DFS230 - M7 - Order Load Management

M7 Release 6.17.298

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Terminology

Term	Description
Balancing Group	A Market hierarchy unit which aggregates Users of a specific Member
Bucket	An atomic unit within which the OMTs are counted for the purpose of evaluation of Order Throttling Rules
CT	ComTrader
Non-CT client	A Trading Client accessing the LTS with a different ApplicationID than the one used by the CT
Cooldown	The period of time placed after the Replenish which needs to pass before the OMTs of a throttled Member are allowed through again
Load	The number of OMTs sent by a Member within a defined timeframe (Observation Window)
LTS	Local Trading Solution
OBK	Orderbook
OMT	A single Order Management Transaction (Order Entry, Order Modification)
OMT Message	An API Message bearing one or multiple OMTs (Order Entries, Order Modifications)
Order Throttling Rule	A set of conditions governing the Order Throttling Status assigned to a Member
Order Throttling Member Status	Status of a Member from the perspective of Order Throttling (No Restriction, Warning, Restriction)
No Restriction Status	No Warnings are pending and Restriction does not apply on a Member
Warning Status	Impending Restriction on a Member due to heavy Load
Restricted Status	Member's OMTs sent by non-CT Traders are being rejected
Replenish Time	The time needed from the start of the Restriction until the load generated by the non-CT Traders of a Member gets below L1 Threshold
Protective Suspension	A mechanism which leads to disconnection of Users generating extreme OMT loads
Tolerance	The period of time for which a heavy OMT load is tolerated by the system before Restriction is applied

1 Introduction

The amount and concentration of Order Management Transactions (OMTs) is considered to be a dimensioning metrics of the usage of M7 performance. This performance is shared, and should be adequately available to all users.

There are two distinct mechanisms introduced by LTS v6.12:

- active limitation of the number of the OMTs accepted from a given M7 Member (Order Throttling)
- a complete suspension of communication with an offending User (Protective Suspension)

The Order Throttling feature is available exclusively to EPEX under the standard contractual conditions.

2 Order Throttling Setup

Order Throttling feature utilizes two new services - The Throttler and the PMI Gateway - which are integrated with the Core and RabbitMQ Broker. As both, PMI Gateway and Throttler do have a direct functional impact, it is practical to describe them in detail.
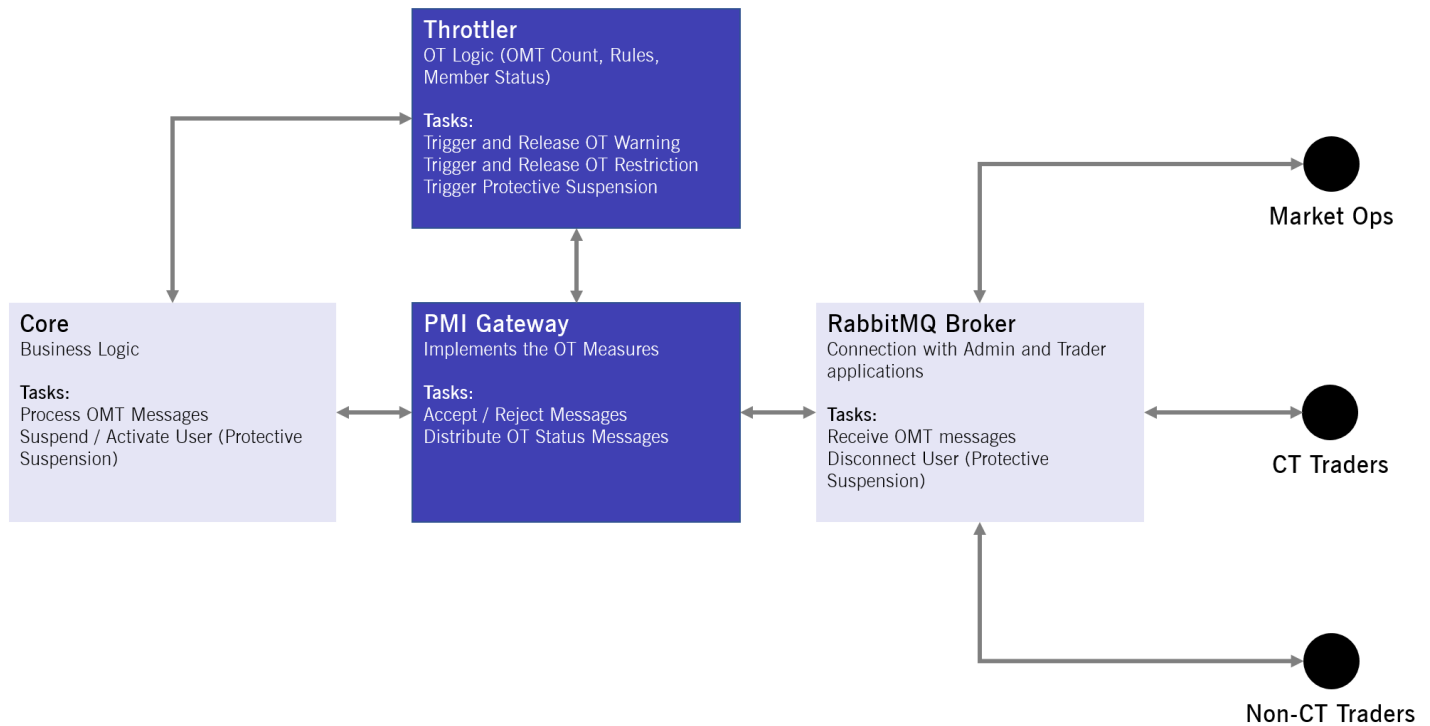
2.1 PMI Gateway

From the perspective of the Order Throttling feature, the PMI Gateway is a component through which all OMT messages need to pass before they can get processed. In the Non-restricted mode, the PMI Gateway allows an OMT message sent by a given Member through to further stages of the processing chain, in the Restricted mode the OMT Message is rejected. The switching between the Restricted and Non-Restricted modes for a given Member is governed by the Throttler component.

2.2 Throttler

2.2.1 Purpose

The Throttler is a separate service which monitors the amount of OMT traffic generated by the Traders of individual Members. The Throttler also records data on Order Throttling Member Status Changes for the reporting purposes.

Based on the continuous evaluation of the amount of traffic generated against a set of configurable Order Throttling Rules the Throttler provides the PMI Gateway with the instructions to:

- warn the Traders of the Members who are at risk of being Throttled
- trigger or lift Order Throttling Restrictions
- trigger the Protective Suspension mechanism on an offending User

2.2.2 OMT Traffic

The traffic concerned constitutes the individual OMTs sent by the Traders of a given Member with an API client different from the ComTrader (non-CT client).

Order Entries and Order Modifies within basket OMT Messages are counted individually. Blanket Order Action (ModifyAllOrdrs) is counted as 1 OMT for the purposes of Order Throttling.

2.2.3 Component Setup

The Throttler is deployed as a separate service interfacing with the PMI Gateway. This has two major implications:

- the reaction of the PMI Gateway may be delayed in regard to the actual moment of the limit exhaustion as registered by the Throttler
- the Throttler service can be deactivated by the System Operator on demand and the PMI Gateway switched to pass-through mode which does not apply any restrictions

The Throttler is built as a lightweight one-purpose service placed off the critical processing path. The service does not implement a resilient failover mechanism. After a restart all Members are unrestricted and their OMT counts are reset to 0.

3 Order Throttling Logic

To facilitate the System Performance Protection and fair use uf resources the System monitors the Load generated by non-CT Traders of a Member and applies OMT rejection under specific conditions and within defined intervals.

All OMTs sent by Traders of a given Member with an API client different from the ComTrader (non-CT client) are rejected within the interval in which the Order Throttling Restriction is being applied by the LTS. The Traders are informed by Warnings about an impending Restriction.

The conditions which lead to the distribution of a Warning, application of a Restriction or release of a Restriction are defined by an Order Throttling Rule. Up to two distinct and independent Order Throttling Rules are configurable per each Member, one suitable for long periods (e.g. 24-hr) and one for short periods (e.g. 10s).

3.1 Load

For the needs of Order Throttling, the Load is understood as the number of OMTs which the non-CT Traders of the given Member have sent within a specific timeframe. The timeframe is formalized on the level of the Order Throttling Rule into the Observation Window (for details see Observation Window).

The counting of OMTs on the Member Level follows these rules:

OMT Message + Content	Rule	Comment

OMT Message + Content	Rule	Comment
Order Entry (OrdrEntry) Order Modification (OrdrModify) Order Activation (OrdrModify) Order Hibernation (OrdrModify) Order Deletion (OrdrModify)	Each OMT within the Message counted as 1 OMT irrespective whether the Message was accepted or rejected by the PMI Gateway due to OT Restriction	All valid as well as specific invalid OMT "attempts" are counted, whether they lead to actual new/modified orders or not: XSD Validation OMT messages (OrdrEntry, OrdrModify, ModifyAllOrdrs) which do not pass the XSD validation count as zero OMTs. XSD validation covers these rules: Structural rules 1) Incorrect element name (<OrderEntry> instead of <OrdrEntry>) 2) Missing mandatory element or field 3) Duplicated field (<Ordr side="BUY" side="BUY">) Data type rules 4) Incorrect field content data type (String "AAA" passed in an integer field) Zero OMT count is applied also in cases where there are one or more invalid OMTs in a basket OrdrEntry or OrdrModify. Basic Business logic validation Apart from the validation by the XSD schema, specific business logic validations apply on all OMT messages. In this validation the content of a field is checked against selected business logic rules (e.g. prod field is mandatory in case the contractId field is omitted in OrdrEntry, stopPx field is mandatory for stop limit order in OrdrEntry). OMT count for messages which do not pass the business logic validation is equal to one (regardless of the number of OMTs in the message)
Mass Activation (ModifyAllOrdrs) Mass Hibernation (ModifyAllOrdrs) Mass Deletion (ModifyAllOrdrs)	Counted as 1 OMT regardless of the number of Orders impacted.	
onThrottling action hibernations onDisconnect action hibernations	Not counted as part of the Load	

The Application ID sent by the Traders is used to distinguish the CT and non-CT Traders (for more detail on Application ID see DFS180 - M7 - Public Message Interface).

3.2 Order Throttling Rules

An Order Throttling Rule is defined by a set of parameters, some of them configurable by the Market Operators or Market Administrators. Two individual Order Throttling Rules can be configured on a Member, one suitable for a short observation interval, one for a long observation interval.

