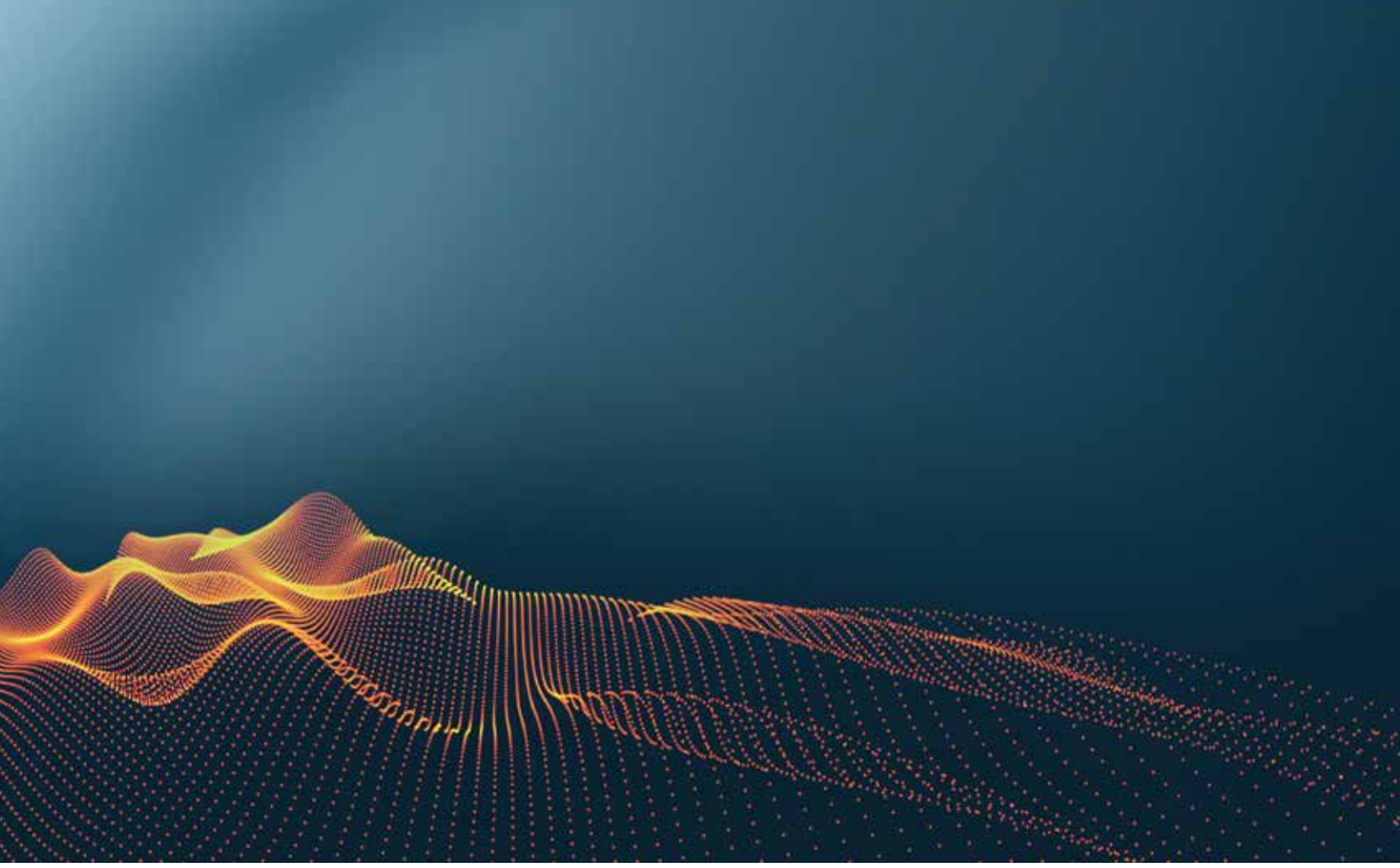

The Modern Event-Driven Architecture (EDA) Landscape

Considerations When Choosing a Platform for Digital Transformation

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VANTIQ

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Overview

While many businesses try to leverage new digital trends to propel their organization forward, there is no single path to digital transformation. One path to digital transformation, event-driven architecture (EDA), is becoming increasingly popular.

"Findings from the [Gartner CEO Survey] clearly indicate that CEOs view digital business as their No. 1 opportunity for growth," said Anne Thomas, vice president and distinguished analyst at Gartner. "Most CEOs also recognize a triangular relationship between technology, product improvement and growth. They recognize that technology is the fundamental enabler of digital transformation and leading digital companies have figured out that EDA is the 'secret sauce' that gives them a competitive edge."

