

Solution Brief

Accelerate IoT Platforms with SingleStore

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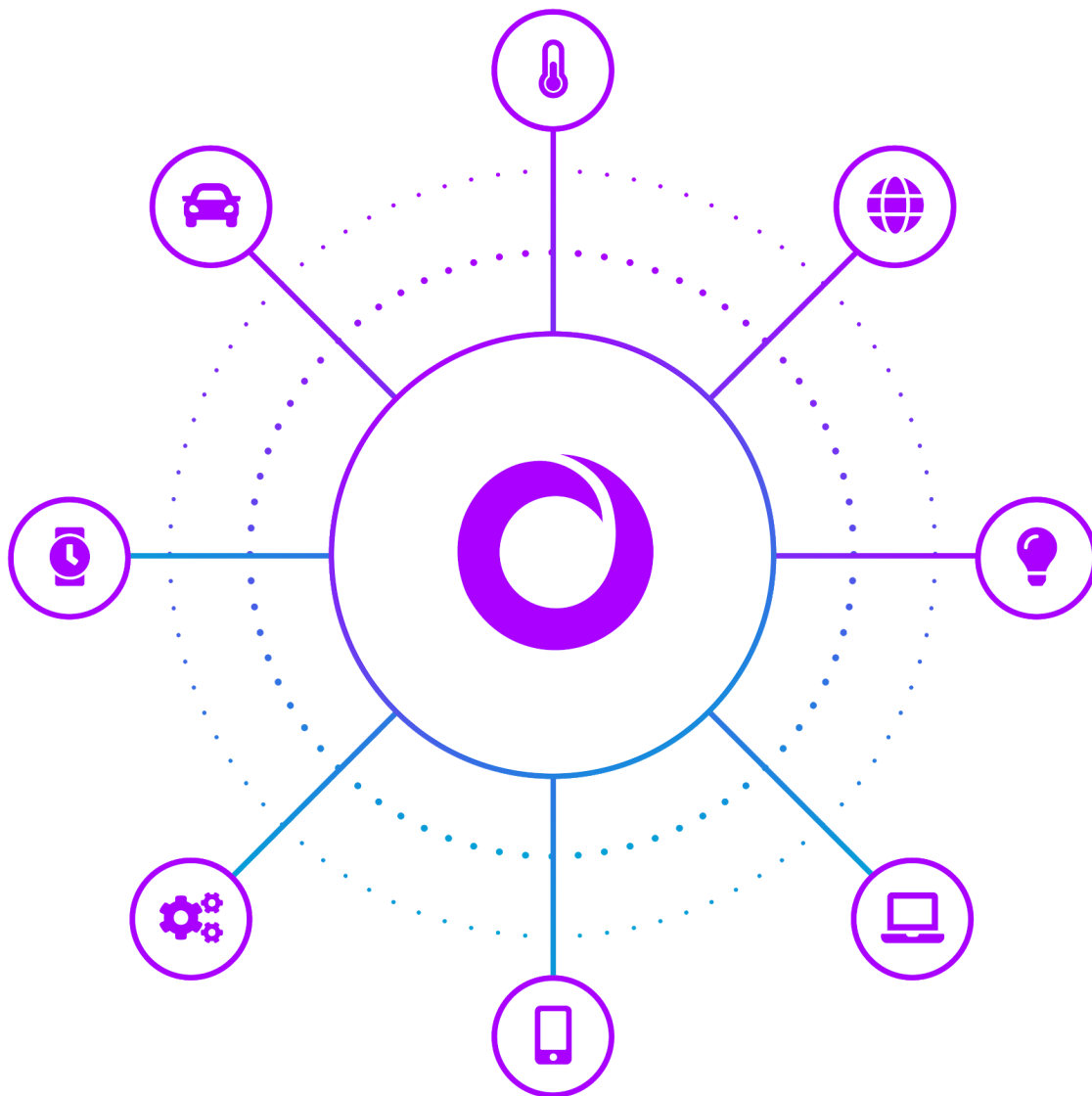


