



Specialist Working Group for Recurrence Prevention Measures (5th meeting)

Total smart exchange

Tokyo Stock Exchange, Inc.

January 15, 2021

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(1) Schedule for Applying Amended Rules, etc.



Draft Schedule for Applying Amended Rules, etc.

- The planned schedule for the application of the various amended rules and operational procedures, etc. is shown in the following table.

- Amended rules and procedures will be applied in sequence after the completion of amendments to the contingency plan, rules, and connection specifications, etc. (around April 2021) as well as the completion of system developments on the TSE side and system failure drills.

	Response	Planned schedule
1	Enhancement of information provision	<ul style="list-style-type: none"> Feb. 2021: Start of operation Ongoing improvements through system failure drills, etc.
2	Rules for handling of entrusted orders, etc.	<ul style="list-style-type: none"> Jan. 2021: Public consultation Apr. 2021: Implementation of rules
3	Amendments to contingency plan	<ul style="list-style-type: none"> Feb. 2021: Public consultation Apr. 2021: Implementation of rules
4	Procedure for gathering opinions (Target)	<ul style="list-style-type: none"> Apr. 2021: Start of operation along with #2 and #3
5	System response (arrowhead and Market Information System (FLEX))	<ul style="list-style-type: none"> Apr. 2021: Specification of response policy in the connection specifications By Mar. 2022: For things such as preparation for a reboot which will require system modifications, amendment of the connection specifications followed by system response and system failure drills, then application in stages*

*Schedules for each of these will be announced in order when finalized.

(2) Development of Rules Regarding Handling of Orders and Procedures for Resuming Trading in the Event of a System Failure, etc.



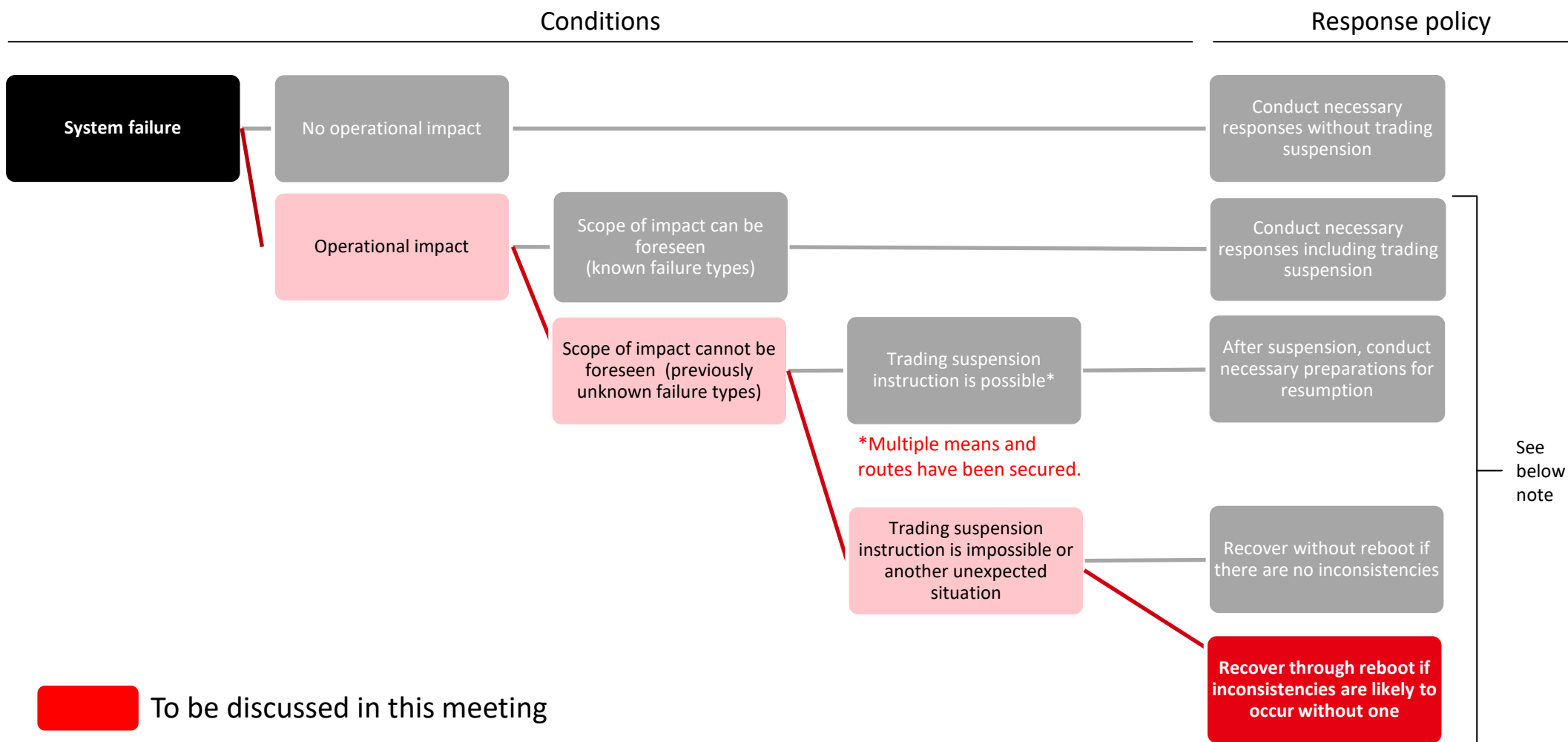
Outline of Discussions at Past WG Meetings and Schedule Going Forward

#	Item	Outline of Discussions at Past Meetings	Schedule Going Forward
1	Development of rules for handling orders to enable trading to resume on the day of the system failure, etc.		
1-1	Clarification of cases for implementing non-acceptance of orders, trading suspension, etc.	<ul style="list-style-type: none"> - Orders will not be accepted and trading will be suspended in cases where the impact of the system failure cannot be foreseen if orders are accepted. - Measures for not accepting orders will be carried out in order of priority based on the impact on trading participants. 	- Policies and operational procedures will be specified in the connection specifications later.
1-2	Handling, etc. of orders entrusted by customers in the case of order cancellation by the Exchange	- While trading participants should in principle resend customer orders when orders are cancelled by the Exchange, rules will be changed to allow alternative handling, such as through special clauses.	As well as amending rules, TSE plans to clarify examples of and ways of thinking about orders for which resending could be considered inappropriate.
2	Development of procedures for resuming trading in the case of an irregular trading suspension		
2-1	Handling of orders affected by invalidation of already accepted orders by the Exchange	- In cases where the Exchange judges that clearing the order book would contribute to a smooth trading resumption, TSE considers manual invalidation of already accepted orders by the Exchange as a possible measure to resolve inconsistency.	- Policies and operational procedures will be specified in the connection specifications later.
2-2	Inconsistency resolution through a system reboot (before the start of trading)	- In the case that a system reboot is necessary to resolve inconsistency, TSE considers it as a possible measure in aiming for a trading resumption.	Specific responses that trading participants will be required to make will be discussed in later WG meetings. (to be discussed in the 5th WG meeting)
2-3	Responses after the start of trading	- The WG has discussed handling of data executed before a system failure occurs during a trading session and procedures for how execution data can be relayed between the Exchange and trading participants.	Responses and procedures, etc. necessary for checking execution data, etc. will be discussed in later WG meetings. (to be discussed in the 5th WG meeting)

Note: As derivatives are different from equities in terms of product features, investor base, IT systems and other things, although we will take into account the equity market discussions, we may carry out different responses in some cases, including reviewing contingency plans.