Though not a new concept, EDA use has dramatically increased, thanks in large part to its suitability for the growing deployment of Internet of Things (IoT) and artificial intelligence (AI) systems. Both technologies need to access huge quantities of data to make complex – often mission-critical – decisions in real time.

However, there are a variety of tools and approaches that can be used to build event-driven applications. Understanding the modern EDA landscape can help you select the best EDA platform to match your specific business and technical needs and achieve your digital transformation goals.

New Uses for Event-Driven Architecture

According to Gartner, EDA is a design paradigm in which a software component executes in response to receiving one or more event notifications. Historically used in back-office infrastructure with message queues and as the basis for user interfaces on the client side, EDA use has been growing for decades.

In recent years, with exabytes of data streaming in from the Internet and devices connected to it, organizations have found a new asset from which they can derive value. The increasing desire to tap into that data for real-time access and response has thrust EDA into many new categories of applications, such as real-time responses to sensory data, triggered by the sensors themselves.

At the same time, technology has finally progressed far enough to help realize the promise of AI. In this scenario, EDA acts as the nervous system, efficiently and effectively moving relevant data to the correct AI processing location and then enabling the AI algorithm to drive complex actions. Many organizations recognize the potential power of AI to transform their business and have begun implementing machine learning, propelling EDA even more deeply into organizations and across a wider set of vertical industries than ever before.

The proliferation of IoT has also increased deployment of event-driven applications that take advantage of edge computing. Edge computing is a distributed computing topology, with information processing occurring where things and people produce or consume that information, on the edge of the model rather than in a centralized location.

The emergence of low-code application development platforms focused on EDA has made it easier than ever to build event-driven applications. This increased speed of development – and relative ease of deployment – has led to an increased demand for event-driven applications that respond in real time.

As EDA continues to adapt to ever-changing business needs and desires, it has become an increasingly popular choice to modernize, automate, and bring intelligence into business operations and processes.

VANTIQ provides the only complete 'nervous system' necessary to ingest streaming data from IoT and other sources, apply AI and machine learning algorithms as necessary, and finally take complex actions in real time.

Limits of Three-Tier Architectures

Platform as a service (PaaS) has been a mainstay in computing for the last decade. It helps eliminate the complexity of building and maintaining the infrastructure typically associated with developing and deploying an application. Customers can access the application via provider-managed or self-managed, multi-tenant or dedicated clouds.

Development and deployment platforms for application services are also increasingly being offered via the cloud. This is because application platform as a service (aPaaS) enables speed, collaboration, and control across the entire application lifecycle. An aPaaS platform also provides the ability to build applications iteratively; provision application software instantly; scale applications on-demand; and integrate applications with other services.

Cloud-based deployment gives the customer the benefits of having access to software as a service (SaaS), including software licensing and delivery via subscription from a centrally hosted location.

Well-known players that offer generic application development platforms via the cloud include Appian, Mendix, and OutSystems, among others. Each of these three vendors enables low-code, rapid application development. However, all are fundamentally based on a conventional three-tier architecture:

- Data tier – Data is persisted and accessed via a database (e.g., relational database management systems – RDBMS – such as Postgres) or application programming interfaces (APIs) to legacy application's data.
- Logic tier – The logic uses an app server to run application logic.
- Presentation tier – For user interface front ends, presentation tiers use native windows, browser, or mobile.

Limits of Three-Tier Architectures

(Continued)

These companies were established in the early- to-mid 2000s, the era when cloud and cloud-connected mobile devices began their rapid growth. Their founders realized the power of building and deploying applications in the cloud.

These firms produced application development tools such as visual, front-end graphical user interface (GUI) builders and visual logic design tools. These products were well-suited to the earlier generation of database-centric applications.

Typical applications built with these products include contact management applications, human resources management applications, and asset management and maintenance scheduling applications. They enable basic user events and, possibly, very limited IoT input.

However, three-tier architecture applications cannot support the business or technology needs of real-time events that are the foundation of most innovative and transformative applications now being conceived. Fortunately, much more advanced development solutions are now available, suited to rapidly building true real-time, event-driven applications.

The VANTIQ aPaaS was engineered from the beginning with an event-driven architecture at its core. While it supports agile, low-code development like other aPaaS, what sets it apart is its ability to rapidly build modern, real-time, event-driven applications.