Table of Contents

Table of Contents	1
1. Introduction	1
2. Business Problem	2
3. Consequences of the Problem	3
4. SingleStore Solution	4
4.1 Technical Solution	4
4.2 Why SingleStore for Accelerating IoT Platforms	5
4.3 Common IoT Apps Powered by SingleStore	7
5. Customer Success Stories	8
5.1 Powering Infiswift's IoT Platform with SingleStore	8
5.2 Top Energy Company in US using SingleStore for Preventative Maintenance	10
5.3 True Digital Group Helps to Flatten the Curve with SingleStore	12

1. Introduction

According to a report by [Gartner](#), the number of connected devices in use will hit 20.4 billion by 2020. The spectrum of use cases for IoT is very broad, due to the fact that smart devices are capable of transforming existing markets and creating new ones - from consumer devices to manufacturing, industrial applications, autonomous vehicles, smart homes, smart cities, and more. [Research by Forrester](#) predicts that with continued growth, the Internet of Things (IoT) will become the backbone of order fulfillment, for example, for both business customers and consumers. Over the next few years, IoT will expand even further, as more devices are connected and available online. As the number of IoT apps grows, the amount of unutilized and under-utilized data also grows proportionally.

[Featured article by CIO.com](#) says that “The internet of things may be your key to data-driven transformation”. Enterprises that have embraced real-time analytics on IoT platforms are already seeing benefits such as improved operational processes, better inventory management, and enhanced equipment maintenance — to name a few. Enterprises should focus on building the right data architecture for IoT systems and establish the ability to effectively analyze vast amounts of data generated in real-time and make actionable insights for the business. The underlying data platform must be fast enough to deliver decision making capabilities based on the analytics on real-time data.

2. Business Problem

As data output from IoT devices grows at an ever-faster rate, the need to have a reliable, modern database platform has become a crucial requirement to power IoT applications. Legacy or traditional single node database platforms can neither be able to support such high performant IoT applications nor be capable of unlocking the value from streaming data. The database which processes IoT data should be capable of integrating huge volumes of data sets in real time,

processing events as they stream, and providing a solid foundation for performing low- latency analytics at high user concurrency against petabytes of data. Without real-time visibility, businesses can't convert rich and invaluable insights into consumer behavior, buying patterns and other key metrics.

3. Consequences of the Problem

Customers in various industries such as renewable energy, agriculture, health care, and manufacturing, use data to build solutions that improve equipment reliability and optimize operations. IoT systems potentially have access to millions of devices that generate streaming data. For example, a single event not detected in real-time and delayed understanding and responding to the health of the machine in real time, may result in a huge failure or complete outage for the entire unit. Hence the inability to perform in-the-moment analytics on real-time data may result in critical outage.

Most of the customer-facing IoT applications must be properly monitored, measured and optimized if they are to deliver real business value. For example, the smart shelf technology in a retail industry can automatically alert warehouse personnel when products need to be replenished. Anomaly detection systems in the manufacturing industry automatically monitor the condition of equipment and alert the supervisor, in case any anomaly is detected which can prevent a huge outage or a complete failure for the manufacturing sector.

Limitations of Legacy Database Platforms

Legacy database platforms cannot help extract the most value out of raw data collected from IoT devices. On legacy systems, IoT workloads often run on expensive hardware resulting in higher maintenance costs. Moreover, the addition of data silos through coupling transactions and analytic systems enhances the overall infrastructure complexity. The highly demanding

requirements of concurrency, performance, and fast ingestion makes legacy database platforms unfit to support modern real-time IoT analytical applications.

Some of the key limitations involved in choosing a legacy platform to build an IoT application include:

- Limitations to scale cluster size, on demand
- Inability to run real-time or near real-time analytics on streaming data
- Limitations in performing real-time and historical data analysis within a single system
- Poor query and data latency
- Added complexity in infrastructure and data management
- Increased operational overhead
- Expensive TCO

4. SingleStore Solution

4.1 Technical Solution

[SingleStore](#) is a distributed, relational, SQL database management system (RDBMS) that features ANSI SQL support and is known for exceptional speed in both query processing and data ingestion with unlimited scaling capability.