(Ref.) Flow of Failure Responses

- The response policy for system failures at the Exchange will be determined as shown in the flowchart below. Although the chart shows that the possibility of a case requiring a reboot is extremely low, we would like to discuss this matter from the perspective of developing necessary rules for the kind of situations which resulted from the failure on October 1 (as opposed to the failure itself).



To be discussed in this meeting

Out of scope

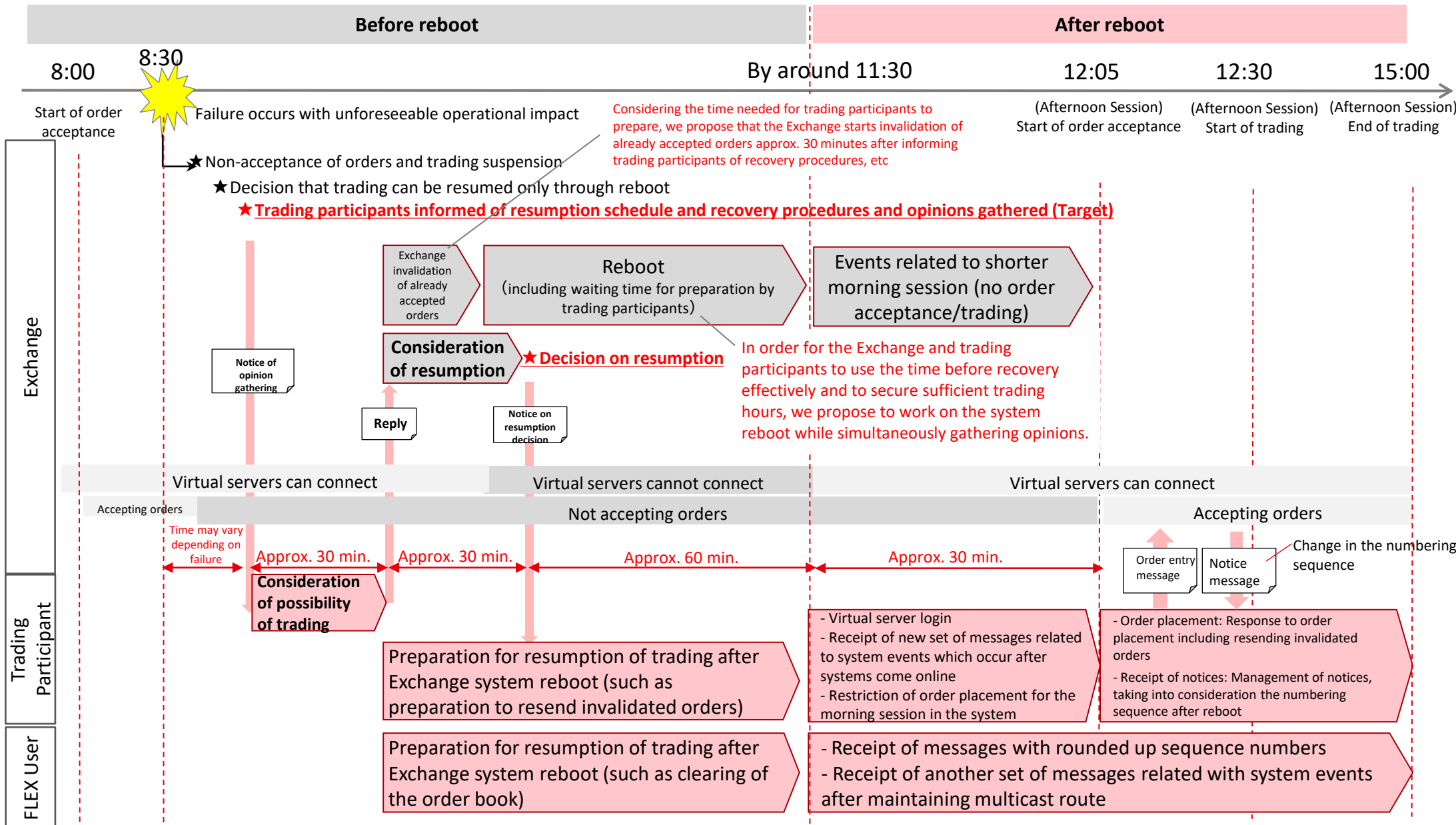
Note: Suspensions and resumptions determined in line with criteria under the Contingency Plan (with opinion gathering procedure if necessary)

- Measures for cases where the Exchange cannot be expected to resolve inconsistency between rules-based handling and the system on its own as well as recovery measures that can be taken in the event of an inconsistency will be clarified as follows depending on the time of failure occurrence. (These are responses to failures with unforeseeable impact or where inconsistency between rules and systems is expected. We do not expect to reboot the system in other cases.)

		Exchange's initial response	Response for recovery	Expected impact
Before start of trading	Before starting order acceptance		- Recovery operations on the Exchange side	- Start time of order acceptance and trading as well as FLEX information distribution time, etc. may be changed.
	Accepting orders (No executed trades)	<ul style="list-style-type: none"> - Non-acceptance of orders and trading suspension for all issues* *If the impact of the failure can be determined on the Exchange side, non-acceptance of orders or trading suspension (with order acceptance) could be implemented for certain issues, as per normal. 	Implementation of the following measures depending on the nature of the system failure: <ul style="list-style-type: none"> - Manual invalidation of orders by the Exchange - System reboot 	<ul style="list-style-type: none"> - In the case where the Exchange invalidates orders but is unable to send invalidation notice messages, trading participants will need to invalidate orders upon receiving information by means other than notice messages. - The schedule for trading hours and FLEX information distribution time, etc. may be changed. The following impacts are expected in the case of a reboot: <ul style="list-style-type: none"> - System events which had occurred after systems came online will occur again after the reboot (with changes such as shortening of the event duration if it is past the event's initially scheduled time) Example: In the case of a resumption from the afternoon session, information on the status of the morning session will be disseminated and a shortened trading period will be provided, but orders will not be accepted.
	After start of trading (Trades executed)	<ul style="list-style-type: none"> - Swift information provision 	Implementation of the following measures depending on the nature of the system failure: <ul style="list-style-type: none"> - Manual invalidation of orders by the Exchange - Resolution of inconsistency, etc. in order execution data, etc. - System reboot 	<ul style="list-style-type: none"> - The notice sequence number system will be revised. - FLEX information: Sequence numbers will be rounded up <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> After the start of trading, in addition to the above, when resending partially executed orders (where remaining orders have been invalidated by the Exchange), trading participants will need to consider their links to customer orders. </div>