Supporting Real Time

Real-time events can be generated during a variety of now common use cases:

- Legacy systems that perform common functions, such as when a new employee is hired, an order is shipped, etc.
- Newly created IoT sources, such as pressure and temperature sensors taking live readings from a compressor
- Location tracking of assets or people via global positioning system (GPS), radio-frequency identification (RFID), or beacons
- AI systems, such as when algorithms suggest options to a customer in a retail outlet
- Real-time data from APIs or messaging protocols such as Representational State Transfer (REST) or MQ Telemetry Transport (MQTT)
- Social media streams and many other scenarios

To support the variety of real-time event use cases now being deployed, leading platform development vendors began implementing a modern architecture. Foundations of this architecture are systems that are responsive, resilient, elastic, and message driven. Designs are typically more flexible, loosely coupled, and scalable than traditional systems. Applications are easier to develop and change.

They are also highly responsive, giving users effective interactive feedback. Loosely coupled design makes them significantly more tolerant of failure. Because of the effective interactive feedback, when failure does occur, issues can be addressed in a simple, easy to deploy method.

To achieve web scale and true real-time, however, traditional aPaaS products (which use three-tier architecture) will need to be re-written in this more modern approach. However, this type of development is complex as it is fully asynchronous. Most event-driven application developers are not familiar with this sort of programming and would need the simplicity of a low-code, model-driven platform to build massively scalable and resilient EDA applications.

> Applications built with VANTIQ are inherently scalable and resilient. There is no need for downtime when updating and enhancing applications and it is easy to integrate real-time VANTIQ applications with legacy systems and data sources as necessary.

Deployment in Distributed Computing

There are significant benefits to having a single, integrated application development platform. However, today, it is well accepted that processing will be distributed, frequently happening close to the data at the edge, and serverless architectures are the state of the art.

Cloud-based solutions are often less expensive and shift costs from capital to operational expenditures. They can also be more powerful than traditional solutions as well as easier to implement, integrate, and scale. Many organizations also value the mobility, remote working, collaboration, and flexibility that are inherent in cloud-based solutions.

This distributed modern world requires a modern, fully distributed system running fully distributed applications across clouds and on the edge. Unfortunately, very few application development platforms can easily support the needs of distributed computing models.

As the volume of real-time data sources and the information they generate continues to increase (especially driven by machine learning and image recognition systems running on the edge), there is a real possibility that these massive data streams could overload networks supporting client-server computing models. In these cases, applications that can shift workloads dynamically (cloud-to-edge, peer-to-peer, mesh, etc.) by being physically distributed are the only solution.

Physically distributed applications are also a requirement when network latency becomes an issue and near real-time actions must occur (e.g., safety issues on an oil rig). By placing data storage and analysis capabilities at the edge, organizations reduce the amount of data sent to the cloud, cutting out unnecessary data transfers, improving cybersecurity, and decreasing network and system response times. As a result, data and analysis on critical processes are kept as up to date as possible.

For these reasons, many believe edge computing and even embedded intelligence will grow dramatically, just as cloud computing did in the early 2000s. However, most application development solutions lack the distribution and federation to support edge computing's low latency requirements.

The VANTIQ platform was engineered from the beginning to support distributed and edge computing models. After developing an application, VANTIQ enables easy deployment of the relevant parts of the system to the appropriate environments or edge nodes and then ensures these systems work powerfully together in real time. Future enhancements are easily streamed out to these nodes as required.

Enabling Human Agility

Going forward, time to result or resolution will continue to drive application design. However, as systems get more complex and intelligent, humans must continue to be involved to address unknown situations or resolve conflicts utilizing their experience and intuition.

Examples include:

- A visual developer interface to easily design and create collaborations via web interfaces, mobile interfaces, natural language processing, augmented reality, and more
- High-level abstractions for assignment, location tracking, recommendations, communication, escalations, and other highly interactive human exchanges

This means that application development platforms must build robust human-to-machine (H2M) collaboration capabilities into their products that support a wide array of potential human-machine interaction scenarios. Development platforms need to include high-level abstractions for developing and running such applications.

Inclusion of certain tools and features can also have a major impact on organizational productivity. For example, it is possible to make anything in an event-driven application change dynamically, including data sources and logic locations, humans can use agile development methodology to improve time to result with no downtime during updates.

Low-level languages would require much greater amounts of coding to make these collaborations possible. As a result, tools built with those languages are often prohibitively time-consuming and inefficient for developing such interactive, event-driven applications.

> Enabling real-time human-machine collaboration is central to the purpose of VANTIQ. VANTIQ makes it easy to build applications that enable software systems, mechanical systems (including robots), and people to interact efficiently in complex scenarios.