Parameter	Description	Configuration
Observation Window	The time frame within which the System evaluates the load (in OMT) generated by a Member	Admin / MOps
Bucket Size	The granularity of the Observation Window	System Operator
L1	OMT Threshold within the Observation Window (Warning, Tolerance initiation, Restriction Release time calculation)	Admin / MOps
L2	OMT Threshold within the Observation Window (Immediate Throttling)	Admin / MOps
Tolerance Period	The Length of the period for which load above L1 is tolerated without activation of Order Throttling	Admin / MOps
Cooldown	The minimum length of the period for which the Order Throttling Restriction is applied on a Member	Admin / MOps

For detailed information on the Order Throttling Configuration Screen in the WebGUI see MFG130 - M7 - Admin Manual for Market Operations WebGUI. Each parameter is explained in detail in a dedicated section below.

3.2.1 Observation Window

The Observation Window (interval in seconds) defines the period within which the system evaluates the load generated by individual Members.

The evaluation runs:

- with start of a new Bucket
- at pre-calculated times (Release Time, End of Tolerance) and
- with each arriving OMT

Depending on the result, changes of the Member Order Throttling Status are triggered. The Observation Window is not continuous, it is broken into discrete intervals (Buckets) and the total load in OMTs within these Buckets is used as the input into the Order Throttling evaluation.

3.2.2 Buckets

3.2.2.1 Size

The Bucket Size (interval in seconds) defines the granularity with which the System calculates the individual OMT Totals within the Observation Window. The Bucket Size is configurable by the System Operator and has a significant impact on the Order Throttling feature behaviour (e.g. with larger buckets, the calculated release times are more coarse). The default Bucket sizes are 1 second for the Short Rules and 900 seconds (15 minutes) for the Long Rules.

3.2.2.2 Boundaries

The boundaries of the bucket respect the Bucket size:

- the Short Rule Buckets start at XX:XX:XX.000 and end after XX:XX:XX.999
- the Long Rule Buckets start at XX:YY:00.000 and end after XX:YY+14:59.999 where YY denotes multiples of quarter hours (i.e. 00, 15, 30, 45)

Buckets of a given Order Throttling Rule never overlap.

3.2.2.3 Contents

The contents of a Bucket is the number of all OMTs received on the RabbitMQ broker from non-CT Traders of a given Member

between its Start and End boundaries. The Bucket does not contain records or references to individual OMTs, it only keeps the total number.

The total is either fixed (in those Buckets whose end time is already in the past) or subject to change with arrival of OMTs (in those Buckets whose start time is in the past but end time is in the future).

3.2.3 L1 and L2 OMT Thresholds

The L1 and L2 OMT Thresholds (number of total OMTs within the Observation Window) define the thresholds at which the Order Throttling Status changes are triggered on a Member.

3.2.3.1 L1 Threshold

The L1 defines the load which is sustainable for the given Member for a period no longer than the Tolerance. At reaching or exceeding of the L1 a Warning Order Throttling Status change is triggered and the Tolerance starts.

The L1 is also the threshold below which a Member's load needs to reduce before the Cooldown is initiated.

3.2.3.2 L2 Threshold

The L2 defines the load which is not sustainable for the given Member even momentarily. At reaching or exceeding of the L2 the Restriction Order Throttling Status change is triggered.

3.2.4 Tolerance

The Tolerance Period (interval in seconds) defines the period within which a continuous load at or above L1 by a Member is tolerated by the System. The Tolerance is initiated at the moment of reaching or exceedance of L1 by a Member and ends either:

- at a Moment the Load reduces below L1 within the Tolerance Period
- with the application of the Order Throttling on the given Member (either through L2 breach or continuous L1 breach beyond the Tolerance Period)

3.2.5 Cooldown

The Cooldown (interval in seconds) defines the minimum period which needs to fully pass after the Restriction has been applied on a Member before the Restriction is released. The Cooldown starts at the moment the load generated by a throttled Member got below the L1. This effectively means that a Member may very well be throttled for a period longer than the configured length of the Cooldown Period, if the load distribution is such that the load within the Observation Window is higher than L1 at the moment the Restriction is applied (for details see Restriction Release).

3.3 Order Throttling Status

3.3.1 Rule Status

The system evaluates the Order Throttling Rule conditions and assigns a Short Rule and Long Rule Status for each Member. These Statuses (No Restriction, Warning, Restricted) are known to both Traders and Admins and are used as an input for the assignment of the overall Member Status. The Rule Statuses provide detailed information about the Order Throttling conditions on individual Rules (e.g. in a scenario where the Warning on the Short Rule is issued whilst a parallel Warning on the Long Rule has been active).

3.3.2 Member Status

As the product of the individual Order Throttling Rule Statuses, Throttler assigns Order Throttling Status to a Member. The response of the PMI Gateway to an OMT Message (accept or reject) is governed by this Status.

At any given time, depending on the conditions, a Member is assigned one of the following Statuses:

Member Status	Effect	Conditions
Restricted	OMT rejection applies	Restricted Status on one or both Order Throttling Rules
Warning	No OMT rejection, the clients have been instructed the reduce the Load, Tolerance is running	Warning Status on one or both Order Throttling Rules Restricted Status on none
No Restriction	No OMT rejection, Standard Operation	No Restriction Status on both Order Throttling Rules

Individual OT Status Changes are described in detail below.

3.3.3 Warning

The Order Throttling Warning Status Change is triggered at the moment the L1 is reached or exceeded on a Rule. It is followed either by:

- the application of Order Throttling Restriction
    - if L2 is reached or exceeded within the Tolerance or
    - full Tolerance passes whilst Member's load remains continuously at or above L1
- or return to Standard Operation
    - When Member's load returns below L1 within the Tolerance

The End of the Tolerance is pre-calculated at the moment the Warning is triggered.

A warning message is broadcast via the API to the Traders of the offending Member. A Warning message is also distributed via the API to the Admins and Market Operators and an entry is displayed in the Message Panel of the Admin WebGUI.

For illustration see the figures below showing scenarios with both, Short and Long Rule Warnings.

3.3.3.1 Sample 1a - L1 Breach, Full Tolerance

The two scenarios below illustrate a full-length Tolerance, the first one on the Short Rule, the other on the Long Rule.
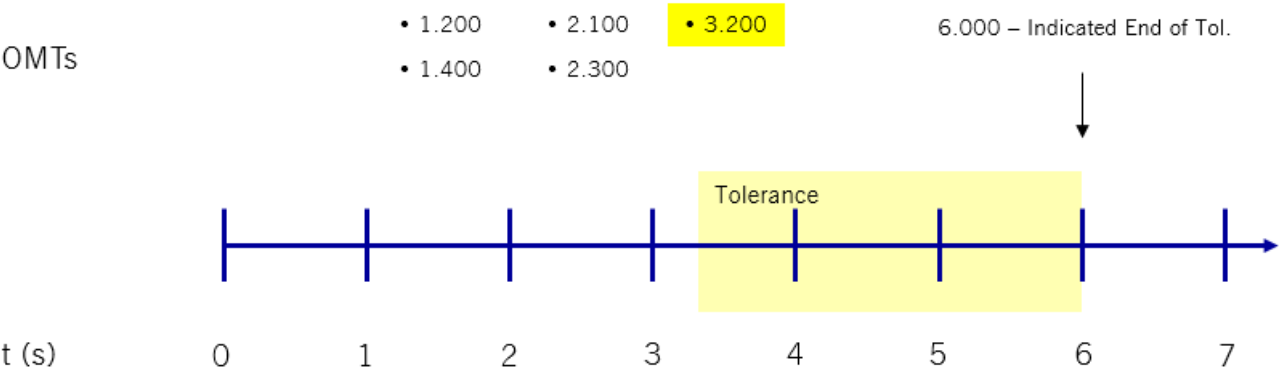
3.3.3.1.1 Sample 1a - Short Rule

Scenario configuration:

Parameter	Value
Observation Window	5 s
Tolerance Period	3 s
Cooldown Period	5 s
L1	5 OMTs
L2	10 OMTs

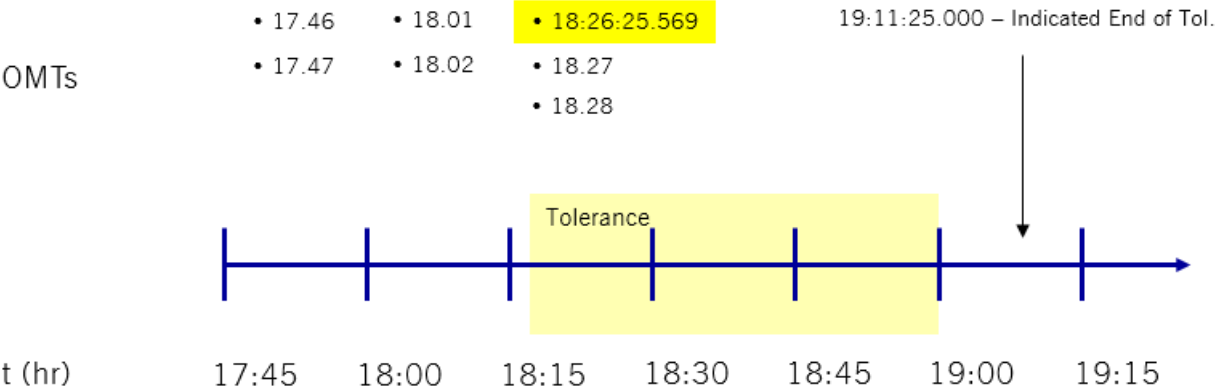| Parameter | Value |

Illustration:

In the diagram above:

- The Warning is triggered at 3.200 s when the load within the OW reaches the L1, the Tolerance starts
- The End of Tolerance is set at 6.000 s (3.200 s + Tolerance Period, rounded down to a full second for both Short and Long Rule)
- A Warning message containing this time is distributed
- No further OMTs are sent, the Tolerance ends at 6.000 s which is also the moment the Load got below L1, no Restriction is applied
- OMTs sent after the Tolerance ended do not trigger a new Warning until the load within the OW reaches L1 again
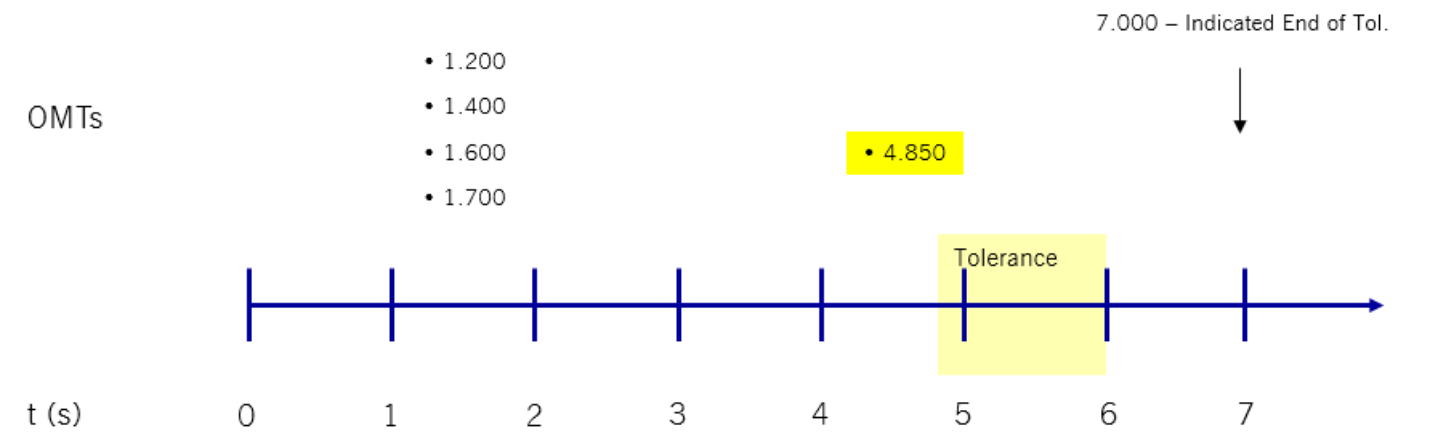
3.3.3.1.2 Sample 1a - Long Rule

