

October 23, 2018
Tokyo Stock Exchange, Inc

Regarding the Equity Trading System Glitch Occurring on October 9, 2018

We sincerely apologize for the inconvenience experienced by investors and many other market participants caused by the glitch that occurred in the equity trading system “arrowhead” on October 9, 2018.

The following is a report on the cause of the incident and steps that the Tokyo Stock Exchange (“the TSE” below) will take to prevent a recurrence in the future. The Commissioner of the Financial Services Agency of Japan has ordered a report on the incident according to Article 151 of the Financial Instruments and Exchange Act, which has been submitted today.

1. Background

On October 9th at 7:31 a.m., an extremely large number of messages were sent to the arrowhead system from Merrill Lynch Japan Securities, which caused one of the four connection devices within arrowhead to come under heavy stress. As a result, the virtual servers connected to this connection device (“Connection Device #1”) were unable to connect to arrowhead. Since securities companies were unable to place orders via Connection Device #1, the TSE sent out notifications to securities companies at 8:03 a.m. and 8:07 a.m. requesting them to use virtual servers¹

¹ Logical devices that are part of securities companies’ systems used for transmitting and receiving data to and from arrowhead.

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connected to one of the remaining three connection devices (“Connection Devices #2 to #4”).

The TSE confirmed that orders were able to be placed normally via Connection Devices #2 to #4, and as such allowed trading for all issues according to the normal trading schedule.

Subsequently, while many securities companies were able to place orders without any problem via one of the remaining three routes, some required time to make the required adjustments and others were unable to make them at all. Consequently, the TSE determined that investors were being impacted, and thus decided to make a formal announcement to all investors regarding the incident on our home page at 11:20 a.m.

2. Overview of System Glitch

(1) Cause of Connection Device #1 Route Becoming Unusable

The direct cause of the incident was that the connection device came under heavy stress as a result of an extremely large number of messages being received from Merrill Lynch Japan Securities. Immediately after a TCP connection² was established as normal between Merrill Lynch’s virtual servers and arrowhead gateway servers at 7:31 a.m., a different virtual server from Merrill Lynch attempted to establish an identical TCP connection. This created inconsistencies in the TCP connection management number, which then led to an extremely large number of retransmission requests being sent to arrowhead in extremely short intervals. This was the result of the same IP address and port number being assigned to two different virtual servers³, and Merrill Lynch mistakenly attempting to connect to arrowhead at the same time with these virtual servers⁴.

When the connection device came under heavy stress, arrowhead suspended the

² TCP is a specific data transmission protocol that emphasizes stability and reliability. A TCP connection is a logical data transmission route that uses TCP.

³ Number that specifies the application in transmission origins/destinations.

⁴ The TSE specifies in connection condition documents provided to securities companies that simultaneously connecting to the system with identical IP addresses and port numbers is prohibited.

functionality of the affected gateway servers as designed for system stability, leading to the incident described.

(2) Reason Some Securities Companies Were Not Able to Respond

With respect to the reason that some securities companies were able to place orders via Connection Devices #2 to #4 and others weren't, each company is currently reviewing their own operational process, system design, and other issues, and the TSE is working with all related parties to confirm connection specifications, testing procedures and other system and process elements.

(3) Penalties

With regards to this incident, the TSE was unable to adequately fulfill its mission as an equity market operator in terms of prioritizing initiatives for developing and managing a reliable system and ensuring market functionality. In light of this, the following penalties have been imposed:

Koichiro Miyahara, President and CEO: 10% reduction in monthly pay for one month

Ryusuke Yokoyama, Senior Executive Officer: Censure

Yasuhiko Tamura, Director, IT Development: Warning

3. Measures to be Taken to Prevent Recurrence

The TSE will create a forum for sharing information with securities companies about the cause of the incident and preventative measures, and will also take the following steps in cooperation with securities companies to further enhance market stability.

Preventative Measure	Details
① System adjustments to prevent recurrence (addressing 2.(1))	<ul style="list-style-type: none">• Investigate whether or not there are any other transmission patterns originating externally that can result in heavy stress on the system.• Change system settings so that all gateway servers

Preventative Measure	Details
above)	<p>will not be simultaneously suspended if a similar situation occurs in the future, while maintaining the existing stability structure.</p> <ul style="list-style-type: none"> • Clarify prohibited connection specifications (e.g. continuously sending messages in extremely short intervals, applying for virtual servers with identical IP addresses and port numbers, etc.). • Clarify points to check when activating virtual servers for production.
② Revision of securities company connections (addressing 2.(2) above)	<ul style="list-style-type: none"> • Specify system response required by securities companies in the event of a malfunction in arrowhead devices within connection specifications. • Planning and execution of malfunction tests with securities companies.