SingleStore, an operational database built for speed and scale, can be an excellent solution to empower the IoT systems with real-time capabilities. In order to flourish in today's IoT environment, enterprises require a data platform that is designed to meet and exceed today's demanding requirements, to maximize operational efficiency and achieve customer success.

A modern, cloud-native data architecture like SingleStore can play a key role in addressing some of the key data challenges faced by the IoT data platforms:

- Data availability

- Fast ingest
- Complex analytics against high volumes of data having different data types
- Ultra-fast and consistent query performance on streaming data
- Increased demand for analytics (also known as concurrency support)
- Architectural complexity

The underlying data architecture plays a major role in enabling organizations to utilize IoT data in the most effective manner. The data architecture layer has to reliably handle operational analytics on ultra-fast streaming data to enable data-driven business decisions. With a legacy data architecture, it's anywhere from challenging to impossible, to deliver live data, apply the best algorithms to it, and deliver real-time insights at a faster rate.

In modern business, the key to success is to make smarter decisions based on real-time insights derived from analytics on fast-moving data. To achieve this goal, we need a robust data architecture that can support high-speed ingestion, fast query response, and a high level of concurrency for queries. SingleStore's key capabilities, such as unlimited scalability and support for fast, SQL-based analytics with high concurrency, and ultra-fast query performance while streaming data, makes it very well-suited to serve as the underlying database platform to solve this business problem.

4.2 Why SingleStore for Accelerating IoT Platforms

SingleStore, being a cloud-native database for operational analytics, built for speed and scale with developer-friendly SQL compatibility, is an excellent choice for a modern IoT ecosystem. As always-on devices and sensors proliferate, their data must be ingested and actionable in the moment. Their infrastructure behind each IoT application will be powered by a real-time database. SingleStore supports fast ingest and concurrent analytics for sensor systems, delivering instant actionable insights.

The following key capabilities of SingleStore are instrumental for an IoT solution:



Streaming Data Ingest and Store

Collect and store multiple streams of data into a relational format for real-time or historical analysis, without relying on slow batch processing.



Fast Query Response

Instantly discover anomalies or predict events in the moment with memory optimized standard SQL.



Proven Compatibility

ANSI SQL compliant with full data persistence improves data accuracy that works with existing business intelligence and middleware tools.



Unlimited Scale and Highly Available

Shared nothing architecture for scale out or up using industry standard hardware. Built-in resilience keeps the database online. Deploy on-premises, as-a-service or a hybrid of both.

- **Scalable Analytics Concurrency.** Scale-out for growing analytics concurrency for ad hoc queries, business intelligence tools, and apps, with industry-standard hardware.
- **SingleStore™.** SingleStore, a new architectural approach brings some of the best features on each table type to the other, reducing costs and increasing flexibility. The two table types (rowstore and columnstore) can be mixed in one database to achieve the optimal design for your workload. The hybrid architecture in SingleStore can also provide significant cost savings for your organization by converging online transactional processing (OLTP) and online analytical processing (OLAP) in one system.
- **Low Latency Analytics.** Reliable sub-second query response time through scale-out and query compilation.
- **Stream Ingestion.** Discover insights on fast-changing data with real-time ingestion, including scalable integration with Kafka.
- **Scale-out Architecture.** Deliver performance as ingest, processing, and query requirements grow, on industry-standard hardware or on the cloud.
- **Fast SQL.** Vectorized and compiled query performance delivers reliable sub-second responses.
- **Interoperable Architecture.** Drop-in compatibility using standard SQL, hardware, and interfaces provides seamless integration.

4.3 Common IoT Apps Powered by SingleStore

I. Anomaly monitoring and detection in real-time

Real-time IoT dashboards, integrated with SingleStore, can show live anomaly alerts from devices in the network. This warns customers of any potential issues that need to be addressed. The analysis of live data helps energy companies perform fraud detection activities, such as manipulation of devices via smart meters.

II. Augmented customer experience

Timely action to address anomalies gives companies the ability to prevent outages, resulting in a much better customer experience and reduced operational costs.

III. Data-driven decisions by analyzing real-time data

SingleStore enables ad hoc queries to be run, drilling down to generate insights from the real-time data.