Scenario configuration:

Parameter	Value
Observation Window	3600 s (1hr)
Tolerance Period	2700 s (45 min)
Cooldown Period	1800 s (30 min)
L1	5 OMTs
L2	10 OMTs

Illustration:

In the diagram above:

- The Warning is triggered at 18:26:25.569 when the load within the OW reaches the L1, the Tolerance starts
- The End of Tolerance is set at 19:11:25.000 (18:26:25.569 + Tolerance Period, rounded down to a full second for both Short and Long Rule)
- A Warning message containing this time is distributed
- Two more OMTs are sent
- The Tolerance ends at 19:00:00.000 which is also the moment the Load got below L1, no Restriction is applied
- OMTs sent after the Tolerance ended do not trigger a new Warning until the load within the OW reaches L1 again

3.3.3.2 Sample 1b - L1 Breach, Reduced Tolerance

To illustrate that the Tolerance may end before the full Tolerance Period passes see following two scenarios - one for the Short and one for the Long Rule.

3.3.3.2.1 Sample 1b - Short Rule

Scenario configuration:

Parameter	Value
Observation Window	5 s
Tolerance Period	3 s
Cooldown Period	5 s
L1	5 OMTs
L2	10 OMTs

Illustration:
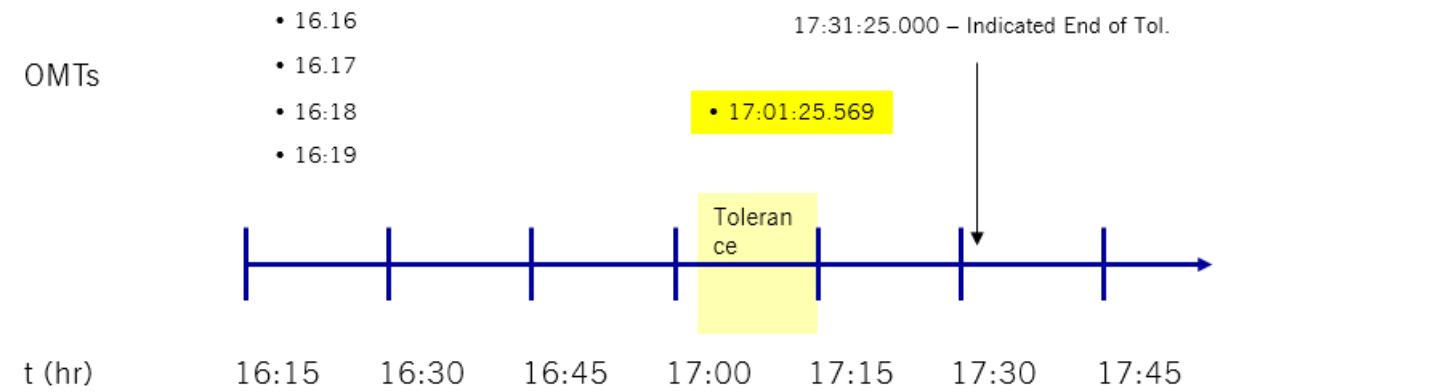
In the diagram above:

- The Warning is triggered at 4.850 s when the load within the OW reaches the L1, the Tolerance starts
- The End of Tolerance is set at 7.000 (4.850 + Tolerance Period, rounded down to a full second)
- A Warning message containing this time is distributed
- At 6.000 the load reduces below L1, the condition for Warning is not valid any more, Tolerance ends
- OMTs sent after the Tolerance ended do not trigger a new Warning until the load within the OW reaches L1 again

3.3.3.2.2 Sample 1b - Long Rule

Scenario configuration:

Parameter	Value
Observation Window	3600 s (1hr)
Tolerance Period	1800 s (30 min)
Cooldown Period	1800 s (30 min)
L1	5 OMTs
L2	10 OMTs

Illustration:

In the diagram above:

- The Warning is triggered at 17:01.25.569 when the load within the OW reaches the L1, the Tolerance starts
- The End of Tolerance is set at 17:31:25.000 (17:01.25.569 + Tolerance Period, rounded down to a full second)
- A Warning message containing this time is distributed
- At 17:15:00.000 the load reduces below L1, the condition for Warning is not valid any more, Tolerance ends
- OMTs sent after the Tolerance ended do not trigger a new Warning until the load within the OW reaches L1 again

3.3.4 Restriction Application

The Order Throttling Restriction is applied at the moment:

- the Tolerance on an Order Throttling Rule is fully exhausted by a Member whilst the load remained continuously at or above L1 or
- the load on an Order Throttling Rule reaches or exceeds L2 momentarily

After the Order Throttling Restriction has been applied, all OMTs sent by the non-CT Traders of a given Member are rejected by the PMI Gateway until the Restriction is released. In response to the OMTs they have sent, the affected Traders receive an Error Message with an explanation and an indication of the time when the Throttling Restriction would be released.

3.3.4.1 Treatment of multi-OMT messages

For OMT messages that contain multiple OMTs (e.g. basket order entries, Order modifications with multiple items), the Order Throttling applies once the given Throttling Rule condition is breached by the first OMT message whose content fully exceeds the given limit.

3.3.4.1.1 Example:

A basket with 30 Order Entries out of which 10 would already bring the Member over the L2 will be allowed through in full, Order Throttling will only apply to the next OMT Message which arrives.

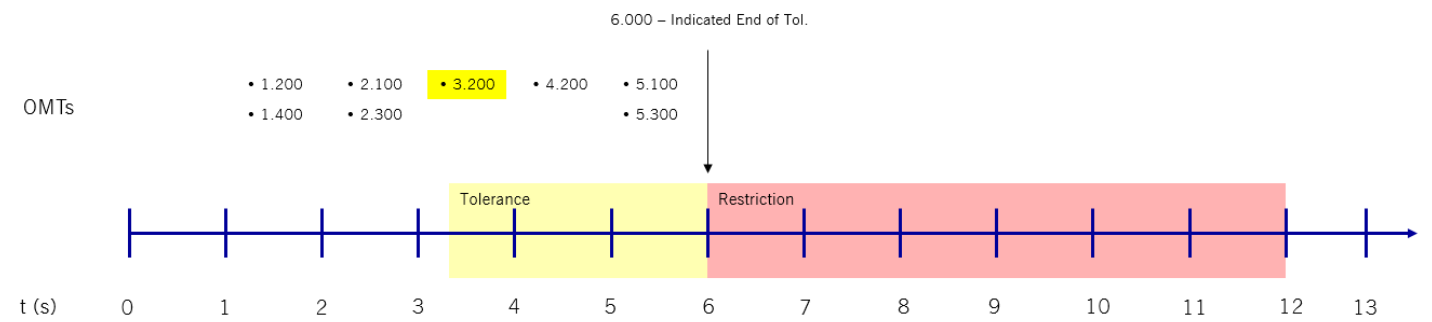### 3.3.4.2 Order Throttling Restriction - Illustrations

The scenarios below illustrate a typical application of a Restriction.

3.3.4.2.1 Sample 2a - Continuous L1 Breach, Short Rule

Scenario configuration:

Parameter	Value
Observation Window	5 s
Tolerance Period	3 s
Cooldown Period	5 s
L1	5 OMTs
L2	10 OMTs

Illustration:
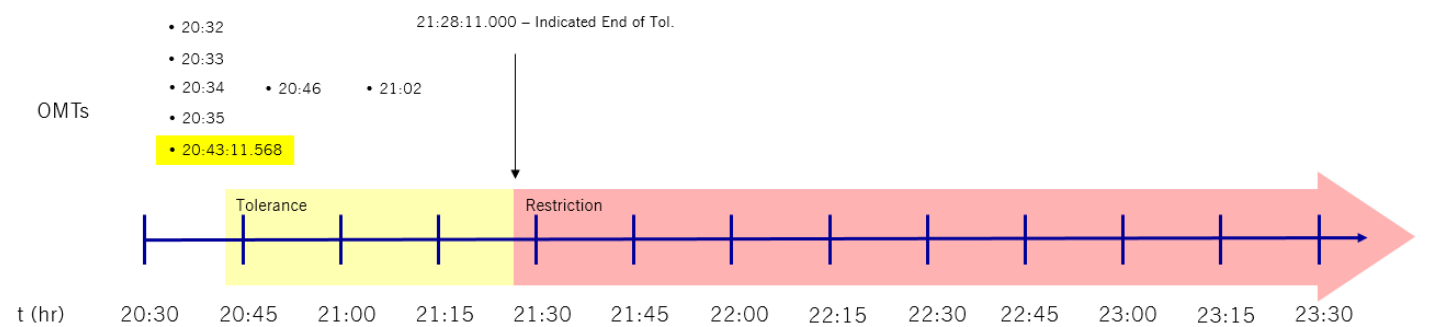
In the diagram above:

- The Warning is triggered at 3.200 s when the load within the OW reaches the L1
- The End of Tolerance is set at 6.000 s (3.200 s + Tolerance Period, rounded down to a full second)
- The load remains above L1 continuously until the End of Tolerance. The load never exceeds L2.
- The Restriction is applied at a 6.000 where the regular check runs, the Restriction Release is calculated at 12.000 as the load gets below L1 only at 7.000 (for details see Restriction Release)

3.3.4.2.2 Sample 2a - Continuous L1 Breach, Long Rule

Scenario configuration:

