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Air Domain Analytics with Kinetica

Harnessing the Power of Real-time Advanced Geospatial Analytics in Air Defense

It's a catch-22

It takes time to aggregate and analyze data, but in the realm of air defense, **time is of the essence**. So how does one efficiently track aerial objects and analyze them for potential threats?

Historically, it's a process that has relied on fusing sensor readings to give a more accurate picture of what is happening in the air. The problem is that there are hundreds of sensing devices for aerial objects—and current composite track solutions simply can't join that many feeds in a timely manner.

What's more, even with strict limits in place on the number of readings that can be fused, it's still a time-consuming process that requires heavy compute power. The result is that these solutions **trade accuracy for speed**. That is by design so as to return an answer—however dated or incomplete. Ultimately, responders **receive incomplete information and minimal time remaining** to muster a threat response.

The Kinetica Solution

Kinetica's solution comes from a partnership with the **Defense Innovation Unit (DIU)** to develop a situational awareness platform that helps commanders and operators identify and rapidly respond to radar tracks that represent threats to any airspace. To make this solution a reality, Kinetica developed capabilities to aggregate incoming feeds from hundreds of sources at once. This includes aircraft beacons, flight plans, radar, weather data, and more.

From this, Kinetica's platform creates a common operational picture that operators and analysts can use to identify, disaggregate, and resolve aerial tracks involving potential threats.

This solution leverages the power of streaming data and advanced geospatial analytics so that operators **detect anomalies fast**—and take immedite action.

How does Kinetica Air Domain Analytics with KineticaWork?

It's geospatial analytics on the fly. Kinetica is simple to use, allowing operators to zoom in on individual flight paths for a real-time view of critical flight information. In a historical first that no other tool has been able to offer, the solution enables users to analyze real-time trail views from 1 minute in length up to 15 minutes.

Native Vectorization: The Secret to Rapid Insights

Vectorization is the newest innovation in database software—and it's what sets Kinetica apart. Like all MPP databases, Kinetica is capable of scaling out—and it also parallelizes data within each node.

This kind of processing power creates a force multiplier that achieves an order of magnitude with higher performance gains using a smaller compute footprint while removing the complex data engineering that other databases require.

The Result?

Maximum Data Freshness

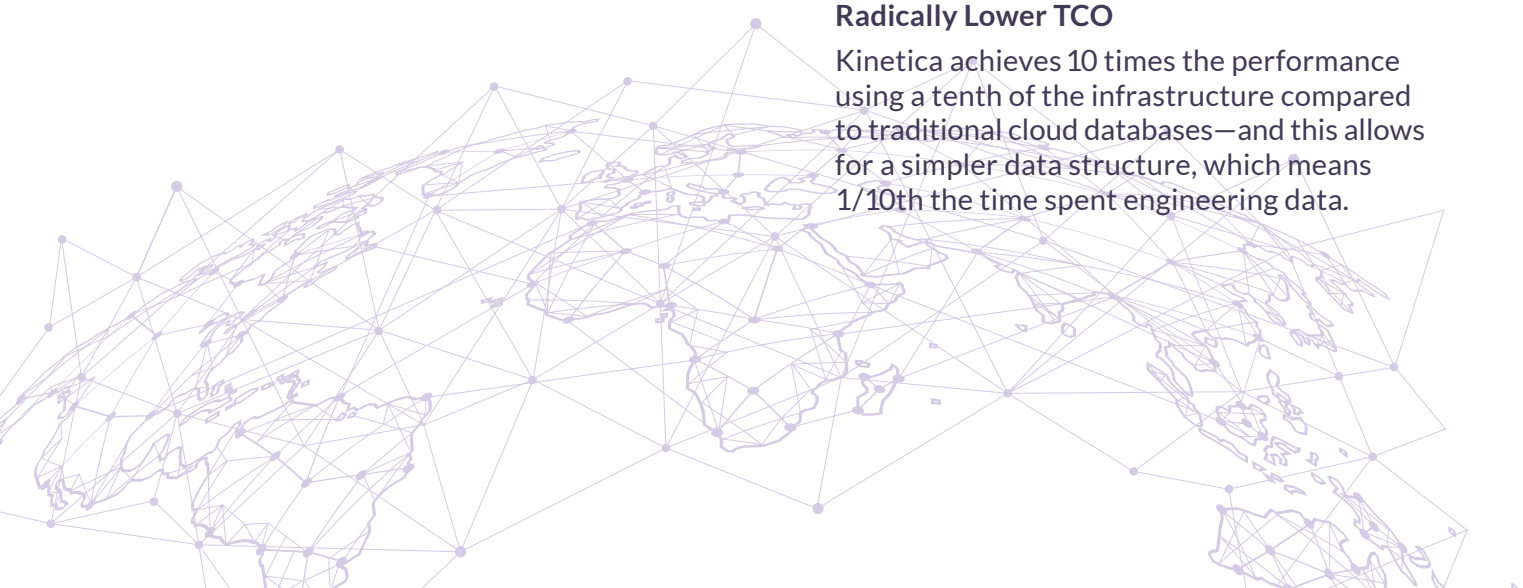
Kinetica achieves the lowest possible latency from the time raw data is created until an answer is returned.

Spatial and Temporal Analytics at Scale

The value in sensor data comes from the fusion of spatial and time series data. Kinetica is capable of applying advanced spatial, temporal, and graph analytics while interactively visualizing billions of data points.

Radically Lower TCO

Kinetica achieves 10 times the performance using a tenth of the infrastructure compared to traditional cloud databases—and this allows for a simpler data structure, which means 1/10th the time spent engineering data.



