# Design and Analysis of a Real-Time Stock Market Monitoring System Using Streaming Data Frameworks

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**Abstract**
Technology has been changing with time. Development has brought in the new better and optimized devices; this has brought the requirement of high transmission data transfer and more speed. The stock market has been developed from offline trading to digital trading, and this change has brought the stock market business to the top with the help of technology. This paper gives the brief intro of the Stock market and talks about NSE and BSE stock exchanges. It also workflow of shares and their prices. And lastly it discusses the streaming data frameworks and analysis of stock market using streaming framework.

**Keywords:** Stock Market, National Stock Exchange (NSE), Bombay Stock Exchange (BSE), DEMAT Account, Streaming Data Frameworks.

## I. Introduction

Trade has always been a major tenet of life philosophy. Historically, the barter system was utilized as a trading regime in which individuals were required to exchange items of equal worth. Individuals were the only ones who agreed on and determined the value. With the development of currency, this system was phased out. The use of cash or money as a medium of exchange was then adopted, making business and trade easier. Today, every country in the globe has defined its own currency, which has a definite value set by the government and is accepted all over the world. Trading has evolved with time, and people are now more interested in investing. Gold, silver, property, and other precious metals are among the investments. Digital trading has progressed and is still improving. Individuals now use the stock market, also known as the share market, as a primary trading platform.

People make money by investing their profits in the stock of other firms. Only bank-verified persons are permitted to deal in stocks, and specific DEMAT accounts are required for trading. Trading in stocks necessitates more forethought and anticipation. Soft computing aids this in a variety of ways. Algorithms provide certain possibilities, and investing based on them could result in gains. A variety of applications need real-time analysis of stream data, which is constrained by the capabilities of previous processing systems. Stock prediction, weather forecasting, product suggestion, and tweets recommendation for users are just a few of the many applications that need real-time data processing.

A data stream can be classified as either online or offline. Online streaming data may be utilized in real-world applications such as network traffic monitoring, database transaction fraud detection, and so on. These need intensive real-time processing, whereas offline data streams correspond to logs that may be gathered from a variety of sources, such as e-commerce websites, financial transaction data, medical reports from the health-care department, and so on. The soft real-time environment may be used to examine them.

Based on the above considerations, the paper is structured into five sections. The initial section introduces the stock market and its technological evolution. The subsequent section outlines the core concepts of share markets and trading operations. The third section details the end-to-end workflow of stock transactions and price determination. The fourth section examines various streaming data frameworks

for real-time analytics. The final section focuses on the implementation and analysis of stock market data using the Amazon Kinesis Streaming Data Framework.

## II. Stock Market

The stock exchange, often known as the stock market, is a real or virtual location where investors can purchase and sell publicly listed company stock, or shares. Supply and demand determine the price of each share. The larger the demand for shares, the higher the price. Because if there is less demand, the price of a share falls. Most countries currently have stock exchanges, but the first appeared in Amsterdam in the 17th century. For example, if an individual purchases 10 shares of ABC Company for Rs.200 each, the individual becomes a shareholder of ABC. The individual has the option to sell ABC shares at any time. With proper understanding of the present state of the company's market and a single call, you can increase your profits. It is stated that if you start investing at an early age and stay involved for a long period, you will earn a high rate of return. One invests in a firm by purchasing stock. The value of a company's stock rises as it expands. Profit is defined as the difference between the price of a share at the time of sale and the price at the time of purchase. When the selling price is less than the buying price, it is called a loss. The price of a share is influenced by a number of things. The value of a stock might fluctuate over time. Every business needs cash or funds for expansion and development, among other things. Crowd fundraising, or taking money from the people or crowd, is one of the most efficient methods. When small amounts of money are added together, they add up to a large quantity, much as droplets add up to the ocean. This money is utilized to launch new projects, which result in more profit, and then the appropriate percentage is repaid to the individual fund.

Two major stock exchanges are National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). These two are regulated by SEBI (Security and Exchange Board of India). SEBI is a statutory regulatory authority that was created on April 12, 1992. It oversees and governs the Indian capital and securities markets, ensuring that investor’s interests are protected by enacting legislation and guidelines.