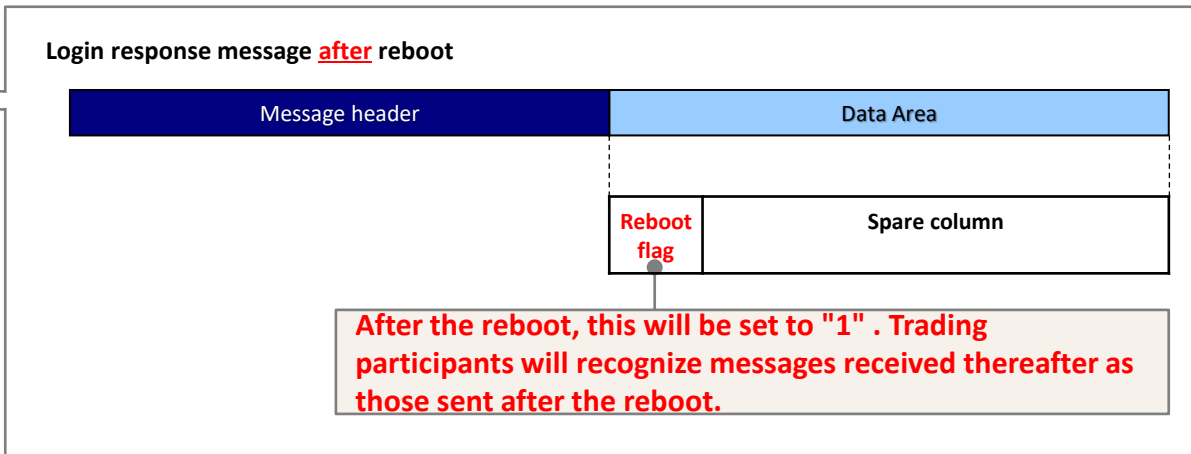
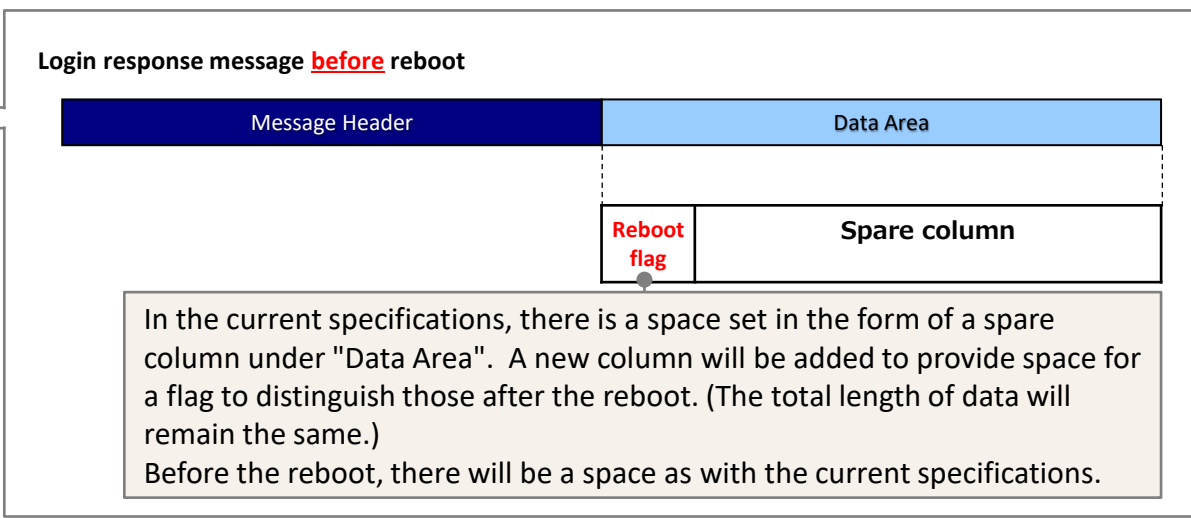
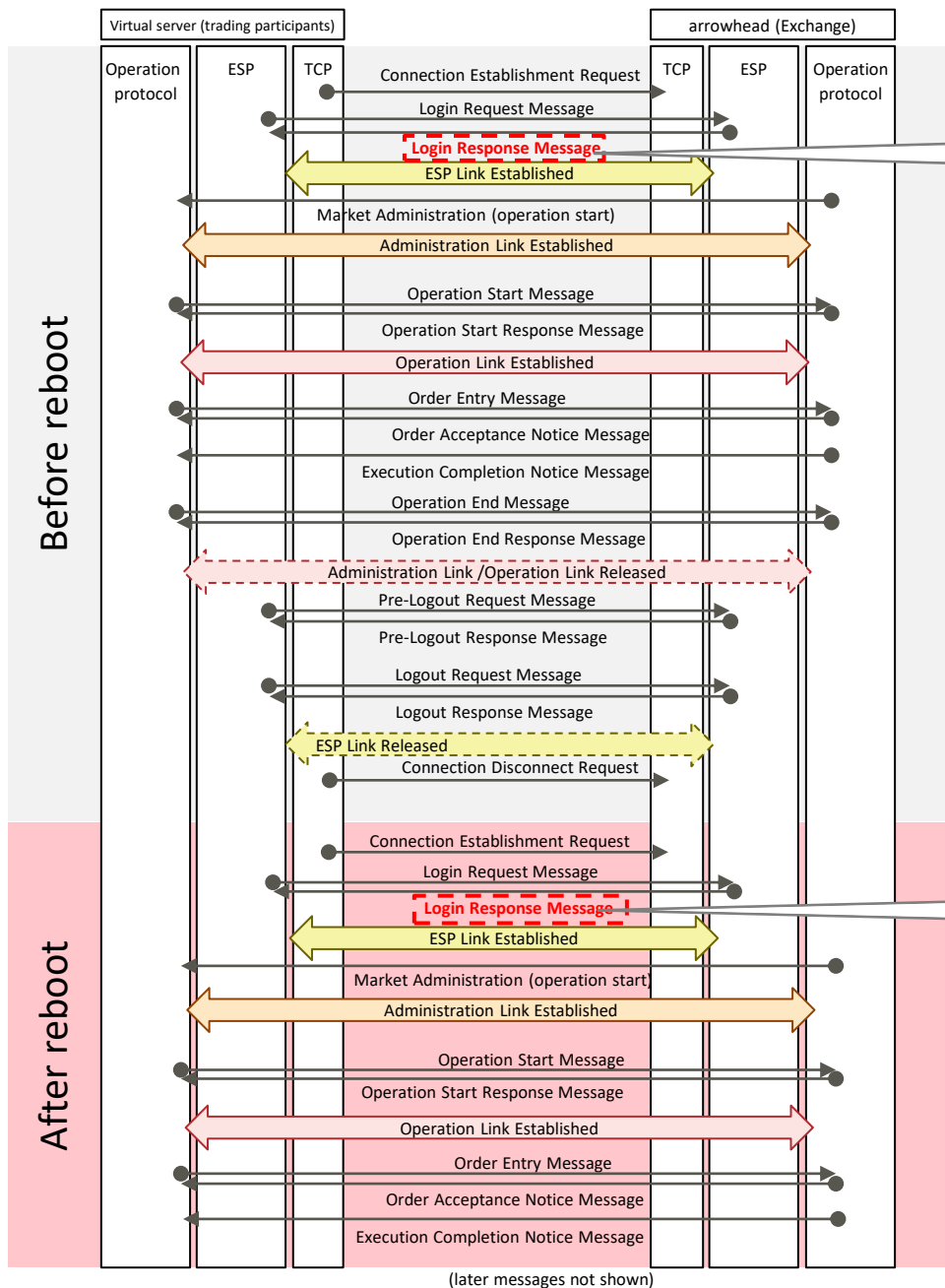
After the start of trading, we expect that splitting up trading hours into morning, lunch and afternoon sessions would make little difference to the preparations needed for recovery and expected impact. (It would, however, affect the decision of whether to resume trading through a reboot, etc. from the perspective of securing sufficient order acceptance time and trading hours.)

