PERFORM AND TRANSFORM WITH COMPOSABLE APM

Achieve performance and transformation goals with composable and interoperable APM backed by the elastic scaling nature of AWS services.

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WHY AN ADAPTABLE DIGITAL FOUNDATION IS CRITICAL

Industrial organizations are under growing pressure to ensure profitable operations for today while setting themselves on a sustainable growth path for tomorrow. Investing in the right processes and technologies is one of the key requirements to achieve this. While there is no doubt about the massive transformation that Industry 4.0 has unleashed, the pace of new technology introduction and obsolescence has been difficult, if not impossible, for many organizations to keep up with.

Balancing legacy and emerging technologies is complicated due to changes in user requirements, reliance on current solutions, and advent of more powerful alternatives, among other reasons. Organizations that are still relying on their legacy technologies without investing in updating them, are likely to be left at a disadvantage in regard to their return on investment (ROI).

As new and old technologies coexist, technical debt could prove to be one of the biggest impediments in realizing value from investments in digital transformations. Although the inefficiencies due to technical debt can be present at different levels and use cases, at an enterprise-level, they are more noticeable when organizations attempt to converge data sources, integrate multiple systems, or even develop in-house digital solutions such as ticketing systems.

Therefore, it's critical for organizations to continually modernize, reevaluate, and realign their technology investments. It ensures that their digital infrastructure is set on a foundation that flexes and adapts to their ever-changing internal and external dynamics. This also requires the organization's software providers to be as committed as the organization itself to modernization and innovation. Together, GE Vernova Power and Energy Resources and Amazon Web Services (AWS) provide guidance backed by deep experience across IT and OT.

CHALLENGES WITH TRADITIONAL OR LEGACY ARCHITECTURES

When discussing traditional or legacy IT, one of the first things that comes to mind is the solutions that are based on monolithic architectures. In such architecture, all components and features of an application/system are packed tightly into a single unified unit, which must be built and deployed in the same way (as a single unit). Due to such packaging of applications/systems, users rely on each component to always be working to gain value from their investment. Monolithic architectures also suffer from other drawbacks including:

MANAGEMENT AND SCALABILITY ISSUES

Since the entire application/system is developed on a single codebase, as the codebase grows over time understanding and management turns difficult.

- Changes to one component may have unintended consequences on others, as components are tightly coupled.
- Scalability is difficult and inefficient. Even if a specific component needs scaling, the entire system/application must be scaled.
- Customizations may become more challenging with different teams trying to attempt them on the same code simultaneously.

PROBLEMS IN DEVELOPMENT, TESTING, DEPLOYMENT, AND REUSE

Development is difficult due to multiple teams working on the same codebase. Testing is painful as changes can impact other dependent components. Also, deployment is complex as entire application/ system needs to be redeployed. As expected, the single monolithic codebase is less reusable.

INABILITY TO LEVERAGE NEW TECHNOLOGY

Monolithic architectures are just that – monolithic or "built-as-one." Hence, as new technology for specific functionalities become more affordable and available, organizations are unlikely to reap the benefits due to inflexibility of their current architecture.

> "To deliver on future strategy, utilities, like their counterparts in other industries, need to become composable enterprises: organizations that deliver business outcomes, and are ready to more quickly adapt to the pace of business change.
> And to do so, utilities need to adopt composable business architecture.[1]"
>
> Gartner®

It's evident from the above that traditional monolithic architectures are not suitable for organizations that want their digital infrastructure to be scalable and adaptable to their dynamic business requirements. It's no surprise there's growing interest in solutions with modular or composable architecture which can be flexed per business needs.

70%

The percentage of large and medium organizations which will include composability in their approval criteria for new application plans by 2024, Per a Gartner, Inc. report[2].

[1]Gartner® "Composable Architecture Solutions for Utility Product Leaders: A Gartner Trend Insight Report," Zarko Sumic, 18 October 2022.

[2]Source: Gartner®, How to Design Enterprise Applications That Are Composable by Default, Yefim Natis, Massimo Pezzini, Anne Thomas, 26 April 2021. Gartner® is a registered trademark and service mark of Gartner, Inc. and/or its affiliates in the U.S. and internationally and is used herein with permission. All rights reserved.

COMPOSABLE OR MICROSERVICES-BASED ARCHITECTURES

The limitations of monolithic architectures led to development of microservices-based architectures, which are modular or composable. Before we dive into microservices-based architecture, let's touch upon what microservices are and their benefits over monoliths. Cloud computing giant and GE Vernova's strategic partner Amazon Web Services (AWS) defines microservices as:

Microservices are an architectural and organizational approach to software development where software is composed of small independent services that communicate over well-defined APIs.

