detailed and accurate responses after all CAT Reporters that are Industry Members and Small Industry Members are subject to the synchronization standards set forth in the Plan.

Nevertheless, despite these concerns and recognition of the limitations of the Survey results, the Participants provide the following suggestions for consideration at a future date regarding potential amendments related to the type of CAT Reporter, type of Industry Member and type of system.

A. Type of CAT Reporter

The Participants evaluated whether it is appropriate to amend the Business Clock synchronization requirements in the Plan based on the type of CAT Reporter – Participant and Industry Members. The current clock synchronization standards impose different standards on Participants and Industry Members. Participants are required to meet a 100 microseconds standard, whereas Industry Members are required to meet a 50 milliseconds standard. The Participants do not recommend changing these standards at this time.

As discussed above, the Survey focused on collecting data regarding Industry Members. The Participants, however, have reported that they comply with the 100 microseconds requirement currently set forth in the Plan. Based on prior analysis of the Participants' clock synchronization practices, the Participants believe that 100 microseconds is an appropriate synchronization standard to apply to the Participants. Moreover, at this time, the Participants do not believe that the same standard should apply to the Participants and to CAT Reporters that are Industry Members and/or Small Industry Members since the Survey results do not reflect a uniformity of synchronization thresholds among all CAT Reporters.

With regard to Industry Members, the data collected indicates that many potential CAT Reporters currently synchronize their Business Clocks at thresholds that are better (i.e., narrower) than currently required by the Plan, although not necessarily to the granularity of the Participants. For example, approximately 64% of respondents indicated that their current synchronization threshold is less than 50 milliseconds, with respondents most commonly reporting that they maintain thresholds of between 1 millisecond and 49 milliseconds (approximately 47%). By comparison, relatively few respondents indicated that they currently maintain synchronization thresholds below 1 millisecond (approximately 17%). The Participants, however, do not believe that this supports decreasing the synchronization thresholds applicable to all Industry Members as a group at this time. As discussed in this assessment, the sample set is heavily skewed toward large broker-dealers (approximately 80% of respondents providing data on current synchronization thresholds), and the Participants have not had an

opportunity to fully evaluate the extent to which the Survey respondents represent large broker-dealers, so additional information is necessary before the Plan may be amended.

B. Type of Industry Member

The Participants evaluated whether it is appropriate to amend the Business Clock synchronization requirements in the Plan based on the type of Industry Member (e.g., ATS, small broker-dealer) when establishing appropriate industry standards. Recognizing the limitations of the Survey, the data suggests that many large-broker dealer respondents may already meet or exceed the standard set forth in the Plan. However, as discussed below, the Participants believe that additional analysis is necessary for implementing any narrower thresholds that are generally applicable to Industry Members or applicable to a particular subset thereof.

The Survey data preliminarily suggests many large broker-dealers currently synchronize their Business Clocks at thresholds that are better (i.e., narrower) than currently required by the Plan. For example, 69% of the large broker-dealer respondents indicated that they have current thresholds of less than the current 50 millisecond standard. In particular, large broker-dealer respondents reported that they used the following standards: 1 microsecond to 499 microseconds (approximately 12%); 500 microseconds to 999 microseconds (approximately 6%); 1 millisecond to 49 milliseconds (approximately 51%); 50 milliseconds to 499 milliseconds (approximately 12%); and 500 milliseconds to 1 second (approximately 3%). Approximately 16% of large broker-dealer respondents did not know their firm's current threshold. Moreover, many large broker-dealer respondents indicated that it would take them no time to comply with narrower standards of 5 milliseconds (approximately 23%), 1 millisecond (approximately 23%), 500 microseconds (approximately 14%) and 100 microseconds (approximately 13%). Although these results do not reflect a consensus among large broker-dealer respondents, the Participants believe that future analysis may indicate that compliance implementation times will decrease due to technological advances in the industry and after large broker-dealers gain experience reporting to the Central Repository. However, large broker-dealer respondents, without a majority or consensus view, also indicated that they would incur a range of costs to comply with narrower synchronization thresholds, with some estimating costs of $5 million or more to comply with thresholds below 1 millisecond. Accordingly, the Participants believe that, although large broker-dealers may be able to comply with a narrower synchronization standard without significant costs in terms of implementation time, monetary costs may be significant and possibly prohibitive. The SEC expressed a similar view when it recently approved the Plan. It explained, "[w]hile the Commission believes that regulators' ability to sequence orders accurately in certain cases could improve if the clock synchronization for Industry Members were finer, the Commission is sensitive to the costs associated with requiring a finer clock synchronization [standard] for Industry Members at this time, and believes that a standard of 50 milliseconds for Industry Members will allow regulators to sequence orders and events with a level of accuracy that is acceptable for the initial phases of CAT reporting."[28]

The Survey results suggest that it would be premature to lower the clock synchronization standards with regard to small broker-dealers. As noted, the number of respondents that

[28] Adopting Release at 84785.

