Margin Trading - WebSocket Private-data Update Messages for Borrowers

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> More information on WebSocket can be found here -
>
> V1: https://api.exchange.bullish.com/docs/api/rest/trading-api/v1/#overview--websockets
>
> V2: https://api.exchange.bullish.com/docs/api/rest/trading-api/v2/#overview--websockets

Goal

The goal of this document is to describe the **update messages** published to WebSocket's **Private Data topics** specific to **Margin Trading in Bullish** for **Borrowers**.

It also details how the numbers in each topic can be reconciled against one another.

Scope

Private Data Updates Only

In general, WebSocket Messages can be divided into the below categories

	Snapshots	**Updates**
Private Data (Authenticated)	Snapshots for Private Data	Updates for Private Data
Market Data (Both Authenticated and Unauthenticated)	Snapshots for Market Data	Updates for Market Data

The scope of this document is confined to the **updates for private-data** for **borrowers on margin**

Private Data Topics

> ⚠ The `spotAccounts` topic is deprecated and is superseded by the `assetAccounts` topic. The latter provides more comprehensive details regarding the assets in the client’s trading accounts.

There are currently 5 topics available under Private Data:

- orders
- trades
- (Deprecated) spotAccounts
- assetAccounts
- tradingAccounts

Fields Comparison - `spotAccounts` Topic vs `assetAccounts` Topic

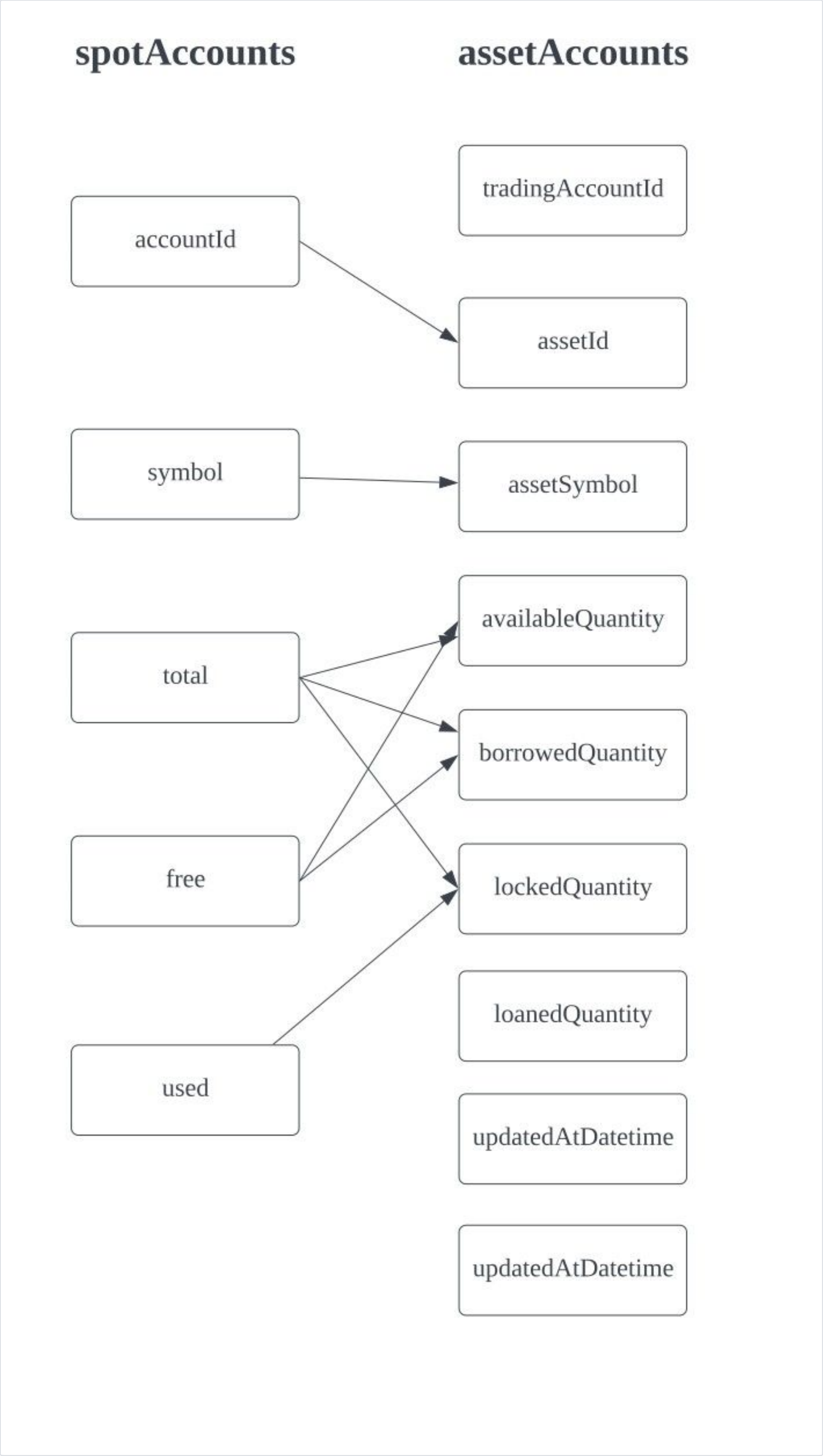
With `spotAccounts` topic deprecated in favour of the `assetAccounts`topic, the below shows