Recovery through Reboot (in event of failure before start of trading)



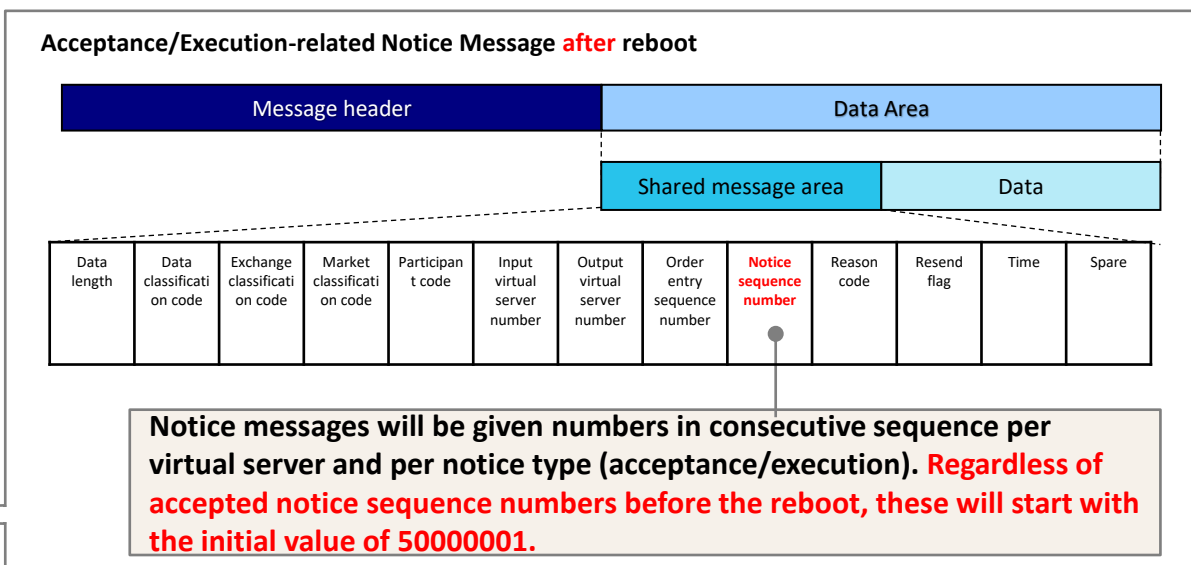
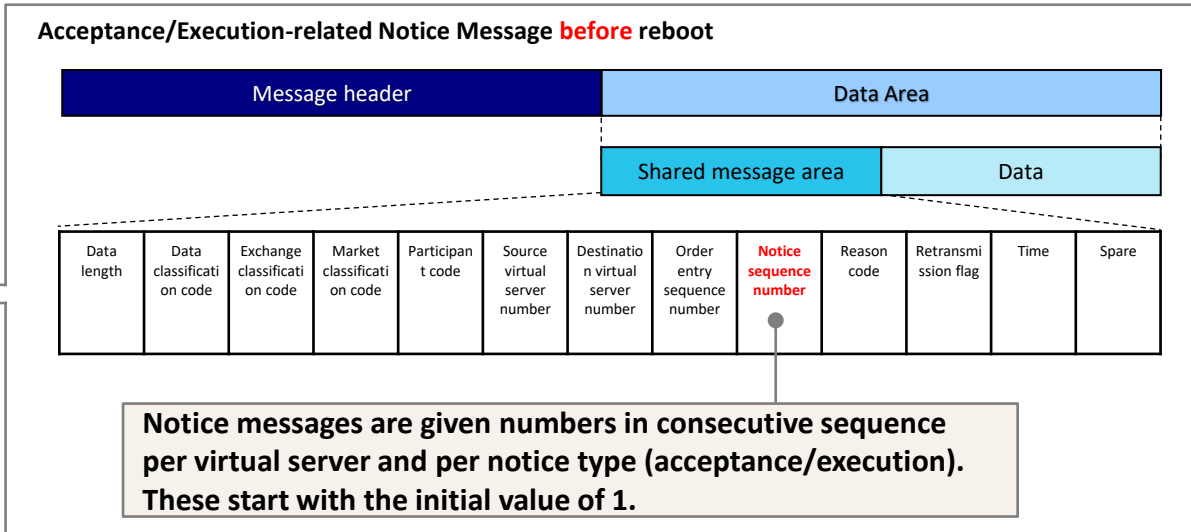
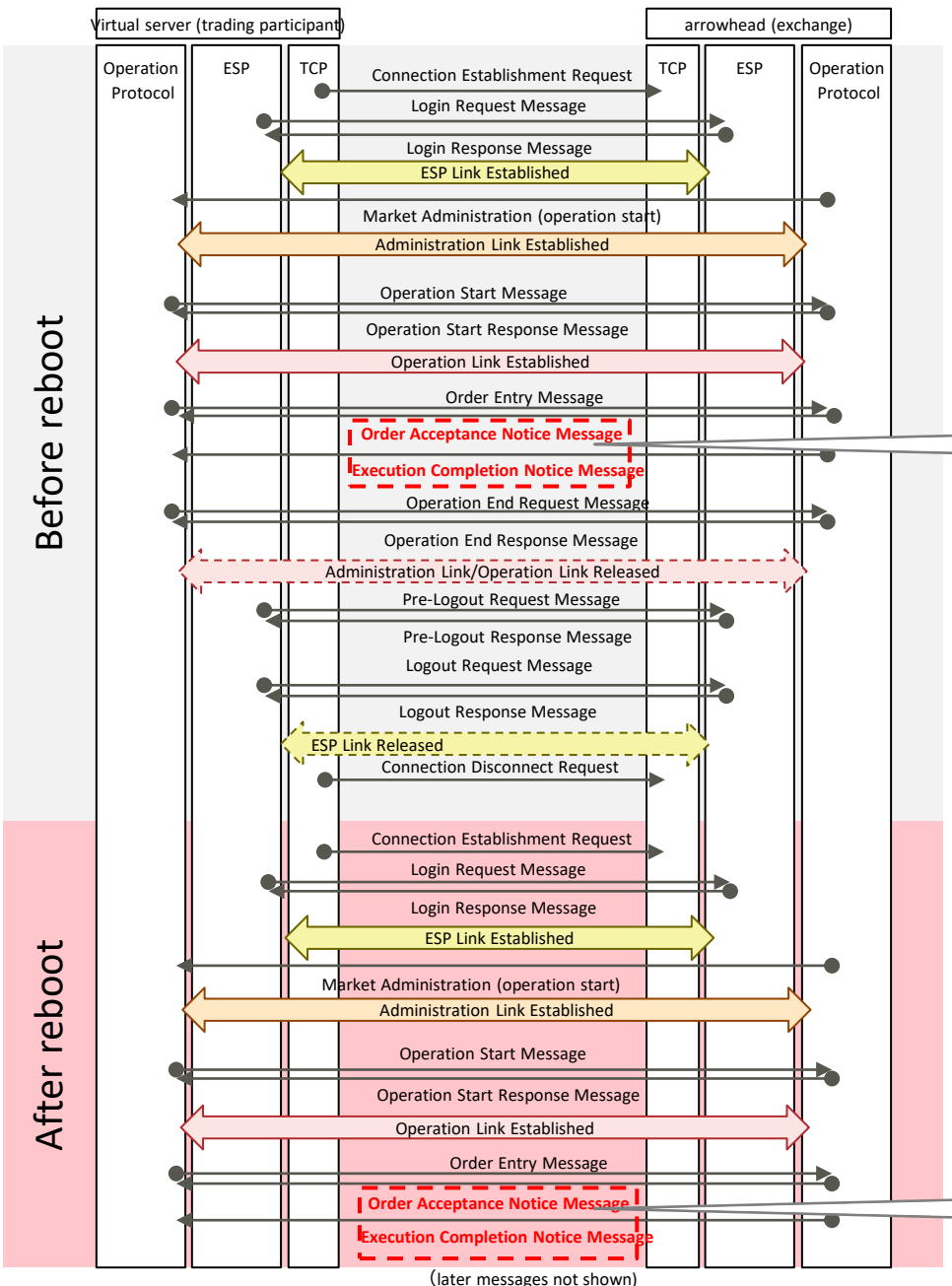
Review of Handling of Sequence Numbers after Reboot (1/3)