IV. Predictive maintenance

Sense and respond to costly maintenance events before they happen. Ingest, analyze and alert with sub-second response time.

V. Connected vehicles

Manage fleet operations in real time combining live and historical data for improved decision accuracy and planning

VI. Smart city and meters

Monitor utility consumption for anomaly detection and planning to optimize costs and improve customer service.

5. Customer Success Stories

5.1 Powering Infiswift's IoT Platform with SingleStore

Infiswift uses SingleStore to deliver reliable and scalable IoT analytics, helping customers in agriculture, renewable energy, and manufacturing optimize costs and improve crop production. Infiswift is an IoT leader, with an innovative platform that can connect and manage any number of endpoints at scale, improving existing services and opening up the opportunities for new ones. For more details, see the [Infiswift case study](#) online.

Business problem

Infiswift needs their platform to be as fast and flexible as possible, while fitting into a tight price/performance envelope. They need to continually build on their existing expertise in SQL and maintain MySQL application interoperability, while providing reliable scalability for fast-changing workloads. And they need to support rich SQL analytics in a unified environment to support both data scientists, working on predictive models, machine learning, and AI, and business users running BI tools and ad hoc SQL queries.

SingleStore solution

The infiswift team needed a database platform that could handle the scale of ingesting and analyzing millions of events in real time. The infiswift team chose for various factors, including:

- Rowstore and columnstore flexibility for optimal performance
- Scalable transactions
- Relational SQL
- Compression
- Avoiding the need to create a caching tier in the solution architecture with an in-memory datastore like Redis

SingleStore is at the center of the database and analytics portion of the Infiswift IoT Platform, described on their [website](#). Like other IoT users, Infiswift has two conflicting needs: (i) very fast

processing through in-memory rowstore tables and (ii) extensive storage for massive amounts of data in on-disk columnstore. The columnstore tables need to be low-cost, and yet fast enough to support real-time analytics.