- how each field in spotAccount topic can be derived from the field(s) in assetAccount topic
- what additional fields in assetAccount topic have

A numeric example showing the conversion of the fields is available in the section `2.b.iii. When The Liquidation Order Gets executed` under `Messages`

Fields in spotAccounts topic	**Corresponding fields in assetAccounts topic**
accountId	assetId
symbol	assetSymbol
total	max(0, availableQuantity - borrowedQuantity) + lockedQuantity
free	max(0, availableQuantity - borrowedQuantity)
used	lockedQuantity

Each field in the `spotAccounts` topic can be derived from the `assetAccounts` topic.



Overview - the `assetAccounts` topic has more fields and is more comprehensive.

Reconciliation

A numerical reconciliation example is available in the section `2.b.iii When the Liquidation Order gets Executed (With Reconciliation)`

spotAccounts Topic vs assetAccounts Topic

Goal is to map each field in spotAccounts topic to one or more fields in assetAccounts topic.

trade Topic vs assetAccounts Topic in an Executed Liquidation Order

Goal is to reconcile both the base and quote asset changes in the executed liquidation order. One from the trades Topic and the other form the assetAccounts topic.

Setup

Borrower

This document follows the journey of a trader on margin (borrower) who

- initially has some BTC and USDC
- has Margin enabled (with Max Initial Leverage > 1)
- has one or more open limit orders short selling BTC
- reaches Max Initial Leverage (MIL) at 3x

In short, BTC will be the `borrowed asset`and USDC will be the `collateral asset`.

Lender

We assume that there are existing Loan Instructions which the borrower can borrow.

WebSocket Messages received by the lender is outside the scope of this document.

Liquidation Penalty

Liquidation Penalty is the extra fee paid for every fill on an order sent by the liquidation engine.

On day-1 of margin, no liquidation penalty is charged.

However, in this example, we assume that liquidation penalty amounted to **50 bps** is charged.

Formula

- In Collateral’s Term
  - (liquidation penalty in bps) * (Borrowed Asset Quantity) * (Collateral Asset Price per unit of Borrowed Asset)

Index Price

With the above setup, we gradually increases the index price of BTC (the borrowed asset). This allows us to bring said borrower through various stages of liquidation.

This document then describes, at each stage of liquidation, what messages are published from the perspective of said borrower.