Proposal 1) Assign login response messages with a flag to distinguish those after the reboot










Review of Handling of Sequence Numbers after Reboot (2/3)

Proposal 2) Assign post-reboot notice sequence numbers rounded up to a higher number



Handling of sequence numbers is as indicated below.

#		Current Set Values (outline)	Set Values for Proposal 1 (outline)	Set Values for Proposal 2 (outline)
1	Message sequence number 	<ul style="list-style-type: none"> Sequence numbers used for ESP link control which are assigned to all messages transmitted and received (consecutive unique numbers that increase in increments of 1). Uniqueness is guaranteed within the scope of ESP link. 	No change	
2	Order entry sequence number 	<ul style="list-style-type: none"> Set per virtual server, in ascending order (skipped numbers are accepted) for each set of order data The initial value is set to 1 or more. Managed on a day-to-day basis regardless of disconnection or re-connection of virtual servers 	<ul style="list-style-type: none"> Set per virtual server, in ascending order (skipped numbers are accepted) for each set of order data The initial value is set to 1 or more. Managed on a day-to-day basis regardless of disconnection or re-connection of virtual servers (<u>however, in the case that the exchange trading system is rebooted, the uniqueness of the numbers will be guaranteed within each system reboot.</u>) 	
3	Fields for internal processing 	<ul style="list-style-type: none"> A unique value is set per participant (via all virtual servers used by said participant) for each exchange, market, and issue. 	<ul style="list-style-type: none"> A unique value is set per participant (via all virtual servers held by said participant) <u>for a whole day for each exchange, market, and issue (however, in the case that the exchange trading system is rebooted, a unique value within each system reboot will be set).</u> 	
4	Notice sequence number 	<ul style="list-style-type: none"> Consecutive sequence numbers are set for notice messages per virtual server and per notice type (acceptance/execution). These start with the initial value of 1. 	<ul style="list-style-type: none"> Consecutive sequence numbers will be set for notice messages per virtual server and per notice type (acceptance/execution). These start with the initial value of 1. <u>If the exchange trading system is rebooted, the value set for the first notice message after the reboot will be 1, regardless of already accepted notice sequence numbers. Consecutive sequence numbers will be set for further notices.</u> 	<ul style="list-style-type: none"> Consecutive sequence numbers will be set for notice messages per virtual server and per notice type (acceptance/execution). These start with the initial value of 1. <u>If the exchange trading system is rebooted, the value set for the first notice message after the reboot will be 50000001, regardless of already accepted notice sequence numbers. Consecutive sequence numbers will be set for further notices.</u>
5	Order acceptance number 	<ul style="list-style-type: none"> Issued for each order received from a virtual server and guaranteed to be unique. Comprised of a "virtual server number" and an "order entry sequence number". 	<ul style="list-style-type: none"> Issued for each order received from a virtual server <u>for a whole day</u> and guaranteed to be unique. <u>However, in the case that the exchange trading system is rebooted, the uniqueness of the numbers will be guaranteed within each system reboot.</u> Comprised of a "virtual server number" and an "order entry sequence number". 	
6	Execution notice number 	<ul style="list-style-type: none"> Set per market/issue and guaranteed to be unique. (Since numbering is conducted for each issue, the numbers are not consecutive per virtual server.) 	<ul style="list-style-type: none"> Set per market/issue <u>for a whole day</u> and guaranteed to be unique. (Since numbering is conducted for each issue, the numbers are not consecutive per virtual server.) <u>In the case of a system reboot, since said numbers will be rounded up all at once, the uniqueness of an execution notice number will be guaranteed throughout a whole day, regardless of the number of system reboots.</u> 	
7	Notice creation number per issue 	<ul style="list-style-type: none"> A number whose uniqueness is guaranteed within notices issued based on the same order per market/issue. As the numbers are ascending, it becomes possible to identify the order of issued notices within the same order. 	No change	