### *A. National Stock Exchange (NSE)*

The National Stock Exchange of India Ltd. (NSE) is India's largest stock exchange and the world's second largest by number of equity share trades. In 1994, the NSE introduced electronic screen-based trading, derivatives trading (in the form of index futures), and internet trading, all of which were firsts in India. Our exchange listings, trading services, clearing & settlement services, indices, market data feeds, technological solutions, and financial education programmes are all part of the NSE's completely integrated business model. The NSE also ensures that trading and clearing members, as well as publicly traded corporations, follow the exchange's rules and regulations.

NSE is a technology pioneer, ensuring the stability and performance of its systems through a culture of innovation and technology investment. The NSE believes that the measure and scope of its goods and services, as well as its prolonged leadership positions across different asset classes in India and globally, enable it to be highly responsive to market demands and changes, as well as deliver innovation in both trading and non-trading businesses to provide high quality resources and applications to market participants and clients.

### *B. Bombay Stock Exchange (BSE)*

BSE (previously known as Bombay Stock Exchange) was founded in 1875 and is Asia's first and fastest stock exchange in the world, with a speed of 6 microseconds. It is also one of India's top exchange groups. BSE has aided the expansion of the Indian corporate sector over the last 143 years by offering an effective capital-raising platform. The bourse, often known as the BSE, was founded in 1875 as the "Native Share & Stock Brokers' Association." In 2017, the BSE became India's first listed stock exchange.

Today, the BSE offers an efficient and transparent market for trading in stocks, currencies, debt instruments, derivatives, and mutual funds. BSE SME is India's largest SME marketplace, with over 250 companies listed and a steady growth rate. The BSE STAR MF platform is India's largest online mutual fund platform, processing over 27 lakh transactions per month and adding about 2 lakh new SIPs each month. BSE Bond, the market leader in the transparent and efficient electronic book mechanism process for private placement of debt instruments, has raised more than Rs.2.09 lakh billion in fund raising from 530 issuances. (Financial Year 2017-2018). The S&P BSE SENSEX, India's most widely followed stock

market benchmark index, is based on the BSE's popular equity index. It is traded on the EUREX as well as the principal exchanges of the BRCS nations (Brazil, Russia, China and South Africa).

## III. Stock Market Workflow

Stock trading starts with a certain level of authentication required. Individuals cannot enter the market and begin trading immediately. The individual must first approach the bank in order to open an account. Two types of accounts are opened such as savings account and DEMAT account. The procedure of opening an account is carried out in accordance with the bank's instructions, and an individual's identity is also verified. A broker has been selected to act as an intermediary between the NSE and the BSE. A savings account is where an individual's funds or savings are kept. A DEMAT account is required for trading; without one, trading is impossible. This account is initially loaded with funds, and then shares are purchased. When a share is sold, the proceeds are credited to the DEMAT account and then transferred to the individual's savings account. As a service fee, the broker charges a set sum each month.

To actually buy shares of a stock on a stock exchange, investors go through brokers — an intermediary trained in the science of stock trading, who can get an investor a stock at a fair price, at a moment's notice. Investors simply let their broker know what stock they want, how many shares they want, and usually at a general price range. That's called a "bid" and sets the stage for the execution of a trade. If an investor wants to sell shares of a stock, they tell their broker what stock to sell, how many shares, and at what price level. That process is called an "offer" or "ask price." Predicting how the stock market will perform is one of the most difficult things to do. There are so many factors involved in the prediction — physical factors vs. physiological, rational and irrational behaviour, etc. All these aspects combine to make share prices volatile and very difficult to predict with a high degree of accuracy.

## IV. Streaming Data Frameworks

Stream processing is used by developers to scan continuous data streams and respond to critical events in timeframes ranging from milliseconds to minutes. Real-time analytics, sophisticated event processing, and streaming analytics are all closely related to stream processing. Stream processing is now the key framework for implementing all of these use cases. Stream processing engines are runtime libraries that allow developers to create code to process streaming data without having to deal with low-level streaming mechanisms.

### *A. Amazon Kinesis Data Streams*

Amazon Kinesis Data Streams can be used to collect and process huge streams of data records in real time. Data processing apps, known as Kinesis Data Stream applications, can be created. A basic Kinesis Data Streams application reads collected data from a stream of data. These applications can operate on Amazon EC2 instances and use the Kinesis Client Library. The processed records can be sent to dashboards, used to generate warnings, dynamically adjust pricing and advertising tactics, or sent to a variety of other AWS services. Kinesis Data Streams can be used for rapid and continuous data input and aggregation. IT infrastructure log data, application logs, social media, market data feeds, and online clickstream data are all examples of data that can be exploited. Processing is often lightweight since the response time for data intake and processing is in real time. The typical scenarios for using Kinesis Data Streams are accelerated log and data feed intake and processing, real-time metrics and reporting, real-time data analytics and complex stream processing.