Messages

1. When Trading Account is Margin Enabled

Topics	What happens?	Frequency	Example Message
trades	N/A		
orders	N/A		

tradingAccounts	An update is published once every 30 seconds on the trading account	Recurring.
		Once every 30 seconds
			`{`
			`    "type": "update",`
			`    "dataType": "V1TATradingAccount",`
			`    "data": {`
			`        "tradingAccountId": "111904161762538",`
			`        "referenceAssetSymbol": "USD",`
			`        "totalBorrowedQuantity": "15107.3159",`
			`        "totalCollateralQuantity": "21099.2971",`
			`        "updatedAtDatetime": "2023-07-25T07:10:11.16`
			`        "updatedAtTimestamp": "1690269011169"`
			`    }`

assetAccounts	N/A		
spotAccounts	N/A		

2. When Trading Account is in Liquidation

2.a. When Margin Call Occurs

- Leverage reaches 5x

Topics	What happens?	Frequency	Example Message
trades	N/A		
orders	N/A		
tradingAccounts	N/A		
assetAccounts	N/A		
spotAccounts	N/A		

2.b. When Partial Liquidation Occurs

- Leverage reaches 6x

2.b.i When Trading Account has Open Limit Orders

Topics	What happens?	Frequency	Example Message
trades	N/A		

orders	The open limit order gets cancelled	Once	{
			    "type": "update",
			    "dataType": "V1TAOrder",
			    "data": {
			        "status": "CANCELLED",
			        "timeInForce": "GTC",
			        "borrowedQuantity": "0.00050100",
			        "baseFee": "0.00000000",
			        "price": "11650.0000",
			        "createdAtTimestamp": "1690267713122",
			        "quoteFee": "0.0000",
			        "statusReason": "Unsolicited cancel",
			        "stopPrice": null,
			        "quantityFilled": "0.00000000",
			        "type": "LMT",
			        "handle": null,
			        "statusReasonCode": 3020,
			        "orderId": "603840999349288961",
			        "quantity": "0.50000000",
			        "margin": true,
			        "side": "SELL",
			        "createdAtDatetime": "2023-07-25T06:48:33.122Z",
			        "isLiquidation": false,
			        "symbol": "BTCUSDC",
			        "averageFillPrice": null
			    }

tradingAccounts	N/A		
assetAccounts	N/A		
spotAccounts	N/A		

2.b.ii When an Aggressive Liquidation Order is Created to Sell Collaterals

Topics	What happens?	Frequency	Example Message
trades	N/A		

orders	• The liquidation Engine creates aggressive limit orders to sell collaterals of the	Once	{ "type": "update",
			    "dataType": "V1TAOrder",
			    "data": {
			        "status": "OPEN",
			        "timeInForce": "GTC",

	trading account in partial liquidation		`"borrowedQuantity": null,`
			`"baseFee": "0.00000000",`
			`"price": "17651.4000",`
			`"createdAtTimestamp": "1690259245994",`
			`"quoteFee": "0.0000",`
			`"statusReason": "Open",`
			`"stopPrice": null,`
			`"quantityFilled": "0.00000000",`
			`"type": "LMT",`
			`"handle": null,`
			`"statusReasonCode": 6001,`
			`"orderId": "680",`
			`"quantity": "0.16104577",`
			`"margin": false,`
			`"side": "BUY",`
			`"createdAtDatetime": "2023-07-25T04:27:25.994Z",`
			`"isLiquidation": true,`
			`"symbol": "BTCUSDC",`
			`"averageFillPrice": null`
			`}`

tradingAccounts	N/A		
assetAccounts	N/A		
spotAccounts	N/A		

2.b.iii When the Liquidation Order gets Executed (With Reconciliation)

This section contains reconciliation details

- spotAccounts topic vs assetAccounts topic
- trades topic vs assetAccounts topic

Liquidation Penalty

Amount in Collateral asset (USDC)

= (**liquidation penalty in bps**) * (**Borrowed Asset Quantity**) * (**Collateral Asset Price per unit of Borrowed Asset**)