 Set on the virtual server side  Set on the Exchange trading system

- In the case of the system failure on October 1, 2020, trading opportunities were not provided for the entire day from opening to closing. However, we will put some focus on clarifying and sharing in advance the main practical response measures, etc. for not only these cases but also cases where a failure occurs after some trades are conducted.
- If a failure occurs after trades are conducted, there will be valid executed trades on the day, so we need to look at this from the important perspective of ensuring that such trades will not affect trading on the next business day or later.

1. Basic Approach

- A basic approach is proposed as follows based on the discussions at the WG meetings so far:
 - Execution Completion Notices sent to trading participants before trading suspension measures, etc. are implemented will be considered valid.

2. Framework for Discussion

- There would be some variations in failures after the start of trading depending on the time they occur (morning/afternoon session or between the sessions) or the server(s) they occur on. Considering the impact on trading participants, etc. and the required responses associated with that impact, we can clarify the following points and propose them for discussion.

(1) Action needed for confirmation, etc. of order/execution status

- When a failure occurs during a trading session, regardless of whether it is a system failure on the Exchange system, a failure at a trading participant, or a communication failure, etc. between exchanges, the status of orders and executions as of the time of the failure needs to be confirmed. Action will then need to be taken over this status such as reflecting it on the system, customer response, error correction, as well as clearing processes such as execution confirmation. What actions and/or rules are needed between the Exchange and trading participants to confirm the status of orders and executions, etc.?

(2) Main restrictions on trading after a reboot

- When resuming trading through a reboot, how should we handle resending of partially executed orders, the order book mid price, trading rules (such as short selling restrictions and trading suspensions), and market information on the day?

- We consider that if a failure occurs during a trading session, the status of orders and executions as of the time of the failure needs to be confirmed and then this can be reflected in the customer response, etc. This applies not only when it is a system failure on the Exchange system or inconsistency has occurred, but also when it is a failure at a trading participant or a communication failure, etc. between exchanges. To do this, other than receiving an Execution Completion Notice from virtual servers, the following functions are currently available:

Functions currently available

- (1) Own Order Status Request function: provides order and execution status history of each order processed within the Exchange. When an order is amended and executed, the information of the original order (i.e., the changed order) can be confirmed. It also provides the status of partial executions.
- (2) Notice Retransmission function : a function which enables resending of notices of orders and executions processed within the Exchange if a request message is sent.
- (3) Drop Copy function : sends acceptance and execution notices to Virtual Servers (Drop Copy) through a different route besides the Virtual Server (Order/Notice) which placed orders.
- (4) Data Output to Media (Notices) :provides all day acceptance and execution notices of the applying trading participant (including Order Acceptance Numbers and the quantity of invalid orders, etc.) in the form of digital media.
- (5) JSCC clearing data : users can confirm execution history separately from execution notices from arrowhead either on the clearing terminal or by using data via “CMF direct-connection”.

- Depending on the status of the failure, Execution Completion Notices, etc. may not be sent to trading participants, and there may be discrepancies in the understanding of the status of orders between the Exchange and trading participants. In preparation for such cases, we propose the following measure:

*As data from Execution Completion Notices, etc. are synchronized and held in multiple servers, the possibility of inconsistency arising from data loss, etc. is low and rarely occurs.

Additional response

- (6) Execution Status List : The Exchange will provide, in data format, a list of information such as Order Acceptance Numbers and the number of executed orders and execution prices as set in Order Acceptance.

- Responses required from trading participants

1. Execution notices already received from the Exchange will be considered valid.
2. As there may be unreceived execution notices, trading participants will need to check the execution status list provided by the Exchange, and if there are any unreceived execution notices, change the order status in their own systems.

Note: Until execution information is finalized, trading participants will need to keep the order capacity of customers restricted. Also, if resending orders is required, preparations will need to be made after execution information is finalized.

(1) Handling of partially executed orders

- Resending the unexecuted parts of a partially executed order* will involve a single order entrusted by a customer being split and sent to the Exchange in two installments. As such, it is necessary to consider the link between the customer and the orders.**

*Where the unexecuted parts of the order have been invalidated by the Exchange.

**Since, after the system reboot, information for in-house processing and the order entry sequence number (order acceptance number) will become available once again, a link could be established using these data.

- If a trading participant does not resend an order for the unexecuted part of the original order, said trading participant will be required to invalidate the customer order and request the customer to send the order again.

(2) Price continuity and application of regulation

- After a reboot, the base price (i.e., the central price on the order book) and application of regulations will be reset to what it was at the start of morning trading. In consideration of system-based restrictions, etc., we propose the following:

(i) Base price: Since the system only allows the base price to be changed per issue and confirmation of post-change prices require considerable time, we propose that the last execution price should not be used, and trading resumed with the base price from that morning.

→In the case that the last execution price deviates largely from the base price at the start of morning trading, executions could be carried out quickly by shortening the special quote renewal time interval. However, since this could affect algorithmic trading, should it be avoided?

(ii) Application of short selling restrictions: Price restrictions will not apply to issues that hit the trigger for short selling restrictions. However, if a price again falls 10% or more from the base price at the start of morning trading it will hit the trigger and the price restrictions will be implemented. Therefore, we will resume trading without applying restrictions such as a trading halt.

→Even for an issue that hits the trigger, trading is possible until the price falls 10% from the base price at the start of morning trading, and short selling in such a range will not cause an excessive price fall. As such, these measures are deemed to not violate the purpose of the short selling restrictions.

(iii) Trading halt due to corporate information: For an issue for which there has been a media report regarding material information, etc., a trading halt will be implemented even after the trading resumption. (However, if disclosure is made regarding said media report via TDnet by 15 minutes before the trading resumption, a trading halt will not be implemented.)

