# Skyler C3 Liquidity Discovery Solution

***Increase your Alpha through faster insights into fragmented liquidity with Skyler's C3 Liquidity Discovery Solution***

**Key Features**

- Maintain full depth book in real time
- Support multiple aggregation views
- Aggregates across multiple venues
- Publish snapshots and updates
- Publish to standard messaging infrastructure
- Quickly add new Level II feeds

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|---|---|
| Latency | ~ 10 micro seconds |
| OS | 32bit, 64bit Linux RH |

Skyler introduces the C3 Liquidity Discovery Solution - the solution for significantly faster and deeper insights into the market's fragmented liquidity. Seize the opportunity to know the market in microseconds, execute smarter trading decisions, and achieve higher Alpha.

The benefits for the customer include:

- Significantly faster insights into fragmented liquidity and therefore improved trading efficiency
- Ability to implement more sophisticated and powerful algorithms due to the comprehensive liquidity information and speed delivered by the C3 Liquidity Discovery Solution
- Shorter development times and far less complexity to deploy an order book infrastructure
- Trading infrastructure with minimal maintenance overhead and high resiliency due to automatic feed arbitration and snapshot capability
- Ability to quickly adapt to changes in the market structure by adding new data feeds

## The Need

Algorithmic trading has undergone a dramatic increase in adoption rate and has evolved into a highly sophisticated tool for a wide group of traders. The proliferation of such trading and fierce competition have contributed to shrinking margins and made differentiation increasingly difficult.

As a result, many players in the securities industry and software vendors, have developed their own next-generation algorithmic trading systems to stay on top of the market. These sophisticated algorithms scour ever deeper within the book across an increasing number of venues for overlooked opportunities. To perform optimally, these systems require even faster execution.

These initiatives exact a high price on existing platforms and systems, causing infrastructure to breakdown under the constantly increasing data volumes, and the associated requirement for increases in throughput rates.

### Why existing systems fail

There are a host of existing offerings that aim to address the need to source liquidity in low latency algorithmic trading. However, most of these fail to meet the performance as well as functional requirements.

- Stream processing engines that focus on fast data stream processing primarily provide a set of pre-defined operators that help aggregate price levels and allow users to subscribe to changes or alerts. But this more general and distributed approach cannot take advantage of relationships between the data that should be managed and maintained as a single entity. As a result, the use of general-purpose stream operators to build and aggregate the book stops short of providing the ultra low latency required for next generation algorithmic trading with views across all liquidity pools.
- In-memory databases can maintain orders as a time series in memory, but they often lack the ability to actually aggregate price levels in the book. As a result, the requested order book is often constructed as part of the query execution, thereby negatively affecting performance.

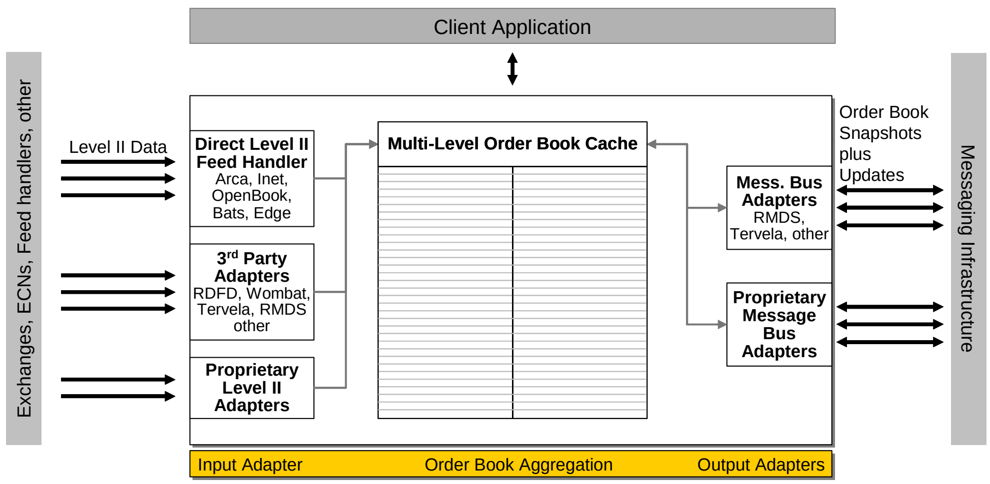
  And, while in-memory time series databases generally support fast analysis, they are not optimized for fast stream-input processing.

As a result, these limitations often lead to a compromise between functionality and performance.

### The Skyler C3 Liquidity Discovery Solution

The Skyler C3 Liquidity Discovery Solution uniquely addresses the needs for ultra low latency order book aggregation and management. This C3 solution provides the following functions:

- Aggregates the order book in real time
- Aggregates individual venues, as well as across all venues
- Manages the entire depth of the book
- Provides multiple aggregation views including no aggregation and price aggregation
- Allows definition of published book views on a per query basis
- Publishes order book snapshots plus updates
- Allows for quick addition of new Level II feeds
- Allows Level I best bid/ask combination with full depth order book feeds
- Allows embedding of custom liquidity analytics for smart decision making
- Provides interfaces to standard messaging infrastructure
- Runs as a standalone application or in process with algorithmic trading systems




### Data Input

The Skyler C3 Liquidity Solution is equipped with a number of feed handlers and adapters to existing feed handling infrastructure to take in the Level II order feeds.