= 50bps * 0.16104577 **BTC quantity** * 11600.7822 **USDC/BTC price**

= 9.34128451001 **USDC**

Topics	What happens?	Frequency	Example Message	Reconciliation (trades vs assetAccounts Topic)	
				BTC	USDC

trades	The executed order becomes a trade	Once	`{`
			`"type": "update",`
			`"dataType": "V1TATrade",`
			`"data": {`
			`"tradeId": "100000000000000009",`
			`"handle": null,`
			`"baseFee": "0.00000000",`
				BTC bought from the liquidation trade
				=
					USDC consumed in the liquidation trade
					=

			`        "isTaker": true,`
			`        "price": "11600.7822",`
			`        "orderId": "680",`
			`        "createdAtTimestamp": "1690259245994",`
			`        "quoteFee": "1.8683",`
			`        "quantity": "0.16104577",`
			`        "side": "BUY",`
			`        "createdAtDatetime": "2023-07-25T04:27:25.994Z",`
			`        "symbol": "BTCUSDC"`
			`    }`
			`}`
				0.16104577 BTC	0.16104577 BTC quantity *
					11600.7822 USDC/BTC price +
					1.8683 quoteFee +
					9.341284 liquidation penalty in USDC
					= 1879.46648 USDC

orders	The aggressive limit order created by the liquidation engine gets executed	Once	`{`
			`    "type": "update",`
			`    "dataType": "V1TAOrder",`
			`    "data": {`
			`        "status": "CLOSED",`
			`        "timeInForce": "GTC",`
			`        "borrowedQuantity": null,`
			`        "baseFee": "0.00000000",`
			`        "price": "17651.4000",`
			`        "createdAtTimestamp": "1690259245994",`
			`        "quoteFee": "0.0000",`
			`        "statusReason": "Executed",`
			`        "stopPrice": null,`
			`        "quantityFilled": "0.16104577",`
			`        "type": "LMT",`
			`        "handle": null,`
			`        "statusReasonCode": 6002,`
			`        "orderId": "680",`
			`        "quantity": "0.16104577",`
			`        "margin": false,`
			`        "side": "BUY",`
			`        "createdAtDatetime": "2023-07-25T04:27:25.994Z",`
			`        "isLiquidation": true,`
			`        "symbol": "BTCUSDC",`
			`        "averageFillPrice": "11600.7822"`
			`    }`
			
			`}`		

tradingAccounts	The executed trade changes the totalBorrowedQuantity and totalCollateralQuantity in the trading Account	Once	`{`
			`    "type": "update",`
			`    "dataType": "V1TATradingAccount",`
			`    "data": {`
			`        "tradingAccountId": "111904161762538",`
			`        "referenceAssetSymbol": "USD",`
			`        "totalBorrowedQuantity": "28456.2608",`
			`        "totalCollateralQuantity": "32972.1419",`
			`        "updatedAtDatetime": "2023-07-25T04:27:25.990Z",`
			`        "updatedAtTimestamp": "1690259245990"`
			`    }`
			`}`
				N/A	N/A

assetAccounts	Balance of BTC (borrowed asset) and	Once	1. USDC balance drops (note how the sum `availableQuantity + lockedQuantity` drops.). ◦ USDC Balance just **before** the liquidation order gets executed i. Note:	**Increase in BTC after**	**Decrease in USDC after liquidation order**