(3) Handling of market information after the trading resumption

- Open/high/low/closing prices, trading volume, trading value, etc. transmitted by FLEX after the resumption will be those from after the resumption. Such information for the whole day (consolidated information before and after the resumption) will be published after the closing of the afternoon session.
- If this information from before the system failure is different from that distributed via FLEX, details of the difference will be published on the JPX website, etc. However, this will not be a condition for trading resumption.
- These restrictions will be also widely communicated to investors in advance.

(3) Clarification of Standards, etc. for Trading Resumption under Contingency Plan



- TSE will establish under the contingency plan a numerical standard not only for the overall share of trading value but also for the share of trading value of possible retail participants, who need particular consideration. However, to enable the participation of retail investors through at least a certain number of trading participants, we also suggest establishing a standard for the number of trading participants.

Standards for Trading Suspensions/Resumptions

- Trading will be resumed when the following standards (1) and (2) are met.
 - (1) The share of trading value of trading participants who are able to participate in trading is **approx. more than 50%**.
 - This standard will be established to ensure liquidity in the entire market.
 - (2) The sum of retail orders brokered by trading participants who are able to participate in trading is **approx. more than 30% of trading value by retail investors** and **the number of trading participants brokering retail orders is 5 or more**.
 - This standard will be established to ensure a certain level of investor diversity and fair price formation.
 - The scope of trading participants engaged in brokering retail orders and the share of trading value by retail investors will be determined/calculated based on the surveys on investment trends by investor category.

- As this failure prevented TSE from providing trading opportunities for the whole day, we could not provide the price discovery service that is expected of us as a market operator, and this was a big problem. As such, we need to focus on being able to provide trading opportunities on the same day wherever possible, even if trading conditions are not based on normal trading hours.
- We have already decided that a minimum of 15 minutes of order acceptance time and trading hours respectively will be secured after the trading resumption (in other words, trading will not be resumed if said time and hours cannot be secured). Below we clarify our position from some additional perspectives.

1. Liquidity and Appropriate Price Discovery

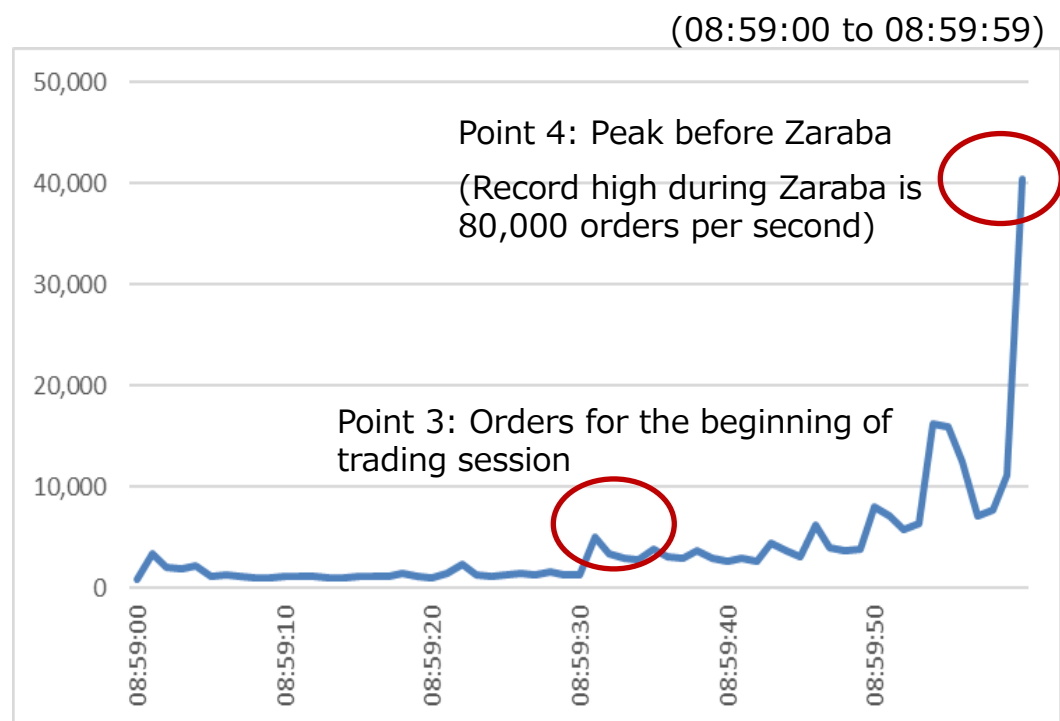
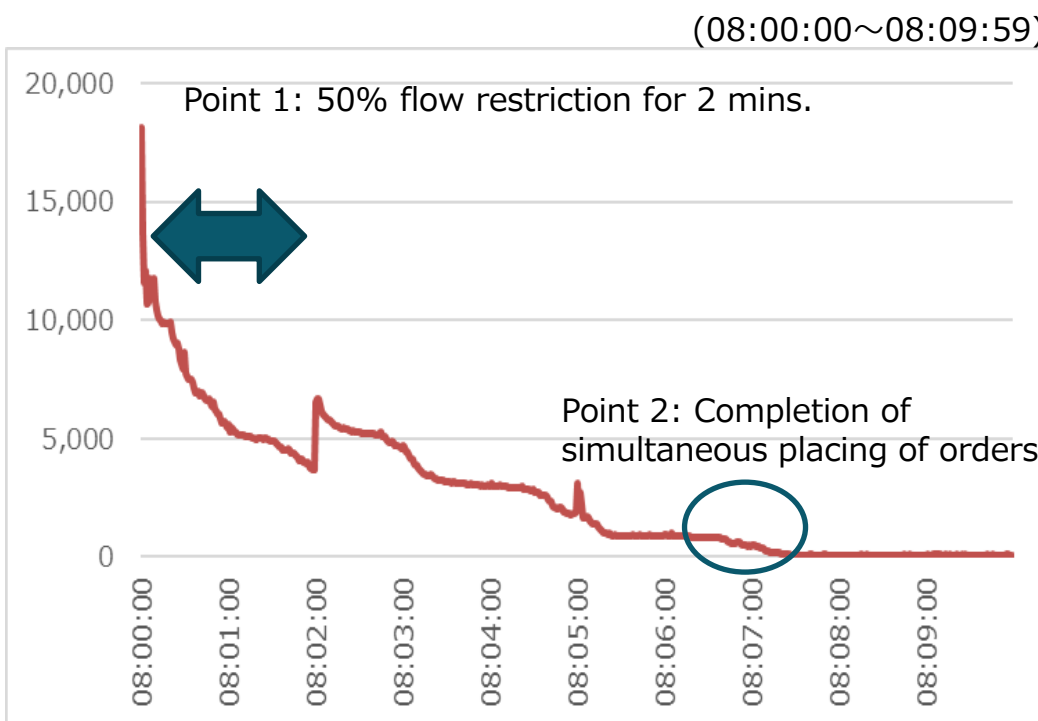
- Trading will be resumed on the condition that the standards for diversity of investors and number of orders as set out in the Contingency Plan are met (in other words, if said standards are not met, trading will not resume). Accordingly, it is deemed that liquidity and appropriate price discovery will be maintained by carrying out Itayose (call auction), etc. based on consolidation of this supply and demand.
- In regular sessions, opening prices are determined for almost all issues within 15 minutes from the start of each session, so it is considered that 15 minutes is appropriate as the lower limit for trading hours.
- At the same time, in the trading rules, the quote rules (special quotes and sequential trade quotes) work to prevent large price fluctuations in short periods of time. These communicate the imbalance between supply and demand to investors for a certain period, while preventing price fluctuations outside the special quote renewal price.*
*Renewal price intervals are approx. 2% and these are updated every 3 minutes. Those for STQs are approx. 4% and 1 minute. The renewal price interval for the closing auction is approx. 4%.