identified as small broker-dealers was limited; only 13% of the respondents identified as small broker-dealers, which does not provide a representative view of small broker-dealers in the industry. Moreover, only approximately 30% of small broker-dealer respondents reported that they used a synchronization threshold less than the 50 milliseconds standard. Specifically, small broker-dealer respondents reported the following current thresholds: 500 microseconds to 999 microseconds (approximately 19%); 1 millisecond to 49 milliseconds (approximately 11%); 50 milliseconds to 499 milliseconds (approximately 26%); 500 milliseconds to 1 second (approximately 11%); and more than one second (approximately 7%). Approximately 26% of small broker-dealer respondents did not know their firm's current threshold. Some, but not a majority or a representative sample, of small broker-dealer respondents indicated that it would take them no time to comply with narrower standards of 5 milliseconds (approximately 29%), 1 millisecond (approximately 17%), 500 microseconds (approximately 33%) and 100 microseconds (approximately 33%). However, as discussed throughout this assessment, the number of respondents that identified as small broker-dealers was limited, which suggests that this data may not be representative of small broker-dealers generally. In addition, given that, throughout the development of the CAT NMS Plan, small broker-dealers and industry associations have noted that they believe that small broker-dealers will be disproportionately burdened when it comes to complying with the Plan requirements, the Participants believe that it is necessary to understand the potential impact of any amendment to the Plan on small broker-dealers. For instance, as was the case with large broker-dealer respondents, small broker-dealer respondents indicated a range of potential costs to comply with a narrower synchronization threshold without a clear consensus or majority view. Although many small broker-dealers estimated that they would incur substantial costs to comply with narrower standards, a significant portion of small broker-dealer respondents could not estimate anticipated compliance costs.

The Survey results also suggest that it may not be appropriate to subject ATSs to narrower synchronization standards at this time. Few ATS respondents indicated that it would take them no time to comply with narrower thresholds of: 5 milliseconds (approximately 18%); 1 millisecond (approximately 29%); 500 microseconds (approximately 17%); and 100 microseconds (0%). Moreover, many ATSs reported that they would incur significant costs to comply with narrower synchronization thresholds. For instance, for thresholds of 500 microseconds and 100 microseconds, the majority of ATS respondents estimated that they would incur initial compliance costs between $1 million and $20 million (approximately 57% each for thresholds of 500 microseconds and 100 microseconds). However, as is the case with data from small broker-dealer respondents, in some respects the data provided by ATS respondents is limited. For instance, as of May 3, 2017, the SEC reported that there are 83 ATSs with current Forms ATS on file, but only 12 respondents (approximately 8%) indicated that they operate an ATS.[29] The Participants believe that it is necessary to better understand the synchronization

[29] Alternative Trading Systems with Forms ATS on File with the SEC as of May 3, 2017, *available at* https://www.sec.gov/files/data/frequently-requested-foia-documentalternative-trading-system-ats-list/atslist0517.pdf. Please note that the 83 ATSs referenced above includes both equity and fixed income ATSs as the SEC's publicly available list does not differentiate equity versus fixed income ATSs.

practices of ATSs, as well as the potential costs that ATSs would incur to comply with narrower synchronization standards.[30]

C. Type of System

The Participants evaluated whether it is appropriate to amend the Business Clock synchronization requirements in the Plan based on the type of system, including: order origination systems; order routing systems; order execution or matching systems; co-located systems; internalization systems; back-office systems; and third-party systems (including vendor systems). Based on the Survey, the Participants do not believe that it is appropriate to apply different synchronization thresholds to different types of systems at this time.

The Survey results did not indicate any consistent patterns that would necessarily support implementing a narrower or higher threshold for particular systems. For instance, with the exception of third-party systems, the majority of respondents that submitted system-level responses indicated that Business Clocks in those systems tend to be narrower than required by the Plan. However, given the ranges provided in the Survey, the Participants cannot precisely determine the current synchronization thresholds commonly used in the various systems addressed in the Survey. Moreover, of the respondents that provided information regarding current synchronization thresholds, approximately 55% indicated that their Business Clock synchronization tolerances did not vary based on whether Business Clocks were located in particular systems. Approximately 19% of large broker-dealer respondents indicated that their synchronization tolerances varied based on where Business Clocks were located; by comparison, no small broker-dealer respondents indicated that their tolerances varied based on location of Business Clocks. This further indicates that additional analysis is necessary to better determine whether, if required to do so, CAT Reporters would be capable of complying with synchronization thresholds that vary by type of system, or whether the costs of doing so would be significant or otherwise prohibitive.[31]

D. Conclusion

As discussed above, the Participants do not believe that it is necessary or appropriate to amend the Business Clock synchronization requirements set forth in the Plan at this time. The Participants will reassess whether the Business Clock synchronization requirements remain consistent with industry standards – or whether it may be necessary to amend such requirements – in the future as part of the annual assessment required by Section 6.8(c) of the Plan. To make such an assessment, the Participants intend to continue working with the Advisory Committee and the industry generally, including CAT Reporters of various sizes and types, to determine whether current Business Clock synchronization practices have changed sufficiently to suggest

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[30] The Participants believe that it may be appropriate for any future assessment of the costs and benefits of imposing a narrower synchronization threshold on ATSs to take into consideration that ATSs often act in a manner similar to exchanges.

[31] In a future assessment, it may be appropriate to consider whether certain types of Industry Members – such as electronic trading firms using a business model that relies on low latency trading strategies – should be subject to narrower synchronization standards, to the extent that the nature of their business would, in practice, require them to use such narrower standards. The Participants will consider collecting additional data in future assessments to evaluate this question.

that narrower synchronization thresholds may be consistent with industry standards. As the Commission noted when it approved the Plan, if the Participants determine based on a future assessment that the clock synchronization requirements in the Plan should be changed, the Participants would need to file a proposed amendment to the Plan with the Commission. Such a submission would enable the Commission, as well as Industry Members and the public, to evaluate the proposed requirements, including anticipated costs, benefits and related implementation time frames.

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Thank you for your attention to this matter. Please contact me at 212-229-2455 if you have any questions or comments.

Respectfully submitted,

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