C3 provides feed handlers to the main North American Level II direct exchange feeds. These include:

- ARCA
- NASDAQ TotalView
- BATS
- NYSE OpenBook
- EDGX
- Other Level II feed handlers for the regional exchanges and some international exchanges are in development

Skyler C3 can interface to existing or proprietary feed handling infrastructure including systems like Wombat, Reuters RDFD, InfoDyne, and others. Skyler C3 can also accept raw or normalized Level II data from messaging infrastructure including RMDS, Tervela, 29West, Solace, and others. Some of these adapters are production ready while others are in development.

The Skyler C3 Liquidity Discovery Solution SDK provides a framework to add new feed handlers or adapters. The SDK includes sample code for customers to develop their own input adapters. Or Skyler can develop custom modules if desired.

**Skyler C3 Feed Handlers**

The Skyler C3 feed handlers, as listed above, manage the communication with the exchanges, receive the raw Level II data and insert them into the order book cache. TCP and UDP transmission protocols can be handled. The Skyler C3 feed handlers manage feed arbitration, offer the ability to persist raw data for replay, and intelligently manage venue states including the staleness of data.

**Order Book Cache**

The Level II data can be sent to one or multiple order book caches. The Skyler C3 order book cache accepts market by order and market by price data input.

The order book cache maintains the full depth of the book by taking every single order and maintaining all price levels throughout the book. It supports no aggregation (every single order is visible) or price aggregation (only the number of orders at a given price level are visible). In addition, it aggregates the book for individual venues and across all venues.

The order book cache also supports different book states accommodating for stale data or non trading venues as well as venue specific flags.

**Top of Book Times Series Cache**

In addition to the real-time order book cache, the Skyler C3 Liquidity Discovery Solution optionally includes a top of book time series cache for analytics, replay, and regulatory compliance.

This in-memory time series cache captures the top of the order book whenever it changes and stores this information including the timestamp. This time series view provides the user with insights into the day's events and with valuable data to run analytics. Whenever a client calls to know where the market was at a given time in the day, you now have the answer – immediately. The top of book time series data can be persisted to disk as may be required to ensure RegNMS and MiFID compliance. For more information on Skyler's dedicated Skyler C3 Compliance solution please visit www.skylertech.com.

**Query Support and Publishing Data**

A client application such as an algorithmic trading system can query the Skyler C3 order book cache by specifying the symbol, venues, aggregation type, and depth of the book. Each client and each request can specify this set of variables separately, providing trading applications the flexibility to execute different and novel trading strategies.

The client side application can request the following order book information:

- Individual snapshots of the order book
- Snapshots plus update (whereas the updates constitute snapshots of the changed books)
- Snapshots plus delta updates (whereas the updates constitute the individual changed records)

The advantages of these mechanisms include a reduction in network usage, the ability to prevent the client application from rebuilding the book from scratch, and flexibility for client applications to receive the order book information at their own pace.

In addition to the order book subscriptions, the client application can also query the top of book time series cache.

In order to submit the queries, the client side application can access the Skyler C3 Liquidity Discovery Solution via the Skyler C3 client side API or via messaging infrastructure.

- The Skyler C3 client side API is available in Java and C++ and runs on 32bit and 64bit Linux and Windows.
- The Skyler C3 message bus adapters include off-the-shelf interfaces to the Reuters RMDS and the Tervela messaging systems. Skyler is currently expanding this set of adapters to also include interfaces to other standard messaging infrastructure including LBM by 29West.




Skyler™

Skyler C3 Liquidity Discovery Solution is also open to interface to proprietary messaging infrastructure. The Skyler C3 SDK can be used to develop these adapters or the client can work with Skyler to build these interfaces.

**Integration into trading infrastructure**

The Skyler C3 Liquidity Discovery Solution can run as a standalone application or can be embedded into trading applications as a third party library. The system is released on 32bit and 64bit Linux. It is a multi-threaded application which exploits available CPU's, both in terms of number of CPU's and speed of the CPUs provided.

**Skyler C3 Software Development Kit (SDK)**

Skyler's C3 SDK libraries and code examples provide developers the ability to quickly interface with the Skyler APIs. The C3 SDK is available in C++. It allows the user to develop custom entities such as input and message bus adapters as well as custom indicator calculations or algorithm modules.

**About Skyler**

Skyler is an enterprise software company delivering ultra low latency trading solutions to the financial services industry. The Skyler C3 Solutions source liquidity, analyze tick data, trigger smarter trading decisions, and achieve higher fill rates at better prices. Skyler's customers benefit from faster insights into activities in the market, the ability to deploy innovative new trading strategies, and faster access to the market and therefore higher trading efficiency. The Skyler C3 Liquidity Discovery, Tick Analytics, Algorithmic Container, Order Routing, and Compliance Solutions are focused on specific customer needs and emphasize flexibility, ease of use, and simplicity of integration. They combine powerful, low-latency in-memory data processing technologies with market specific business logic modules.

To test drive the Skyler C3 solutions, contact 925.689.9814 or contact@skylertech.com. Please visit us at our website www.skylertech.com.