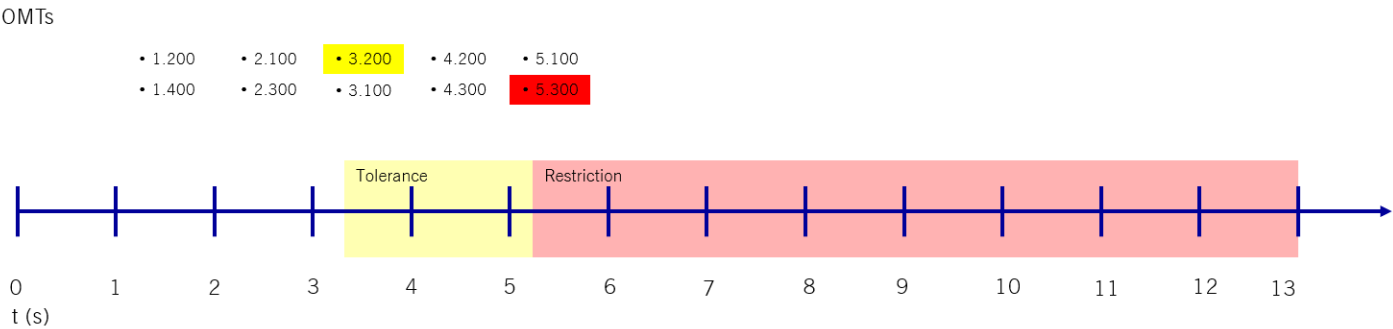| Parameter	Value
Observation Window	3600 s (1hr)
Tolerance Period	2700 s (45 min)
Cooldown Period	14400 s (4 hrs)
L1	5 OMTs
L2	10 OMTs

Illustration:

In the diagram above:

- The Warning is triggered at 20:43:11.568 s when the load within the OW reaches the L1
- The End of Tolerance is set at 21:28:11.000 (20:43:11.568 + Tolerance Period, rounded down to a full second)
- The load remains above L1 continuously until the End of Tolerance. The load never exceeds L2.
- The Restriction is applied at a 21:28:11.000 where the regular check runs, the Restriction Release is calculated at 01:30:00.000 as the load gets below L1 only at 21:30:00.000 (for details see Restriction Release)

3.3.4.2.3 Sample 2b - L2 Breach, Short Rule

Scenario configuration:

| Parameter	Value
Observation Window	5 s
Tolerance Period	3 s
Cooldown Period	5 s
L1	5 OMTs
L2	10 OMTs

In the diagram above:

- The Warning is triggered at 3.200 s when the load within the OW reaches the L1
- The End of Tolerance is set at 6.000 s (3.200 s + Tolerance Period, rounded down to a full second)
- The Traders of the Member keep generating load which reaches L2 within the Tolerance Period
- The Restriction is applied at a 5.300, the Restriction Release is calculated at 13.000 as the load gets below L1 only at 8.000 (for details see Restriction Release)

3.3.4.2.4 Sample 2b - L2 Breach, Long Rule

Scenario configuration:

Parameter	Value
Observation Window	3600 s (1hr)
Tolerance Period	2700 s (45 min)
Cooldown Period	14400 s (4 hrs)
L1	8 OMTs
L2	10 OMTs

Illustration:
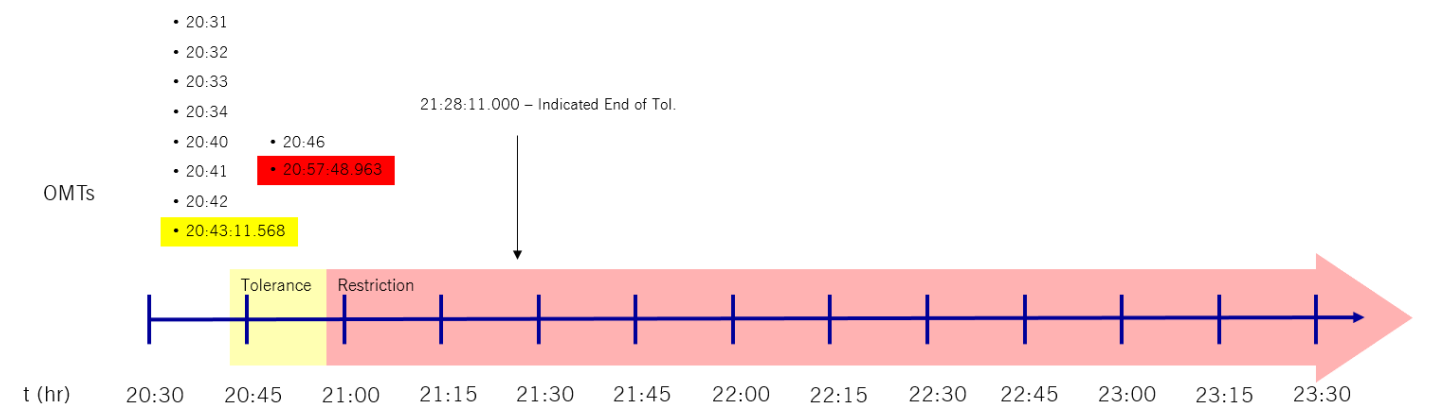
In the diagram above:

- The Warning is triggered at 20:43:11.568 when the load within the OW reaches the L1
- The End of Tolerance is set at 21:28:11.000 s (20:43:11.568 + Tolerance Period, rounded down to a full second)
- The Traders of the Member keep generating load which reaches the L2 within the Tolerance Period
- The Restriction is applied at a 20:57:48.963, the Restriction Release is calculated at 01:30:00.000 as the load gets below L1 only at 21:30:00.000 (for details see Restriction Release)

3.3.5 Restriction Release

The Order Throttling Restriction is released at the moment the Cooldown configured on the given Order Throttling Rule fully passes. The Release time gets flexibly extended if the Traders of the given Member do not reduce the load they are generating below L1.

3.3.5.1 Release Time Calculation and Postponement

Once the Order Throttling Restriction is applied and OMTs from non-CT Traders of a given Member start being rejected a period of low activity needs to pass before the Restriction is released.

The length of this period depends on two factors:

- the length of the Cooldown Period and
- the time needed from the start of the Restriction until the load generated by the non-CT Traders of that Member gets below L1 (Replenish Time)

As the Cooldown is always initiated at a Bucket boundary (e.g. 13:06:15.000 on the Short Rule with 1 second Buckets or 13:15:00.000 on the Long Rule with 15 minute Buckets) and the Cooldown granularity respects Bucket size, the Order Throttling Restriction release times are also always lined up with Bucket boundaries.

The Release time calculation algorithm is common for both, Short and Long Rule.

The release time calculation is summarized below:

1. On a trigger (a Throttling Restriction application or arrival of a new OMT whilst throttled), the algorithm seeks the earliest moment the Load gets below L1
2. The Cooldown is then added to this time to find the Order Throttling Restriction Release Time

### 3.3.5.1.1 Illustration of the Release Time Calculation

The Release Time calculation is illustrated on a set of examples with common entry conditions and a sample configuration

shown below. As the calculation is the same for Long and Short Rule, the samples abstract from actual Bucket sizes (e.g. 1 s and 15 minutes) and replace them with a "unit". For clarity, the reference OW is marked green.

Sample configuration:

Parameter	Value
Observation Window	3 units
Tolerance Period	3 units
Cooldown Period	5 units
L1	5 OMTs
L2	7 OMTs

Entry conditions:
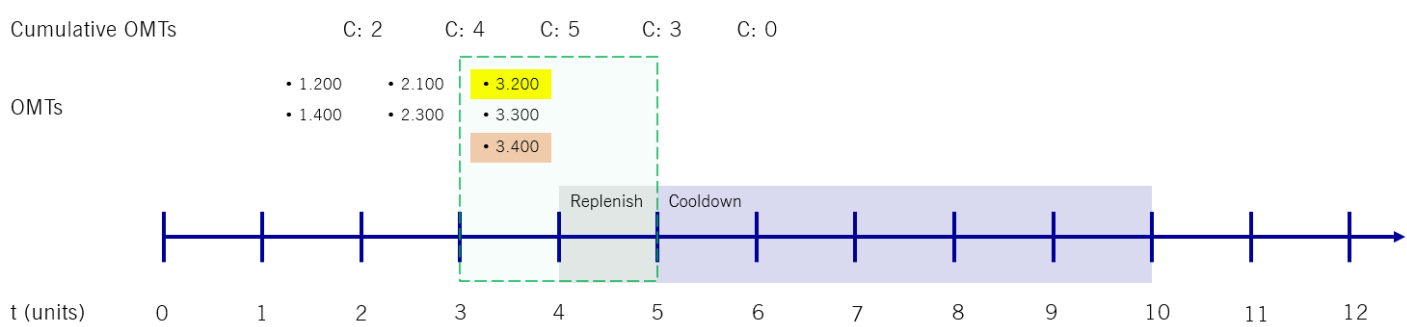
The samples below have all the same entry conditions:

1. A Warning is issued at 3.200 units (marked yellow)
   - Explanation: The load within the OW reached L1
2. The Order Throttling Restriction is applied at 3.400 units (marked orange)
   - Explanation: The load within the OW reached L2
3. Indicative Release Time provided in the Status message is set at 10.000 units
   - Explanation:
     - At 5.000 the Load reduces below L1, cooldown starts
     - The Cooldown ends at 10.000 (the start of the Cooldown + the Length of the Cooldown Period)

The individual samples illustrate how the Release Time would be recalculated depending on the activity on the given Member whilst being restricted.