Comparing Conventional Air Domain Composite Track Solutions with Kinetica

Whether in airspace defense or in big business, there are **3 critical requirements** for analyzing location-enriched IoT data:

Data Fusion

Current solutions can fuse location enriched data. However, they have limitations and diminishing performance returns. Most peter out at fusing about 12 sensor feeds in what is called a composite track system. Essentially, these systems eventually hit a point where they can go no further. To get full value, you need linear scalability on data fusion so you are not limited in the amount of sensor feeds you are able to fuse. This is one of many advantages of the Kinetica solution.

Data Freshness

In air defense and elsewhere, decisions need to be made in real time. Answers that come in minutes too late may be too late to prevent a disaster.

Data Visualization

To increase accuracy and facilitate better decision-making, it's imperative to see as much data as possible. The Kinetica solution facilitates interaction with the data on a map —drilling down, adjusting time periods and pinpointing critical data. This expansive data visibility helps find the proverbial needle in a haystack.

Kinetica is able to create server-side rendered visualizations of geospatial queries. Plot billions of points on a map, create heat maps, color code by area and generate tracks of how objects move in both space and time.

One of the core challenges with displaying spatial information is moving data from the database layer to the visualization layer. Serializing and moving millions to billions of objects from one technology to another takes time.

Kinetica is able to solve this bottleneck by generating geospatial tiles directly on the server through a Web Mapping Service (WMS). WMS tiles are typically used as overlays on top of a map. The type of image tiles returned, the data used to generate the tiles, and the graphical styles in the tiles are specified in the query string of the WMS call.

Kinetica addresses each of these requirements, making drastic improvements on traditional air domain composite track solutions.

	Without Kinetica	With Kinetica
Data Fusion	Dimensionality Reduction ◆ Fewer than a dozen radar types ◆ Hundreds of thousands of data points ◆ Smaller boundaries	**Full Corpus of Data** ◆ Hundreds of radar types ◆ A few billion data points ◆ No boundaries
Data Freshness	Slower response, acting on older data in rapidly evolving situations	**Significantly faster response**, even with exponentially more data processed
Data Visualizing	See only a fraction of the data	See all of the data

CASE STUDY

Norad

At the North American Aerospace Defense Command (NORAD), the mission is to monitor North American airspace to defend against threats. That's why, in a joint venture in February 2021, NORAD, the Defense Innovation Unit (DIU), and the United States Northern Command (USNORTHCOM) awarded a $100 million contract to Kinetica to build Pathfinder.

Pathfinder is a new system comprising vectorized analytic databases occupying a couple hundred nodes in the AWS GovCloud. It's capable of pulling in about 1,000 sources of data continuously via Apache NiFi, with upwards of 5 billion new objects per day ingested into the distributed relational database.

In other words, every object in the sky above the US and Canada is tracked by this system—from jetliners to flocks of migratory geese. This vast amount of data comes with an inherent problem in that it's nearly impossible for humans to analyze it all. That's why Pathfinder relies on machine learning and analytics. Previously, all of this collected data stayed in separate systems—and that prevented NORAD from seeing a full picture.

Now, Pathfinder can use machine learning to analyze data from not only military systems, but also commercial systems and other government agency systems. This provides a unified operational picture and allows for much faster threat detection and response.

Challenge	Solution	Outcome
Evolving threat environment	Kinetica implements nation's largest IoT deployment	Military obtains fused operational picture
Advanced threats demand speed and precision	Fused analysis across multi-domain sensors	Threat classification slashed by minutes
Minutes wasted on manual correlations of 300+ sources	500M aircraft track points analyzed per day	Greater accuracy to catch advanced threats
Threats slip through unnoticed	Machine learning to detect anomalies	Automatic predictions of threat indicators

> *We dramatically reduced their decision time—they have about 12 minutes to make a decision, and we've cut minutes off that."*
>
> —Mike Brown | Director | Defense Innovation Unit

CASE STUDY

Federal Aviation Administration

Within the FAA, there existed a need to modernize systems and introduce new capabilities. That included the ability to monitor unmanned aircraft systems, and adding automated decision support tools to performance-based navigation (PBN).

Kinetica's solution implemented near-live flight tracks that fuse moving targets with known metadata, including beacons, FlightID, acaddress, actype, and more. This solution attaches the maximum amount of information possible to each track.

The results significantly improved safety, performance, and oversight of NAS operations. The FAA can now access more accurate flight metrics, and they have improved their ability to detect new anomalies.

> *The Federal Aviation Administration uses Kinetica on AWS to monitor and analyze entities in motion with greater precision and accuracy."*
>
> —Author Unknown

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To create your **FREE Kinetic Cloud Account** with instant access to Kinetica Cloud and your very own Database for Time and Space, visit the **website** or **contact Kinetica** today.

About Kinetica

Kinetica is the creator of the next-generation, real-time analytical database for time series and geospatial workloads with the unrivaled scale, speed and specialized analytics required for modern location intelligence.

Many of the world's largest companies across the public sector, financial services, telecommunications, energy, healthcare, retail, automotive and beyond rely on Kinetica to create new location-driven solutions to outperform the competition, including the US Air Force, USPS, Citibank, T-Mobile, and others.

Kinetica is a privately held Series B startup, backed by leading global venture capital firms Canvas Ventures, Citi Ventures, GreatPoint Ventures, and Meritech Capital Partners. Kinetica has a rich partner ecosystem, including AWS, Microsoft, NVIDIA, Intel, Dell, Tableau, and Oracle. For more information and to try Kinetica, visit **kinetica.com** or follow us on LinkedIn and Twitter.

About AWS

Amazon Web Services (AWS) is the world's most comprehensive and broadly adopted cloud offering, with more than 200 fully featured services available from data centers globally. Millions of customers —including the fastest-growing startups, largest enterprises, and leading government agencies— are using AWS to lower costs, increase security, become more agile, and innovate faster.