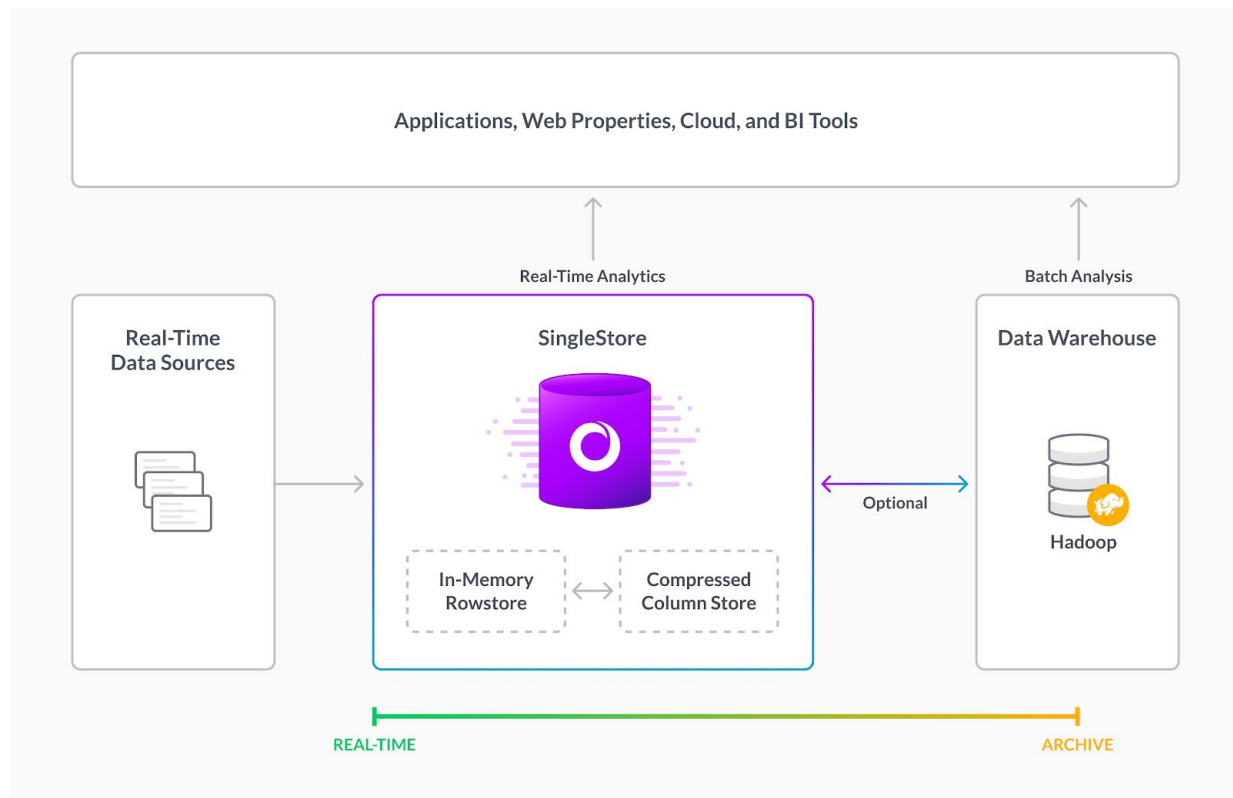


Figure 1. Architecture overview

SingleStore provides unique capabilities while integrating smoothly with data warehousing solutions, BI tools, and much more. SingleStore powers the Infiswift IoT platform, which is highly scalable and extensible. Infiswift leverages SingleStore's flexibility - not only in using rowstore and columnstore tables appropriately, but integrating with data warehousing solutions such as AWS Redshift and Google Bigquery, as well as Hadoop/HDFS, freeing Infiswift from lock-in to any specific vendor. They can then run real-time analysis through SingleStore and batch analysis through a data warehouse provider.

Positive Business Outcomes

- 10x query performance over competing solutions
- 7x data compressions
- Transactional consistency, and rapid scale-out in the cloud
- Simplified data architecture with the unique combination of an in-memory rowstore engine with a memory and disk-based columnstore made for efficient processing
- Significant cost savings

Customer testimonial

“Our customers lead their industries with the implementation of IoT solutions. For these solutions to be successful, we need to analyze data extremely quickly to form insights and often take automated action. SingleStore was the only solution that could meet both our real-time and historical data requirements to provide full data availability and access for our IoT platform.”

- by Jay Srinivasan, CTO at infiswift

5.2 Top Energy Company in US using SingleStore for Preventative Maintenance

A large energy company using SingleStore for upstream processing, which is a solid use case of predictive analytics in a machine learning application. The company delivers preventive maintenance for their oil drills across the globe using this data platform. The preventive maintenance approach helps them to correct the root cause of detected failure and avoid breakdowns to their equipment.

Business problem

Design a highly scalable data platform which is capable of continuously ingesting raw data from a variety of sensors and allowing predictive machine models to run in parallel to determine the scoring for oil drill health, all in real time.

Reference architecture

Oil drills are deployed across different locations around the globe. These drills are equipped with various sensors (such as vibration, direction, and temperature) and generate data continuously. The raw data generated gets pushed into a Kafka queue as a first step. Data is then pulled from the

Kafka queue into a Spark cluster, where a PMML model calculates the health of a drill based on real-time data. The scored data then lands in SingleStore to power a real-time operational dashboard where the drill operators can make informed judgments based on events or anomalies detected by processing real-time data.