Case 1

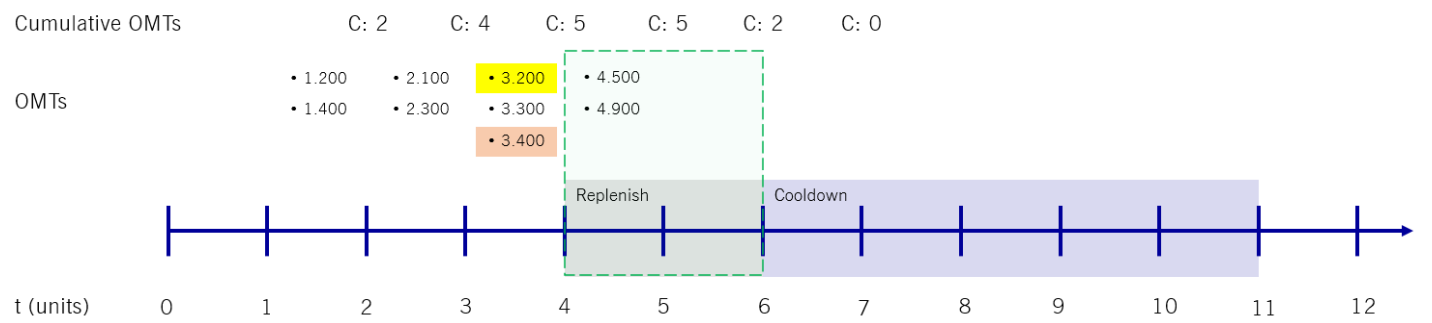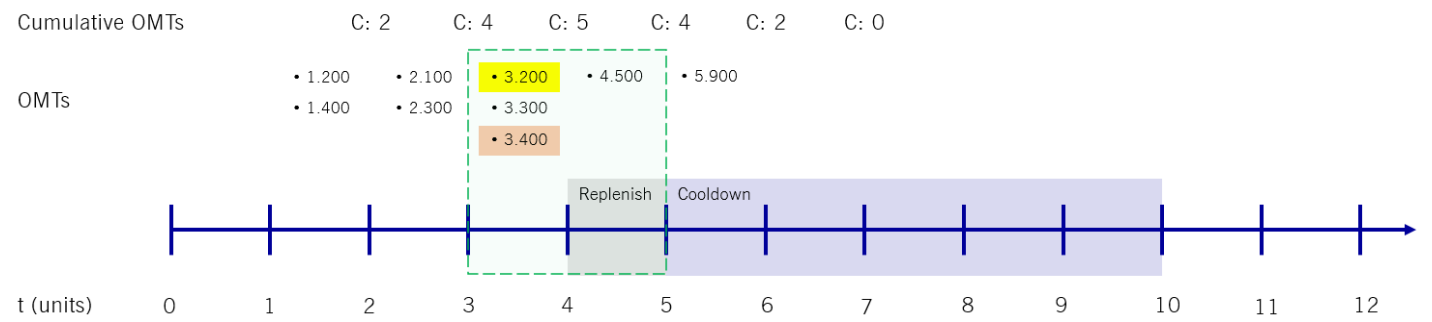In the diagram below, an additional OMT was received at 4.500:
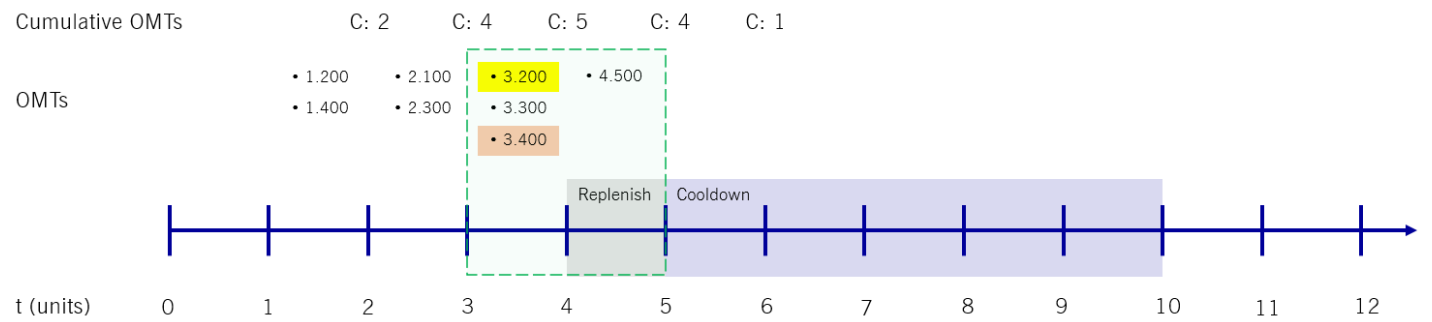
Comments:

- The release time is recalculated with the reception of an OMT.
- The actual release time recalculated with the last OMT (received at 4.500) is 10.000.
- In this case it is the same as the indicated release time, the moment the Load reduces below L1 remains at 5.000

Case 2

In the diagram below, additional OMTs were received at 4.500 and 4.900:

Comments:

- The release time is recalculated with the reception of each OMT.
- The actual release time recalculated with the last OMT (received at 4.900) is 11.000.
- In this case it differs from the indicated release time, the moment the Load reduces below L1 moves to 6.000.

Case 3

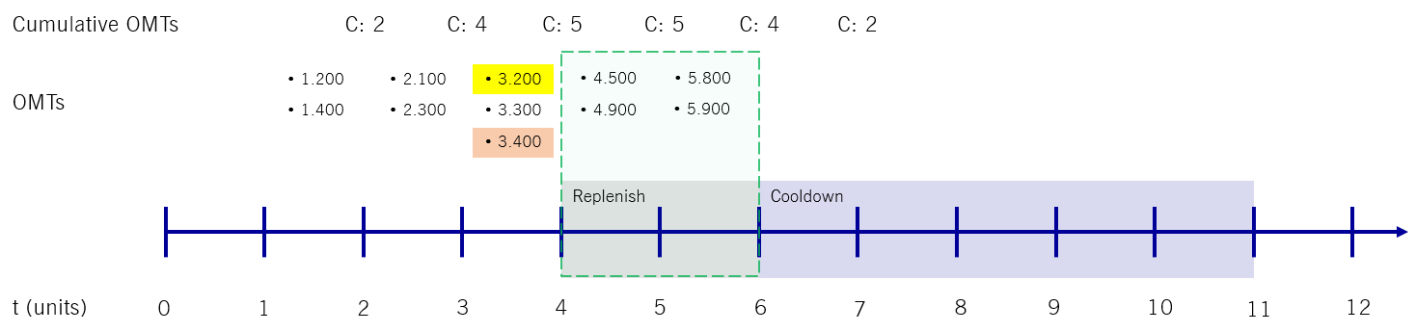In the diagram below, additional OMTs were received at 4.500 and 5.900:

Comments:

- The release time is recalculated with the reception of each OMT.
- The actual release time recalculated with the last OMT (received at 5.900) is 10.000.
- In this case it is the same as the indicated release time, the moment the Load reduces below L1 remains at 5.000

Case 4

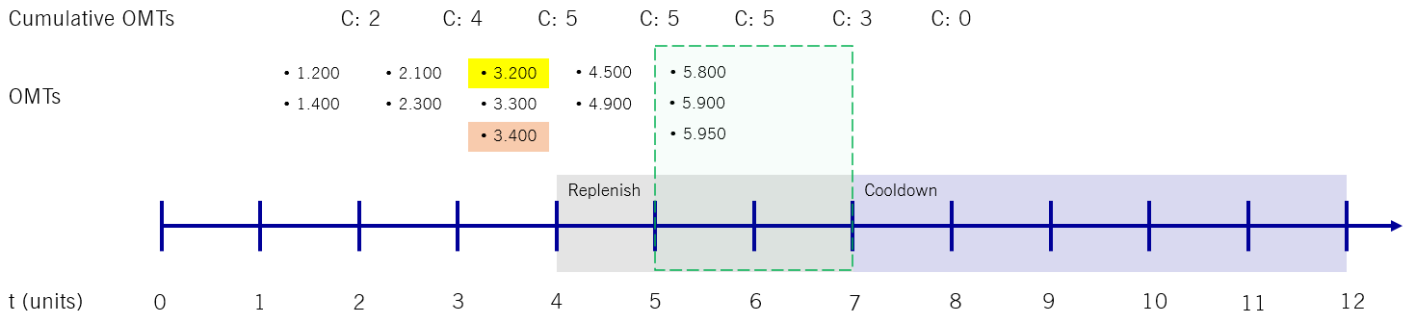In the diagram below, additional OMTs were received at 4.500, 4.900, 5.800 and 5.900:

Comments:

- The release time is recalculated with the reception of each OMT.
- The actual release time recalculated with the last OMT (received at 5.900) is 11.000.
- In this case it differs from the indicated release time, the moment the Load reduces below L1 moves to 6.000.

Case 5

In the diagram below, additional OMTs were received at 4.500, 4.900, 5.800, 5.900 and 5.950:

Comments:

- The release time is recalculated with the reception of each OMT.
- The actual release time recalculated with the last OMT (received at 5.950) is 12.000.
- In this case it differs from the indicated release time, the moment the Load reduces below L1 moves to 7.000.

4 Order Throttling Status Information

4.1 Order Throttling Status Inquiry

The Traders of a Member are able to retrieve the information on the status of the Order Throttling via the API in order to monitor and manage the amount of OMTs they generate. An inquiry request (ThrottlingStatusReq) on the Order Throttling status on a Member is available with a response (ThrottlingStatusResp) providing Status and Configuration information for each individual Throttling Rule.

Status Information:

- Member Order Throttling Status
- Short and Long Rule Order Throttling Status
- Indicative Throttling Release Time (if Restriction Status applies on a Rule) or End of Tolerance (if Warning Status applies on a Rule) for each Rule
- Information on Load (OMT within a specified Observation Window)

Configuration Information:

- L1 and L2 Thresholds
- Observation Window
- Tolerance
- Cooldown

For more details on the Request and Response messages see DFS180 - M7 - Public Message Interface

Complete with the data received from the OrderExeRprt broadcasts client applications can implement tools which allow monitoring of the headroom available. This approach can be used to reduce the amount of Inquiry Requests the client applications send.

Depending on the Order Throttling Status of the Member, the information contained in the response to the Order Throttling Status Request either contains Load data (OMT counts):

- valid at the moment of the processing of the request (valid for Members not in Restricted Status) or
- valid at the moment of the Member Status Change to Restricted or calculated with arrival of the most recent OMT (depending on which of these two events came later)

Diagrams below provide an insight into the logic and illustrate the fact that the calculation by individual Trader clients can only be done on the Balancing Group level.

4.1.1 Illustrative Diagrams

The potential combined usage of the Throttling Status information and the OrderExeRprt broadcasts by a Trader client application is captured in the diagrams below in samples of:

- two traders from the same BG of the same Member and
- three traders from two different BGs of the same Member

sending OMTs and receiving OrderExeRprt broadcasts and calculating current Order Throttling status based on the response provided to the Throttling Status inquiry in the past.

Both Samples assume following configuration:

Parameter	Value	Comment
L1	20 OMTs	for details see L1 and Warning
Observation Window	10 s	for details see Observation Window and Bucket

The Samples abstract from listing other Parameters as they are not necessary for the illustration.

The Samples illustrate the scenario of a Trader client application calculating the number of OMTs remaining before the L1 would be exceeded (called Headroom) at two separate moments when:

- the Status information is received and
- 3 seconds have passed since the last Status information has been received at a steady trading activity on a given Member
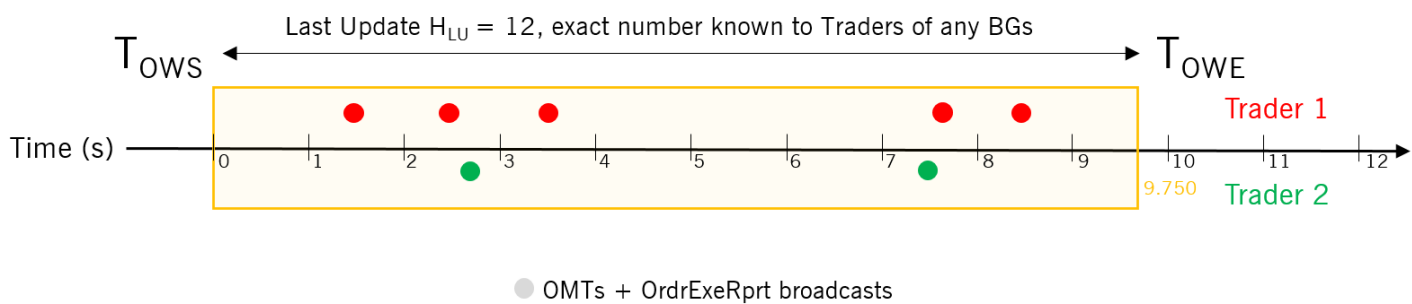
4.1.1.1 Sample 1 - One Member, One BG, Two Traders

In the first sample, there are two Traders on a given Member, both belong to the same Balancing Group (BG).