EDA for IoT Use Cases

Today, hundreds of platform vendors support IoT with device provisioning, data access, and control, either in the cloud or at the edge. Industry research firm Statista expects the worldwide IoT market to grow from $164 billion in 2018 to $1.6 trillion by 20251. Firms already in this space include Dell, EdgeX Foundry, ThingWorx, Kepware, PTC, and Predix from GE.

The IoT platforms usually move data to the cloud when needed for data-intensive applications such as big data analysis or to support machine learning algorithms for AI. Many operate in the industrial IoT space, where systems determine predictive maintenance actions and improve overall asset performance, requiring them to be event driven at the edge.

However, these platforms generally act as special purpose databases and, therefore, are incapable of supporting real-time, event-driven applications.

In addition, most IoT platform vendors do not offer full application development environments; those that do, offer limited products that are primarily focused on dashboarding and do not meet the changing needs of modern businesses. For IoT devices to work, applications need to be created to transfer data based on the activity of the IoT device to its processing center and, often, back to the device – enabling actions in real time.

Application development firms working with these IoT platform vendors must also be able to easily consume data from IoT platforms and be interoperable with other applications, many of which are specific to certain use cases or industries.

> Digital transformation via IoT comes from taking powerful actions, not simply looking at dashboards. Detailed dashboards can be built in VANTIQ, but the real power of an IoT-enabled VANTIQ application is when the data streams are used to take actions in real time.

1 Size of The Internet of Things (IoT) Market Worldwide From 2017 To 2025 (In Billion U.S. Dollars), February 2019, Statista

EDA for AI Use Cases

Technology has finally evolved to the point where the promise of AI is nearing fulfillment. Self-driving cars are becoming more capable and industries are constantly inventing new AI use cases. In fact, McKinsey & Company estimates that AI techniques have the potential to create between $3.5 trillion and $5.8 trillion in value annually across nine business functions in 19 industries2. They estimate that this translates into an additional $13 trillion of global activity by 2030.

However, this growth is not just because of more data to power machine learning, advanced analytical algorithms, better storage, and new processors. Performing tasks intelligently requires a sense-and-response ability that cannot occur without event-driven applications processing the data in the correct locations at the correct times. Put another way, if algorithms on processors are the brain of an AI system and storage is the bones, then event-driven applications are the nervous system.

As a result, organizations have been able to turn data into an asset from which they can derive significant new value. But, as with many other situations, the value of AI-sourced data is in direct correlation to how quickly the information can be acted upon.

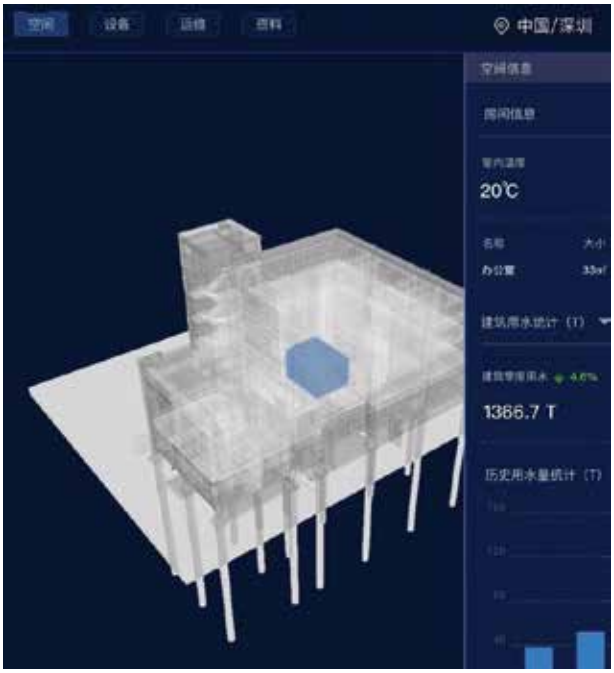
AI and Machine Learning (ML) are powerful technologies, but require VANTIQ to use their outputs to take complex actions in real time. VANTIQ is not an AI or ML tool – instead, it enables powerful applications to be created using these tools.

2 Notes From The Ai Frontier: Modeling the Impact of AI on the World Economy, Sept 2018, McKinsey & Company McKinsey Global Institute

EDA and Digital Twins

A digital twin is a key enabling concept in business digitization efforts. At its simplest, a digital twin is a digital representation of an asset. The asset may be a physical asset such as a sensor, a machine or vehicle, or it may be a logical asset such as a business process or service. The digital twin can be used as a proxy for the asset making it convenient for integration into digital control systems and business analysis systems. Driven by instrumentation of the asset the Digital Twin behaves as a high fidelity, digital simulation of the behavior of the asset.