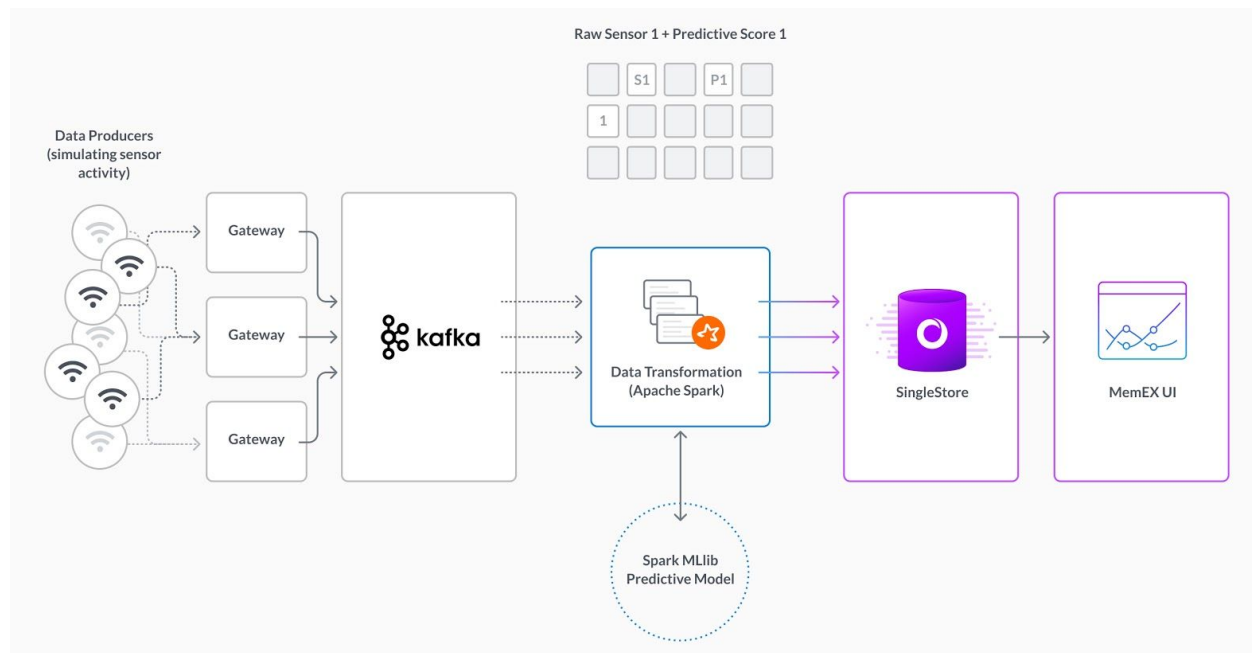


Figure 2. Reference Architecture for Predictive Maintenance

Key considerations for using SingleStore:

- Can query while you ingest data
- Highly scalable
- Ultra-fast ingestion
- Massively parallel processing data architecture
- Perform ML scoring and data ingestion in parallel

Positive Business Outcomes

- Leverage predictive analytics in machine learning application using SingleStore
- Deliver preventive maintenance for oil drills across the globe

- New data platform with SingleStore also helps the customer to correct the root cause of detected failure and avoid potential breakdowns to their equipment, that prevents any major outages.

5.3 True Digital Group Helps to Flatten the Curve with SingleStore

True Digital Group aims to become the ultimate digital transformation enabler for everyone in southeast Asia. Today, they provide a unique ecosystem of digital platforms and solutions and offer a portfolio of digital services, aimed respectively at consumer, merchant, and enterprise markets. Key businesses include Digital Media, O2O and Privilege, Data Analytics, IoT and Digital Solutions, as well as True Digital Academy.

Business problem

Architect an accurate real-time resource to public health and government officials to prevent new potential COVID-19 outbreaks.

SingleStore's solution

The solution leveraged SingleStore for its ability to perform high-speed parallel data ingestion, low-latency analytic SQL queries with high concurrency and geospatial calculations. SingleStore is now used as the operational database to power their Tracepulse app that tracks social distancing metrics in real time, helping to prevent new outbreaks of COVID-19 in Thailand. This app leverages SingleStore Pipelines and geospatial capabilities to process raw event data from mobile phone pings, then performs continuous location metric calculations on the streaming data, displaying all of this on interactive map displays in real time.

Positive Business Outcomes

- Real-time alerting system, powered by SingleStore, automatically determines where large gatherings are forming by tracking the geographic density of the anonymized mobile phone location data

- SingleStore solution delivers stream processing on 500,000 anonymous location events per second for more than 30 million mobile phones
- Automatic alerts, and interactive geospatial drilldown which gives public health officials the real-time visibility needed to be proactive to limit the spread of the virus.

Refer to the [case study](#) for more details.

Customer testimonial

"We chose SingleStore because no other product that we could find was able to do geolocation calculations for our scenario as fast as they could."

- Jean-Francois Gebhart, COO of IoT, True Digital