Sample Reference Data Setup:
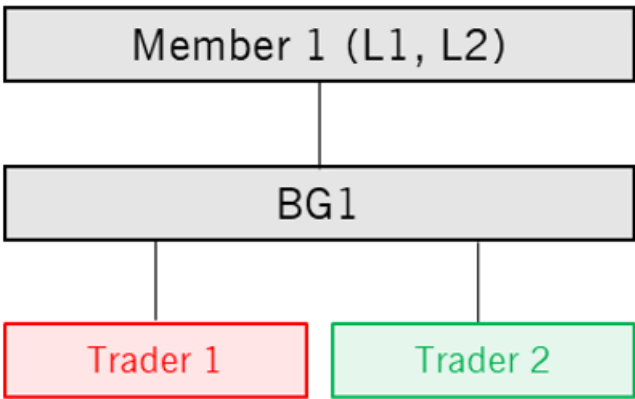
At the beginning (at point 9.750 s), the Headroom (H_{LU}) calculated at the reception of the Order Throttling Status update is 12 (L1: 20 => 19 is the full Headroom - 7 OMTs within the OW)

OMTs + OrdrExeRprt broadcasts

After 3 seconds (at point 12.750 s) the Observation Window moved ahead, so now it starts at point 3.000 s and ends at point 12.750 s. 3 OMTs fell out of the Observation Window, a total 2 new OMTs were added by Trader 1 and Trader 2. The Headroom at current time (H_C) is 13 (L1: 20 => 19 is the full Headroom - 6 OMTs within the OW reconstructed from the OrdrExeRprt broadcasts)
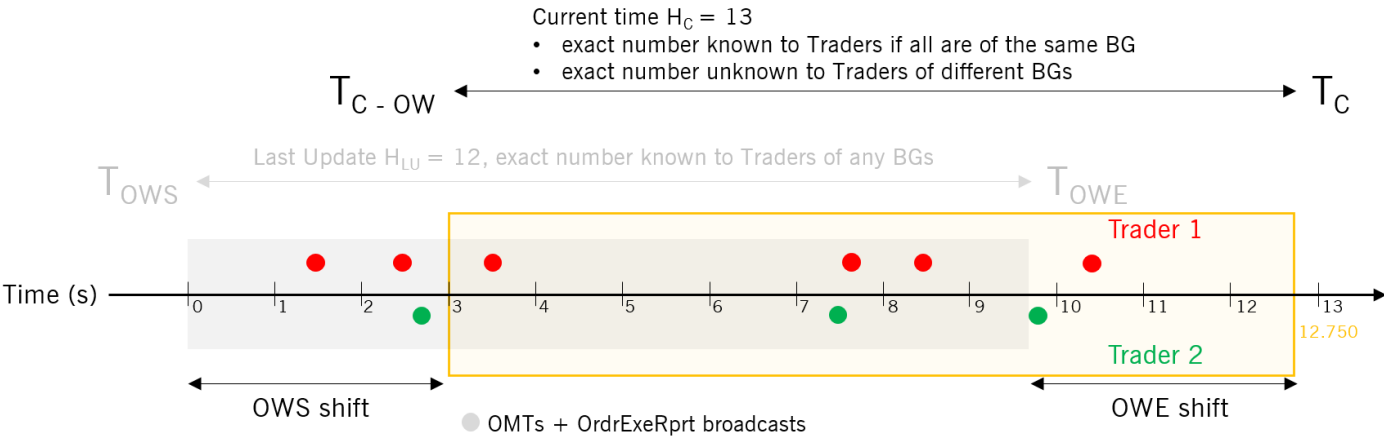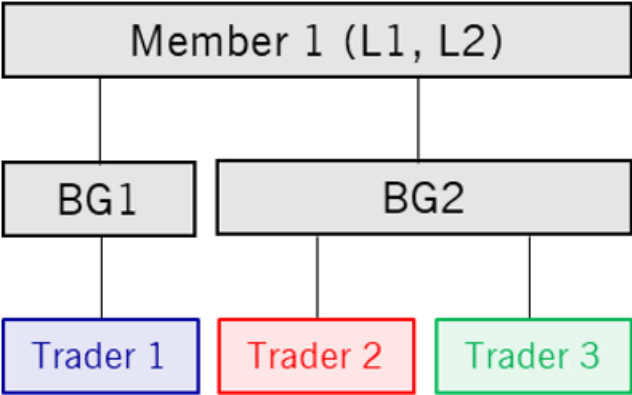
The calculation below shows the steps the client application of a given Trader would perform to find out current Order Throttling Status without sending a new Order Throttling Status Request.

L1: 20 OMTs (max. 19 OMTs before a Warning is triggered)
Observation Window: 10 s

Momentary Headroom (H_*)
H_{LU} ($s_{0.000} - s_{9.750}$): 12 OMTs (19 − (5 + 2))
H_C ($s_{3.000} - s_{12.750}$): 13 OMTs (19 − (4 + 2))

$H_{C[Trader\ X]}$: H_{OE} + (total ΔOMT with OWS shift) − (total ΔOMT with OWE shift)
Respective Δ for a BG calculated on client's side using OrdrExeRpts

$H_{C[Trader\ 1,\ Trader\ 2]}$: 12 + (2 + 1) − (1 + 1) OMTs

4.1.1.2 Sample 2 - One Member, Two BGs, Three Traders

In the second sample, there are three traders on a given Member, they each belong to one of the two BGs configured on that Member.

Sample Reference Data Setup:

At the beginning (at point 9.750 s), the Headroom (H_{LU}) calculated at the reception of the Order Throttling Status update is 6 (L1: 20 => 19 is the full Headroom - 13 OMTs within the OW)
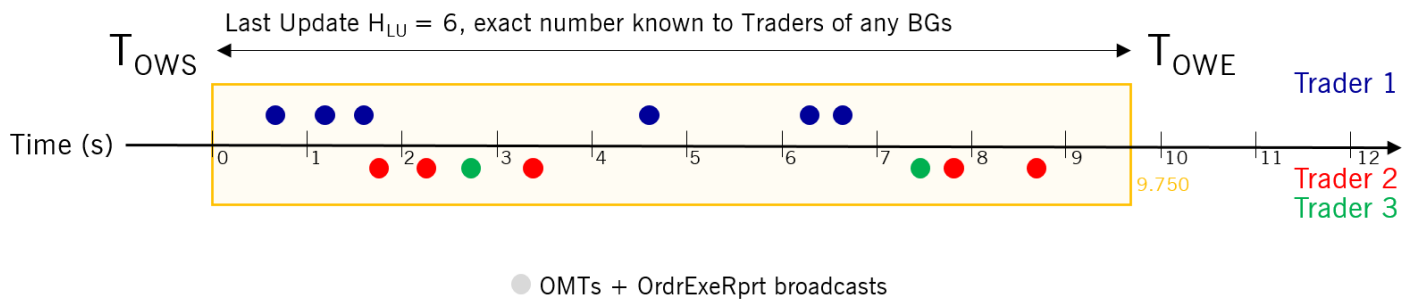
OMTs + OrdrExeRprt broadcasts

After 3 seconds (at point 12.750 s) the Observation Window moved ahead, so now it starts at point 3.000 s and ends at point 12.750 s. 6 OMTs fell out of the Observation Window, a total 4 new OMTs were added by Trader 1, Trader 2 and Trader 2. The Headroom at current time (H_C) is 8 (L1: 20 => 19 is the full Headroom - 11 OMTs within the OW reconstructed from the OrdrExeRprt broadcasts)
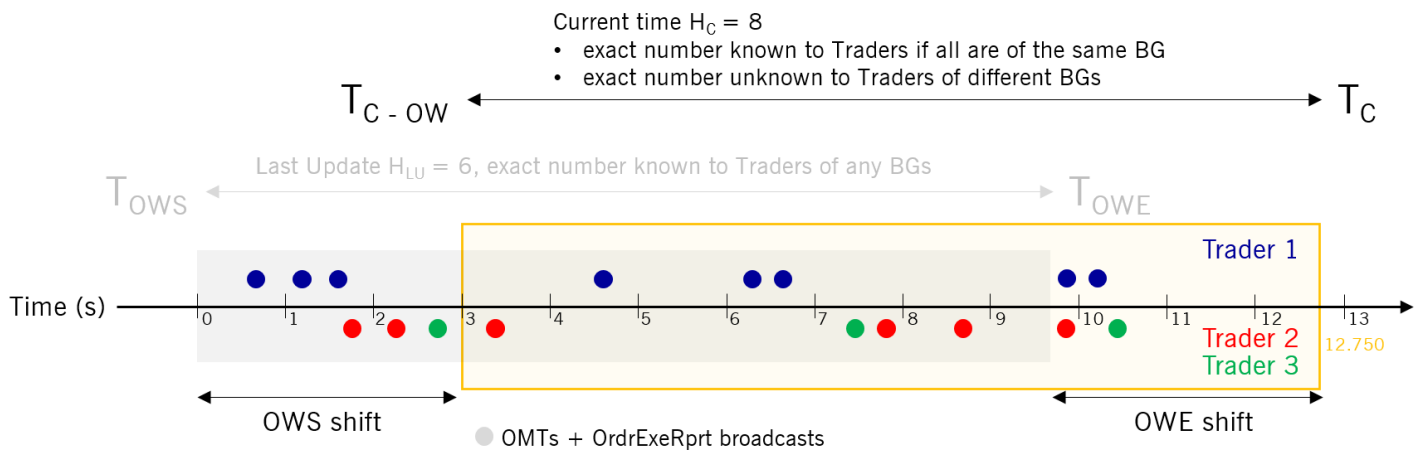
OMTs + OrdrExeRprt broadcasts

The calculation below shows the steps the client application of a given Trader would perform to find out current Order Throttling Status without sending a new Order Throttling Status Request. In the case of Members with Multiple BGs with each containing an active Trader, the validity of the calculated result would be limited.