### *B. Apache Storm*

Apache Storm offers extremely low latency and is well suited for near real-time processing workloads. It analyses enormous amounts of data while delivering results with lower latency than most other systems. Spouts and bolts are the foundation of the Apache Storm Architecture. Spouts are information sources that send data to one or more bolts. This data is linked to other bolts, and the overall topology is represented as a DAG. Developers decide how to connect the spouts and bolts.

### *C. Apache Flink*

Flink is built around the idea of streams and transformations. Data enters the system from a source and exits through a sink. Apache Maven is used to create a Flink task. Maven includes a skeleton project that includes all of the packing needs and dependencies, allowing the developer to add specific code. Apache

Flink is a batch processing framework that also handles stream processing. Flink considers batches to be data streams with finite limits.

*D. Apache Samza*

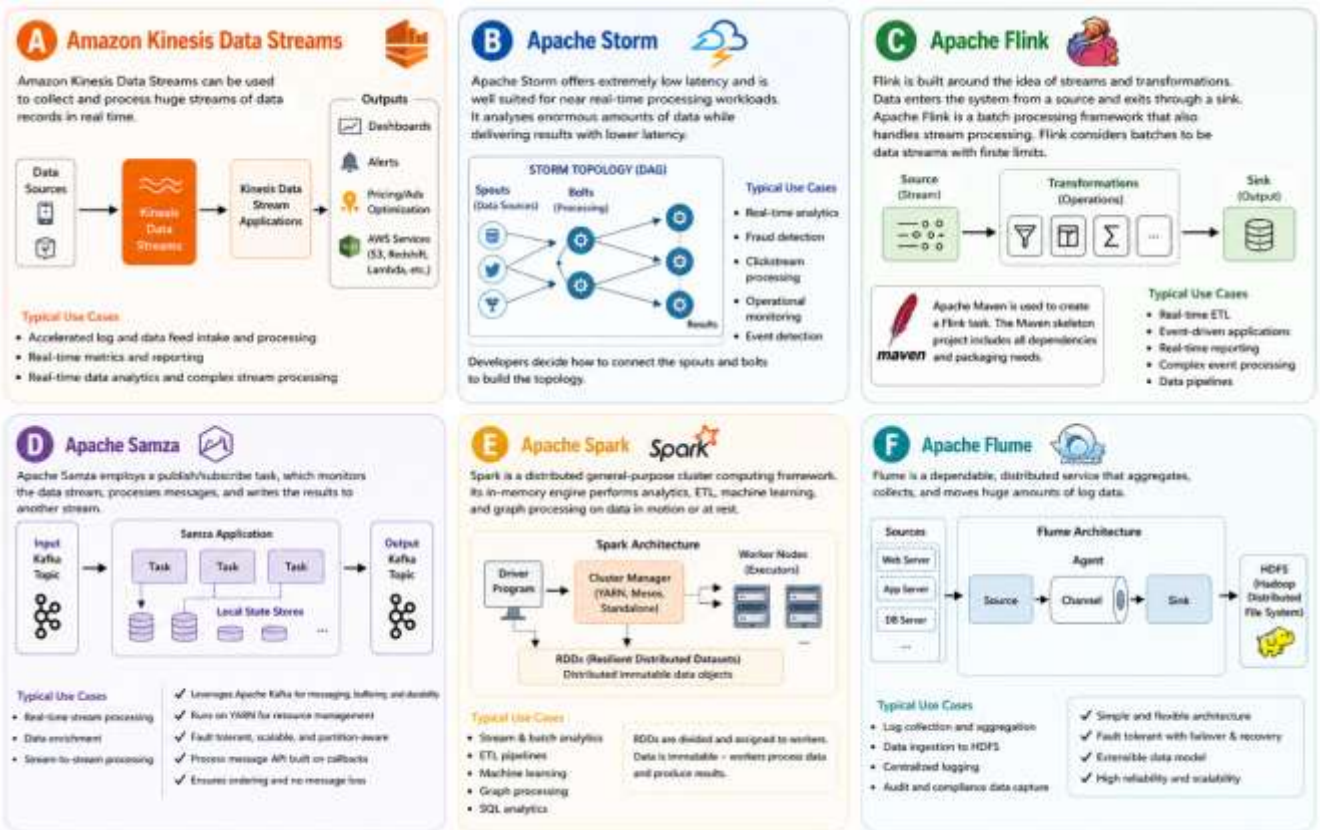
Apache Samza employs a publish/subscribe task, which monitors the data stream, processes messages, and writes the results to another stream. Samza may split a stream into numerous partitions and generate a task replica for each partition. Apache Samza provides buffering, fault tolerance, and state storage by leveraging the Apache Kafka messaging system, architecture, and guarantees. Samza relies on YARN to negotiate resource allocation. A Hadoop cluster, on the other hand, is required (at least HDFS and YARN). Samza has a process message API that is built on callbacks. It collaborates with YARN to provide fault tolerance and migrate your jobs to another machine if one of the cluster's machines dies. Samza handles messages in the order in which they were received, ensuring that no communication is lost. It is also scalable due to the fact that it is partitioned and distributed at all levels.