2. System Capacity

- The system has the capacity and processing capability to deal with the numbers of orders and executions that it receives from 8 a.m. to 9 a.m. in normal conditions. Accordingly, the system can handle a 15-minute order acceptance period and a 15-minute trading time without problems.

Order Acceptance Period after a System Reboot

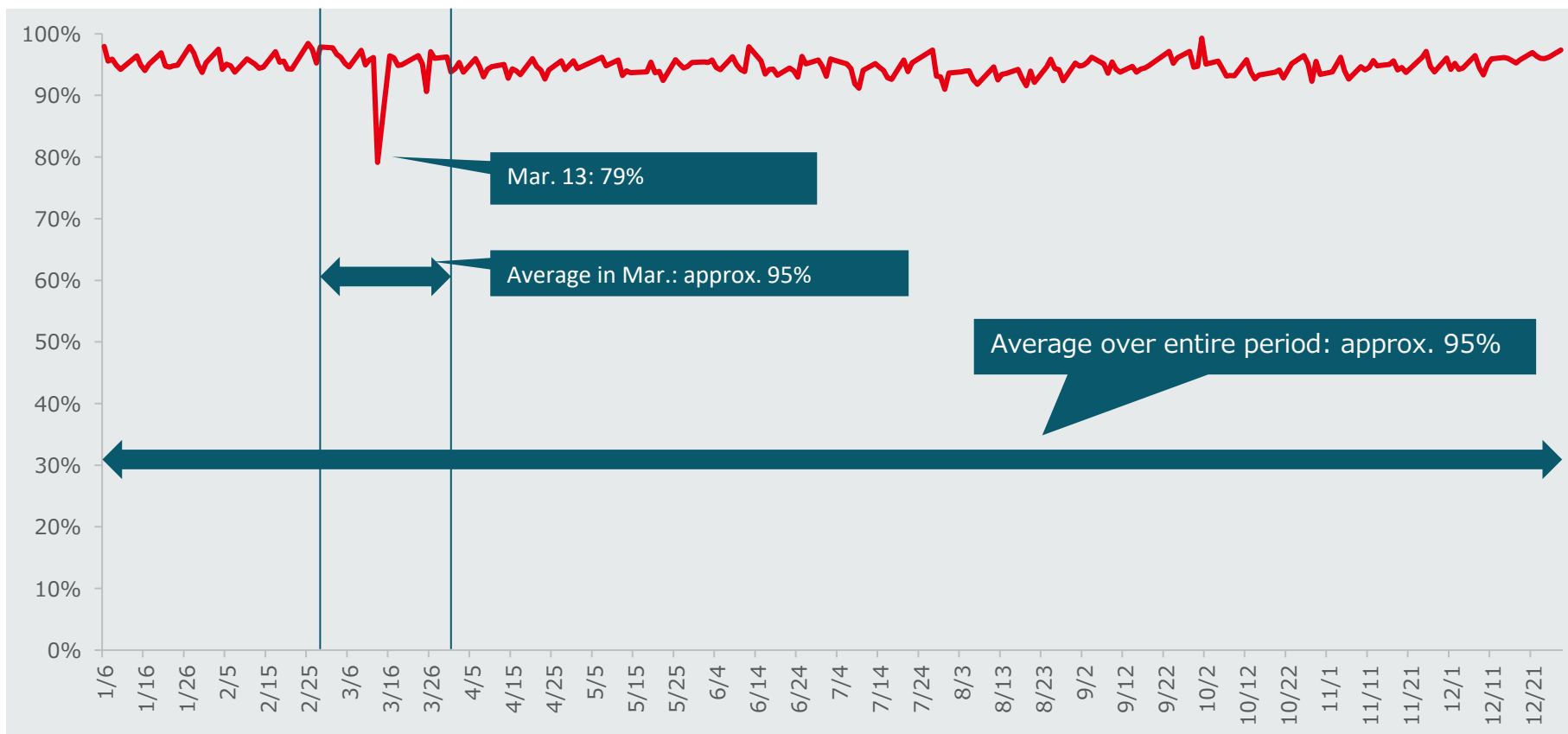
- Normally, even with a 2-minute order flow restriction from 8 a.m., the placement of orders completes within approx. 7 minutes from the start of order acceptance.
 - It has been confirmed that, from 30 seconds before the start of a trading session, the number of orders meant for the start of the session (including order corrections and cancellations) increases. (During the period from 8:10 a.m. to 8:59 a.m., the number of orders per second is approximately 100 to 4,000.)
 - Since the total number of orders during the morning order acceptance period is approx. 2.5 million, even if 5 million orders, twice that number, were placed at 18,000 orders per second, which is within the order flow restriction, the required time would be approx. 5 minutes.
- ⇒ Even if new orders were to come in before the resumption of order acceptance, it is predicted that a 15-minute order acceptance period would enable placement of orders and adjustments for the opening of the session.
- Averages of the numbers of orders placed per second from Dec. 1, 2020 to Dec. 18, 2020



Opening Price Formation after Start of Trading Session

- The chart below shows the ratios of stocks whose opening prices were formed by 9:15 a.m. after the start of the morning trading session.
- Over the period, approximately 95% of opening prices of all stocks were formed by 9:15 a.m. This was the same in March 2020 when the market was highly volatile.
- It is assumed that, even in the case of some changes in the market environment, opening prices for almost all stocks would be formed within 15 minutes.

Ratio of stocks whose opening prices were formed by 9:15 a.m.(Jan.2020 – Dec. 2020)



¹ All issues listed on TSE excluding foreign stocks and those listed on TOKYO PRO market (issues not traded on the relevant day are also excluded.)