Up to now, most digital twins are used to simulate physical systems and detect issues prior to the system going 'live'. But EDA makes it possible to take the concept of digital twins to an entirely new level. By being able to analyze data streaming in about the real-time status of an asset, an application can be created that can either automatically, or in conjunction with human operators, address issues with the asset. Alternatively, machine learning algorithms can be used to predict future states of the asset based on its current status, and then enable powerful actions to take place. Systems based on next-generation digital twins will certainly have EDA at their core.



3D digital twin model of a commercial building, whose systems are now monitored and controlled in real-time by an event-driven application.

The VANTIQ Platform was designed for rapid creation of digital twins or easy integration with digital twin systems that already exist. By adding VANTIQ to a digital twin, complex actions can be taken by the physical systems that the twin represents.

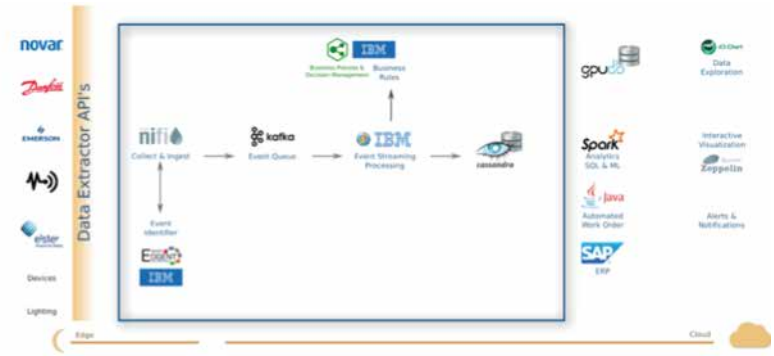
In-House Solutions

Some complex industries with a significant dependence on technology for basic operations are choosing to execute digital transformation via event-driven applications entirely in-house. These firms can devote enough human resources to build a real-time EDA software stack, including assembling their own infrastructure, tools, cluster management, distributed computing, event message brokering, and collaboration capabilities from scratch.

Their developers are experts in a wide variety of core technologies. They work in an environment that will allow sufficient development, testing, and integration time to build what must, by necessity, be a hyper-complex system.

An example of the resulting technology stack, built and used by a global retailer in its real-time, event-driven supply chain application, is below.

This in-house option is increasingly unappealing to many firms, even if they have the expertise and funding in-house, simply due to the time involved in assembling such a system and building the required applications on top of it. However, most firms do not have the in-house expertise to build a distributed, collaborative, real-time event-based system. They lose additional time and incur additional cost simply finding and onboarding the developers they need.



Beyond those considerations, because of employee turnover, few organizations have the long-term stability of their technical employee base necessary to ensure consistency during the entire, lengthy development process, let alone after go-live.

This lack of continuity puts smooth execution of a vision today at risk and significantly complicates adaptation of the existing system over time.

By combining the principles of low-code, agile application development with event-driven architecture, organizations are able to build, deploy, and maintain the next generation of real-time applications with VANTIQ that would have been unimaginable only a few years ago.

Conclusion

In every era, new business goals and new technologies require changes to how existing computing paradigms are applied to business-driven needs. That is fundamentally why VANTIQ was created.

While EDA has existed in one form or another for decades, the current set of market demands makes it the logical choice for firms executing digital transformation via IoT, AI, and other use cases with similar, rigorous requirements.

Event-driven applications built with VANTIQ offer the components necessary for these mission-critical systems, including real-time data transfer, distributed design, collaborative capabilities, scalability, and resilience.

The EDA landscape includes tools that can support specific types of event-driven capabilities better than others. But there is only one complete platform that will allow you to weather the changes of tomorrow even as you leapfrog your competition today.

For more information, contact Info@VANTIQ.com.

ABOUT VANTIQ

Customers around the globe rely on VANTIQ to quickly and easily create the next generation of transformative digital applications to serve the Internet of Things (IOT), smart cities/buildings, oil and gas, healthcare/life sciences, and telecommunications, among other industries. VANTIQ powers these mission-critical real-time business operations with our low code event-driven architecture (EDA) application development platform. Founded in 2015 by renowned business and technology leaders Marty Sprinzen and Paul Butterworth, VANTIQ dramatically reduces time-to-market, significantly lowers development and maintenance costs, and provides maximum agility in response to constantly changing operational requirements. Learn more at www.vantiq.com.