L1:	20 OMTs (max. 19 OMTs before a Warning is triggered)
Observation Window:	10 s

Momentary Headroom (H_*)

H_{LU} ($s_{0.000} - s_{9.750}$):   6 OMTs ($19 - (6 + 5 + 2)$)

H_C ($s_{3.000} - s_{12.750}$):   8 OMTs ($19 - (5 + 4 + 2)$)

$H_{C[Trader X]}$: H_{OE} + (total ΔOMT with OWS shift) – (total ΔOMT with OWE shift)
Respective Δ for a BG calculated on client's side using OrdrExeRpts

$H_{C[Trader 1]}$: $6 + (3 + y_1 + z_1) - (2 + y_2 + z_2)$ OMTs
y and z components unknown

$H_{C[Trader 2]}$: $6 + (x_1 + 2 + 1) - (x_2 + 1 + 1)$ OMTs
$H_{C[Trader 3]}$: $6 + (x_1 + 2 + 1) - (x_2 + 1 + 1)$ OMTs
x component unknown

4.2 Status Broadcasts and WebGUI Information Messages

The information on the Order Throttling events is provided to Traders (via API Messages) and Admins (via CT and Admin / MarketOps WebGUI).

For details of individual messages see DFS200 Messages.

4.2.1 Traders

The Traders receive informative broadcasts via the API with Order Throttling Status Changes registered on their Member.

The messages contain following items:

- Member Identification
- Order Throttling Member Status
- Order Throttling Short Rule Status
- Order Throttling Long Rule Status
- Timestamp of the change
- Indicative time of Order Throttling Restriction Release (if Rule Status is Restricted) or Indicative time of Order Throttling Tolerance Period end (if Rule Status is Warning)
- Identification of the User who sent the relevant OMT
- Identification (ClientCorrelationID) of the last OMT accepted (for the Order Throttling Restriction applied message)

4.2.2 Market Operators and Admins

The Admins and Market Operators receive informative Broadcasts and WebGUI messages with Order Throttling Status Changes on any Member.

The messages contain following items:

- Member Identification
- Order Throttling Member Status
- Order Throttling Short Rule Status
- Order Throttling Long Rule Status
- Timestamp of the change
- Indicative time of Order Throttling Restriction Release (if Rule Status is Restricted) or Indicative time of Order Throttling Tolerance Period end (if Rule Status is Warning)
- Identification of the User who sent the relevant OMT
- Identification (ClientCorrelationID) of the last OMT accepted (for the Order Throttling Restriction applied message)

The Order Throttling Information Messages are shown in the Message Panel of the CT to the Admins and Market Operators (for more information see MFG120). In the WebGUI, the Public Messages panel is used (for more information see MFG130).

5 Order Action on Order Throttling Restriction

To allow basic control over the open Orders in the Orderbook (OBK) at the moment the Order Throttling is applied, a Trader may specify at the moment of logging into the session the Order action to be taken. For this the Login Request (LoginReq, see DFS180) includes two optional fields describing whether Order hibernation shall be applied to the Orders in the OBK in case the Order Throttling Restriction is applied on the Member the Trader belongs to. One parameter specifies the User-level action, the other the Member-level action.

The Order Action Codes (broadcast in the OrdrExeRprt, see DFS180 and provided in the Reports, see DFS190) of the Order hibernation resulting from the application of Order Throttling are consistent with the hibernation resulting from the disconnect action:

- for local Orders, the resulting action is UHIB (Order deactivated by the user)
- for remote Orders it is SHIB (Order deactivated by the system)

Following values are accepted in the respective User-level (onThrottlingActionUser) and Member-level (onThrottlingActionMember) fields of the Login request.

5.1 Member-level actions

This field specifies the general Order action on the whole Member. The Trader who last logged in and filled in the field defines what the Member-level action will be.

| Value	Explanation
NONE_MBR_ORDERS	Sets no action to be applied on any Orders in the OBK belonging to the User's Member in case OT is applied. Individual User-level actions apply.
HIBE_MBR_ORDERS	Sets Order hibernation action to be applied on any Orders in the OBK belonging to the User's Member in case OT is applied. Overrides individual User-level actions.

5.2 User-level actions

This field specifies the Order action on the Orders owned by the Trader or its BG. In case HIBE_MBR_ORDERS is active, its value overrides any User-level action specified.

Value	Explanation
NONE_USER_ORDERS	Sets no action to be applied on any Orders in the OBK belonging to the User. If the Member-level onThrottling action has been set to HIBE_MBR_ORDERS, Orders are hibernated
HIBE_USER_ORDERS	Hibernate User's Own Orders on Order Throttling.
HIBE_BG_ORDERS	Hibernate Trader BG's Orders on Order Throttling.

5.3 Illustration

All potential combinations of settings of the onThrottling action and the resulting actions are illustrated in the diagram below:
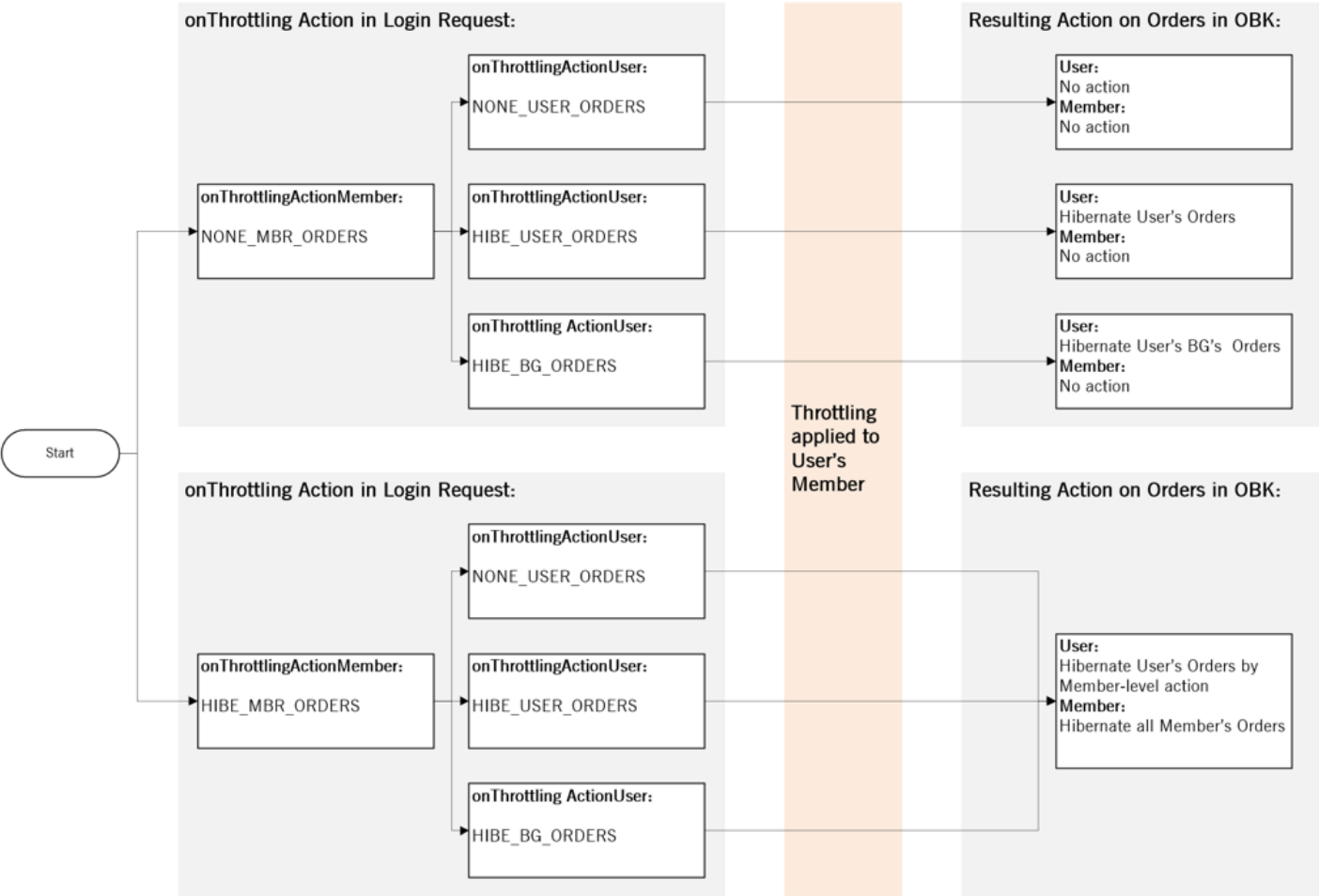
6 Order Throttling Reports

The Order Throttling feature is supplemented by a report which provides the Market Operators and Admins with the information on individual Order Throttling Status Changes (events) in a chronological order and with the specification of the affected Member. The report is available in the .csv format from the Order Throttling Configuration Screen (for more details see MFG130 - M7 - Admin Manual for Market Operations WebGUI).

The data in the report are available for the period of the past 15 days from the moment of generation. The 15-day timeframe is precise, no allowance for Trading Day cycle is provided (e.g. report generated on 17th Oct 2021 at 16:03:52 will provide data starting from 2nd Oct 2021 16:03:52).

The filename of the .csv containing the Report follows this pattern: "ESU_Report_ _.csv" where the Start and End dates are provided in the YYYYMMDD format.

The report includes following columns:

Column	Explanation
member	The Member ID of the Member affected by the Order Throttling Event
eventTimestamp	Timestamp of the event in ISO 8601, precise to a second
orderThrottlingEvent	Member Order Throttling Status
shortRuleStatus	The Short Rule Order Throttling Status
longRuleStatus	The Long Rule Order Throttling Status

For each Member, the Report includes also the starting "NO_RESTRICTION" entry which corresponds to the time the Throttler component was initialized, if this event happened within the 15-day timeframe.