*E. Apache Spark*

Spark is a distributed general-purpose cluster computing framework that is open source. The in-memory data processing engine of Spark does analytics, ETL, machine learning, and graph processing on data that is in motion or at rest. It provides high-level APIs for Python, Java, Scala, R, and SQL programming languages. Resilient Distributed Datasets are the foundation of the Apache Spark Architecture (RDDs). These are distributed immutable data tables that are divided and assigned to workers. The data is implemented by the worker executors. Because the RDD is immutable, the worker nodes cannot make changes; they process data and produce results.

*F. Apache Flume*

Flume is a dependable, distributed service that aggregates, collects, and moves huge amounts of log data. It has a simple and adaptable architecture. It is fault-tolerant and robust, with failover and recovery capabilities and configurable dependability. It employs an extendable data model. The main idea behind Flume's architecture is to gather streaming data from web servers and store it in the Hadoop Distributed File System (HDFS).



## V. Analyzing Real-Time Stock Data Using Kinesis Data Analytics

In this scenario, stock trades are ingested into a data stream and a simple Amazon Kinesis Data Analytics application is written to do computations on the stream. It describes how to transmit a stream of records to Kinesis Data Streams and how to build an application that consumes and processes the records in near-real time. One may process and analyse streaming data using Java or Scala with Amazon Kinesis Data Analytics for Flink Applications. The service allows the user to create and run Java or Scala code against streaming sources in order to do time-series analytics, feed real-time dashboards, and generate real-time metrics. The programme does not use real-world stock market data, but rather mimics a stream of stock deals. It accomplishes this by employing a random stock trading generator. You might be interested in deriving relevant, timely statistics from a real-time stream of stock trades if you have access to one. For instance, you could conduct a sliding window analysis to find the most popular stock purchased in the last 5 minutes. Alternatively, you may want to be notified whenever a sell order is placed that is too large (that is, it has too many shares). You can add similar functionality to the code in this series by extending it.

The process for analysing the real-time stock starts by creating an AWS account and creating an administrator user. This allows one to access all the services provided by AWS. After that, AWS CLI interface is used for Amazon Kinesis Data Analytics for Flink Applications. Next using AWS CLI one can create and run Kinesis Data Analytics for Flink Applications. Here two Kinesis Data streams will be created, one will be Input Stream and other is Output Stream for the application source and destination streams respectively. Now for Input Stream python will be written to send data to the application. Now to make an application function one will write Apache Flink Streaming Java Code. Now further this java code will be uploaded on Amazon simple storage service. One has the choice to run the application on Amazon Console or AWS CLI. Mostly the Amazon console is used because AWS CLI needs to be downloaded. But on the other hand, the process to run an application is too short on AWS CLI compared to Console. So using either of the two one can now run Kinesis Data Analytics Application, or start the application or stop the application and will be able to analyse the stock market prediction with the help of output Stream.

## VI. Conclusion

For prediction of the stock market, real-time stream processing is required. For investors, the stock market or share market is basically the platform to buy and sell the shares of a company and gain profit out of it. There are two major concepts such as NSE and BSE used for stock exchange. Investors need to have a savings account and DEMAT account to make a trade in the stock exchange. One invests in different shares by analyzing the stock market. There are different Streaming Data Frameworks used for stock market analysis and one of the frameworks used in this paper for analysis is Kinesis Data Streams. The application is created for stock analysis using Kinesis Data Analytics and this application can be used for real-time stream processing which will help to analyse the real-time stock market data.

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