	USDC (collateral asset) change		1. The reason why availableQuantity increases is that **not all** of the USDC locked in the liquidation order gets sold. However, if we check the sum `availableQuantity + lockedQuantity`, it is clear that USDC balance has dropped.
			2.
			◦
			`{`
			`    "type": "update",`
			`    "dataType": "V1TAAssetAccount",`
			`    "data": {`
			`        "tradingAccountId": "111904161762538",`
			`        "assetId": "5",`
			`        "assetSymbol": "USDC",`
			`        "availableQuantity": "28207.0523",`
			`        "borrowedQuantity": "0.0000",`
			`        "lockedQuantity": "2859.8396",`
			`        "loanedQuantity": "0.0000",`
			`        "updatedAtDatetime": "2023-07-25T04:27:25.996Z`
			`        "updatedAtTimestamp": "1690259245996"`
			`    }`
			`}`
			◦ USDC Balance just **after** the liquidation order gets executed
			◦
			`{`
			`    "type": "update",`
			`    "dataType": "V1TAAssetAccount",`
			`    "data": {`
			`        "tradingAccountId": "111904161762538",`
			`        "assetId": "5",`
			`        "assetSymbol": "USDC",`
			`        "availableQuantity": "29187.4254",`
			`        "borrowedQuantity": "0.0000",`
			`        "lockedQuantity": "0.0000",`
			`        "loanedQuantity": "0.0000",`
			`        "updatedAtDatetime": "2023-07-25T04:27:25.998Z`
			`        "updatedAtTimestamp": "1690259245998"`
			`    }`
			`}`
			2. BTC has non-zero **availableQuantity** (to be used to repay **borrowedQuantity**).
			a. Note:
			i. `availableQuantity` **Delta =** 0.16104577 (now) - 0 (previously) = `quantity` **in trade topic** = 0.1610457.
			ii. When the hourly auto-repayment comes, the **availableQuantity** will be used to reduce the **borrowedQuantity**. However, this will not happen right after the liquidation order is executed. That is why we see a non-zero **availableQuantity** here. which could potentially be used to reduce **borrowedQuantity.**
			`{`
			`    "type": "update",`
			`    "dataType": "V1TAAssetAccount",`
				liquidation order
				= 0.16104577 available Quantity
				= 0.16104577 BTC
					= Delta of (availableQuantity + lockedQuantity)
					= Sum of availableQuantity + lockedQuantity before -
					Sum of availableQuantity + lockedQuantity after
					=
					(28207.0523 + 2859.8396)
					- (29187.4254 + 0)
					= 1879.4665 USDC

<table>
<tr><td></td><td></td><td></td><td>

```
    "data": {
        "tradingAccountId": "111904161762538",
        "assetId": "1",
        "assetSymbol": "BTC",
        "availableQuantity": "0.16104577",
        "borrowedQuantity": "1.62824806",
        "lockedQuantity": "0.00000000",
        "loanedQuantity": "0.00000000",
        "updatedAtDatetime": "2023-07-25T04:27:25.998Z",
        "updatedAtTimestamp": "1690259245998"
    }
}
```

</td><td></td><td></td></tr>
<tr><td>spotAccounts</td><td>

- Balance of BTC (borrowed asset) and USDC (collateral asset) change

</td><td>Once</td><td>

- USDC balance drops
    - USDC Balance just before liquidation order gets executed
        1. **used = lockedQuantity = 2859.8396**
        2. **free = max(0, availableQuantity - borrowedQuantity) = max(0, 28207.0523 - 0) = 28207.0523**
        3. **total = max(0, availableQuantity - borrowedQuantity) + locked = 28207.0523 + 2859.8396 = 31066.8919**

    -
      ```
      {
          "type": "update",
          "dataType": "V1TASpotAccount",
          "data": {
              "type": "spot",
              "accountId": "5",
              "symbol": "USDC",
              "total": "31066.8919",
              "free": "28207.0523",
              "used": "2859.8396"
          }
      }
      ```
    - USDC Balance just after liquidation order gets executed
        - **used = lockedQuantity = 0**
        - **free = max(0, availableQuantity - borrowedQuantity) = max(0, 29187.4254 - 0) = 29187.4254**
        - **total = max(0, availableQuantity - borrowedQuantity) + locked = 29187.4254 + 0 = 29187.4254**
    -

```
{
    "type": "update",
    "dataType": "V1TASpotAccount",
    "data": {
        "type": "spot",
        "accountId": "5",
        "symbol": "USDC",
        "total": "29187.4254",
        "free": "29187.4254",
        "used": "0.0000"
    }
}
```

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</table>

2. BTC remains unchanged (Note: We can confirm the values of the fields are correct)
   a. **used** = **lockedQuantity** = 0
   b. **free = max(0, availableQuantity - borrowedQuantity) = max(0, 0.16104577 - 1.62824806) = 0**
   c. **total = max(0, availableQuantity - borrowedQuantity) + lockedQuantity = max(0, 0.16104577 - 1.62824806) -0 = 0**

```
{
    "type": "update",
    "dataType": "V1TASpotAccount",
    "data": {
        "type": "spot",
        "accountId": "1",
        "symbol": "BTC",
        "total": "0.00000000",
        "free": "0.00000000",
        "used": "0.00000000"
    }
}
```