Using the samples from sections above, following report excerpts illustrate common scenarios.
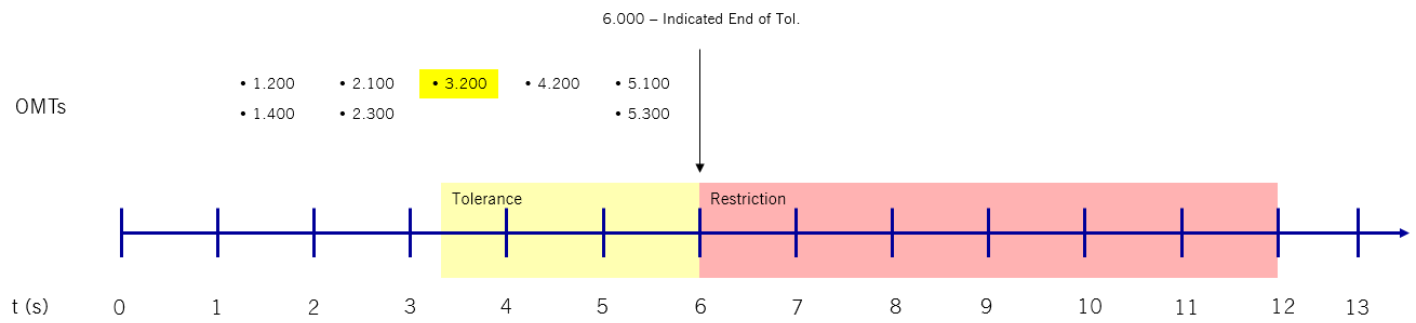
6.1 Sample 1 - Triggered Short Rule Warning
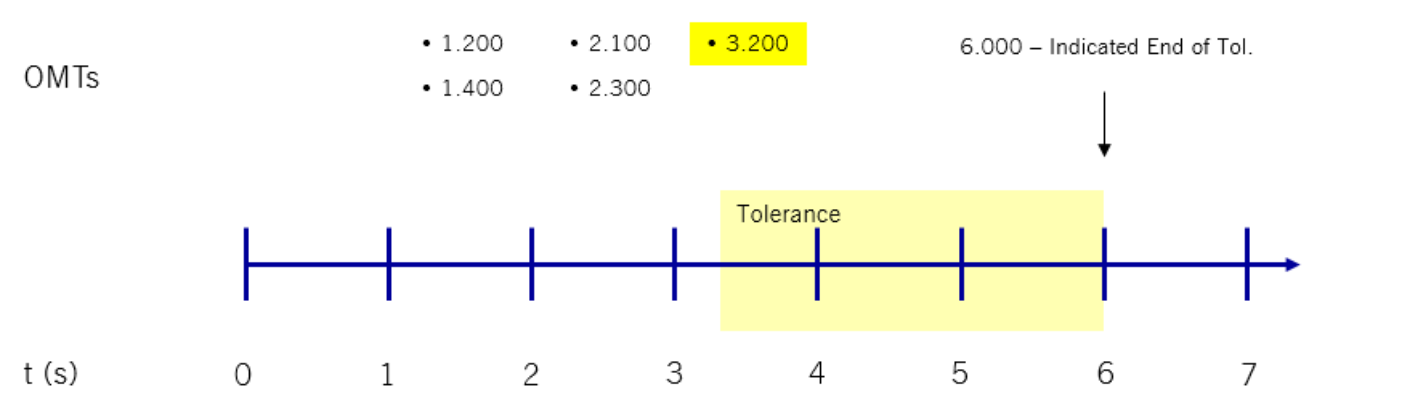
The Order Throttling Report would contain following entries:

member	eventTimestamp	orderThrottlingEvent	shortRuleStatus	longRuleStatus
MBR01	2021-09-17T03:12:19	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION
MBR01	2021-09-30T16:10:03	WARNING	WARNING	NO_RESTRICTION

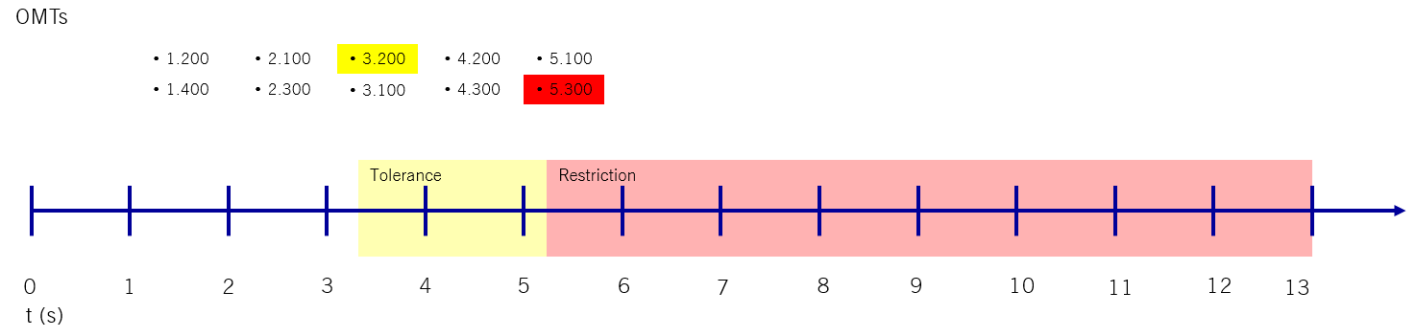| member	eventTimestamp	orderThrottlingEvent	shortRuleStatus	longRuleStatus
MBR01	2021-09-30T16:10:06	NO_WARNING	NO_RESTRICTION	NO_RESTRICTION

6.2 Sample 2 - Exhausted Short Rule Tolerance

The Order Throttling Report would contain following entries:

member	eventTimestamp	orderThrottlingEvent	shortRuleStatus	longRuleStatus
MBR01	2021-09-17T03:12:19	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION
MBR01	2021-09-30T16:10:03	WARNING	WARNING	NO_RESTRICTION
MBR01	2021-09-30T16:10:06	RESTRICTED	RESTRICTED	NO_RESTRICTION
MBR01	2021-09-30T16:10:12	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION

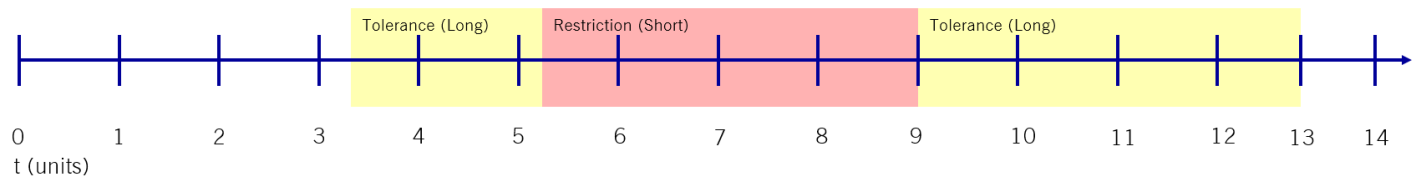## 6.3 Sample 3 - L2 Short Rule Breach

The Order Throttling Report would contain following entries:

member	eventTimestamp	orderThrottlingEvent	shortRuleStatus	longRuleStatus
MBR01	2021-09-17T03:12:19	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION
MBR01	2021-09-30T16:10:03	WARNING	WARNING	NO_RESTRICTION
MBR01	2021-09-30T16:10:05	RESTRICTED	RESTRICTED	NO_RESTRICTION
MBR01	2021-09-30T16:10:13	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION

6.4 Sample 4 - Long Rule Warning interrupted by a Short Rule Restriction

The diagram below illustrates a scenario in which a Tolerance on the Long Rule is started and then a rapid L2 breach occurs through a Basket Order Entry on the Short Rule which leads to the application of Restriction. The Tolerance on the Long Rule however continues uninterrupted and once the Short Rule Restriction is released, the Member gets back to the Warning state.

OMTs / Comments

The Order Throttling Report would contain following entries:

member	eventTimestamp	orderThrottlingEvent	shortRuleStatus	longRuleStatus
MBR01	2021-09-17T03:12:19	NO_RESTRICTION	NO_RESTRICTION	NO_RESTRICTION
MBR01	2021-09-30T16:10:03	WARNING	NO_RESTRICTION	WARNING
MBR01	2021-09-30T16:10:05	RESTRICTED	RESTRICTED	WARNING
MBR01	2021-09-30T16:10:09	WARNING	NO_RESTRICTION	WARNING
MBR01	2021-09-30T16:10:13	NO_WARNING	NO_RESTRICTION	NO_RESTRICTION

7 Protective Suspension

Protective Suspension is applied when the OMT Message load a non-CT API Trader generates reaches a specified Threshold (Protective Suspension Threshold). In contrast to the Order Throttling where Member-level OMT rejection is applied, the offending Users are disconnected from the RabbitMQ broker and suspended when the Protective Suspension is triggered.

There is no automatic User status switch in place, the Users on which the Protective Suspension was applied must be manually reactivated by the Admins. The Admins receive a Warning in CT as well as WebGUI in case the Protective Suspension was applied on a User.

The Protective Suspension mechanism monitors only one metrics - the number of OMT Messages generated by a User within the past second. There is also only one Threshold in place, Protective Suspension is applied immediately once the Protective Suspension Threshold is reached, there are no Warnings nor any form of Tolerance.

7.1 Protective Suspension - Illustration

For illustration see the figures below based on a sample configuration:

Parameter	Value
Observation Window	5 s
Tolerance Period	3 s
L1	5 OMTs
L2	10 OMTs
Protective Suspension Threshold	1000 OMT Messages /s

The Protective Suspension is applied when an OMT Message arrives with which the OMT Message total count from the start of the given second reaches the Protective Suspension Threshold.
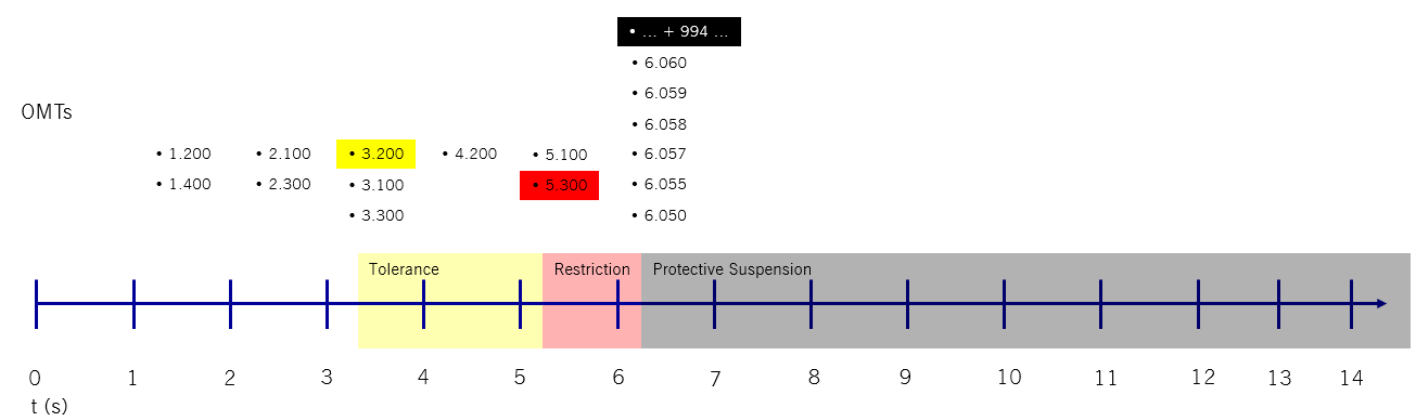
In the diagram above:

- The standard conditions are observed until the start of the 6th second, after that point the load suddenly dramatically increases
- As soon as the number of OMT Messages reaches 1000 between 6 s and 7 s marks, the Protective Disconnect is applied. The offending User is disconnected from the RabbitMQ Broker and suspended. No further OMTs (or other messages) can be sent until the Admin takes a manual action and activates the User.