				- trades topic = 0.16104577 BTC - assetAccounts topic = 0.16104577 BTC **Both are equal!**	- trades topic = 1879.46648 USDC - assetAccounts topic = 1879.4665 USDC **Both are equal**

2.c When Full Liquidation occurs

- Leverage reaches 12x

2.c.i When Trading Account has Insufficient Fund

Topics	What happens?	Frequency	Example Message
trades	N/A		

orders	The aggressive limit order placed by the liquidation engine cannot be executed because of insufficient fund.	Recurring.
		Error Messages stop when sufficient fund is deposited into the trading account, upon which the order gets executed.
			{
			    "type": "error",
			    "dataType": "V1TAErrorResponse",
			    "data": {
			        "handle": null,
			        "requestId": "1111",
			        "orderId": "85046",
			        "symbol": "BTCUSDC",
			        "message": "Insufficient balance",
			        "errorCode": 3005,
			        "errorCodeName": "INSUFFICIENT_BALANCE"
			    }
			}
			
			{
			    "type": "update",
			    "dataType": "V1TAOrder",
			    "data": {
			        "status": "REJECTED",
			        "timeInForce": "GTC",
			        "borrowedQuantity": null,
			        "baseFee": "0.00000000",
			        "price": "238900.1000",
			        "createdAtTimestamp": "1690351352354",
			        "quoteFee": "-0.0001",
			        "statusReason": "Insufficient balance",
			        "stopPrice": null,
			        "quantityFilled": "0.00000000",
			        "type": "LMT",
			        "handle": null,
			        "statusReasonCode": 3005,
			        "orderId": "85046",
			        "quantity": "0.05317730",
			        "margin": true,
			        "side": "BUY",
			        "createdAtDatetime": "2023-07-26T06:02:32.354Z",
			        "isLiquidation": false,
			        "symbol": "BTCUSDC",
			        "averageFillPrice": null
			    }
			}

tradingAccounts	N/A		

assetAccounts	Regular updates of the insufficient collateral assets used in the liquidation order	Recurring.
		Error Messages stop when sufficient fund is deposited into the trading account, upon which the order gets executed.
			• Note that only the collateral asset (USDC) is reported.
			{
			    "type": "update",
			    "dataType": "V1TAAssetAccount",
			    "data": {
			        "tradingAccountId": "111904161762538",
			        "assetId": "5",
			        "assetSymbol": "USDC",
			        "availableQuantity": "12716.8680",
			        "borrowedQuantity": "0.0000",
			        "lockedQuantity": "0.0000",
			        "loanedQuantity": "0.0000",
			        "updatedAtDatetime": "2023-07-26T06:17:52.460Z",

			`"updatedAtTimestamp": "1690352272460"`
			`}`
			`}`

spotAccounts	Regular updates of the insufficient collateral assets used in the liquidation order	Recurring.
		Error Messages stop when sufficient fund is deposited into the trading account, upon which the order gets executed.
			`{`
			`"type": "update",`
			`"dataType": "V1TASpotAccount",`
			`"data": {`
			`"type": "spot",`
			`"accountId": "5",`
			`"symbol": "USDC",`
			`"total": "0",`
			`"free": "0",`
			`"used": "0.0000"`
			`}`
			`}`

2.c.ii. When Trading Account has Sufficient Fund

- Messages are similar to Partial Liquidation. The only difference is that the liquidation engine tries to repay all the BTC debt (borrowed asset)

2.d When Account Default occurs

- Leverage reaches leverage 30x

Topics	What happens?	Frequency	Example Message
trades	N/A		
orders	N/A		
tradingAccounts	N/A		
assetAccounts	N/A		
spotAccounts	N/A		