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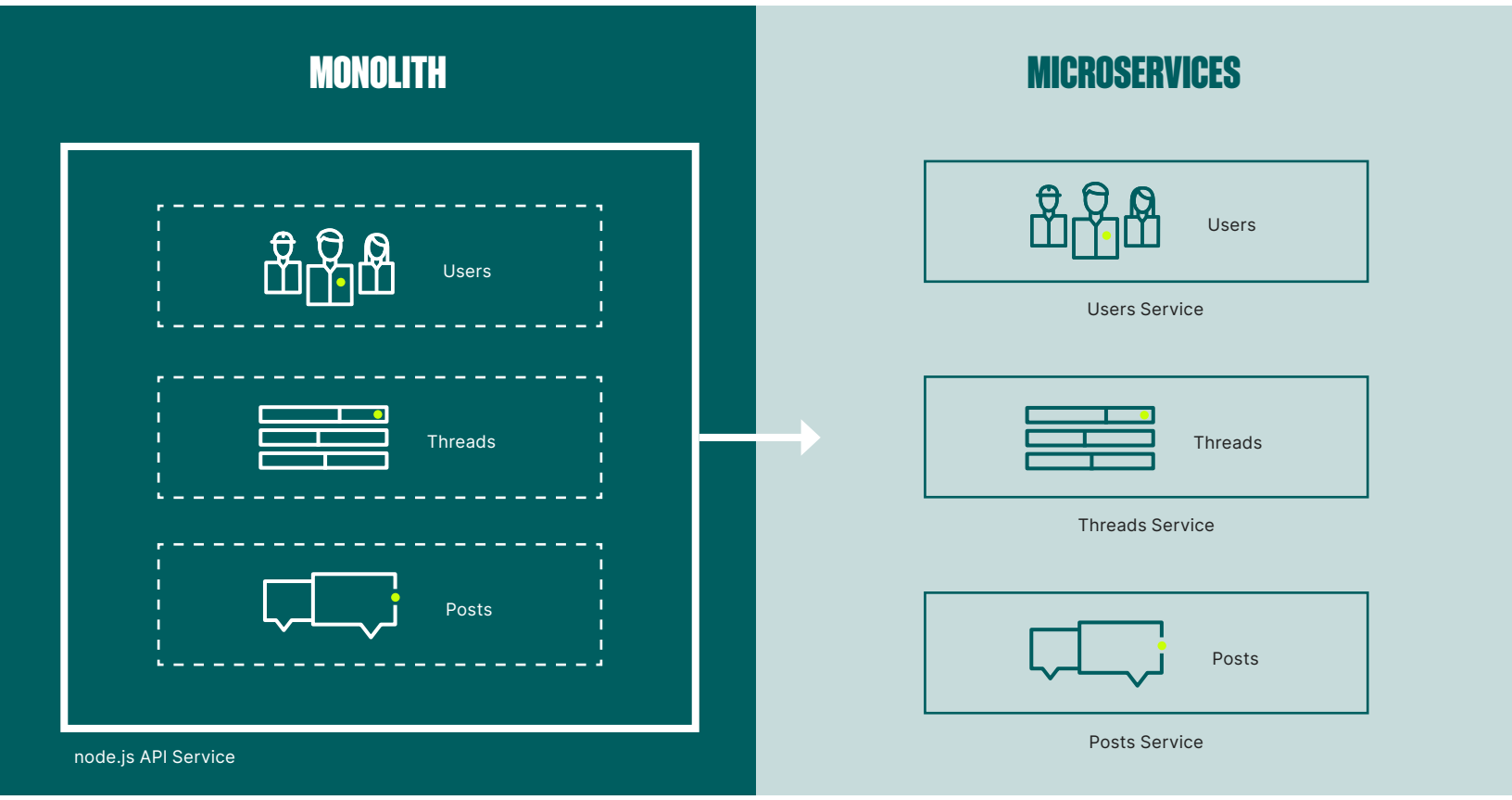
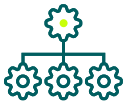
Thus, unlike monoliths which rely on a single code base, microservices break that into multiple, independent code bases. Hence, in a microservices architecture, an application is built as independent components that run each application process as a service. As the services run independently, each service can be updated, deployed, and scaled to meet requirements for specific functions of an application.



**By removing restrictions of monolithic architectures, a microservices approach allows for more flexibility for the user

MICROSERVICES OFFER SEVERAL BENEFITS COMPARED TO MONOLITHS



SCALING

Allows each service to be independently scaled to meet demand for the application feature it supports. This means that your applications, or parts of it, can be scaled vertically or horizontally to meet the needs of users in near real-time.

BUSINESS AGILITY

Small, independent teams can take ownership of their respective services and work independently or collaborate faster. By having owners of specific services governed internally and/or supported by vendor(s), work involving applications can be done faster and innovation can become commonplace.

DEVELOP, TEST, DEPLOY, AND REUSE

- Independent units help in fast, easy, and more frequent updates and deployments
- Easier to isolate, fix issues, experiment, and test
- Small, well-defined modules enable teams to use functions for multiple purposes

LEVERAGING THE BEST-SUITED TECHNOLOGY

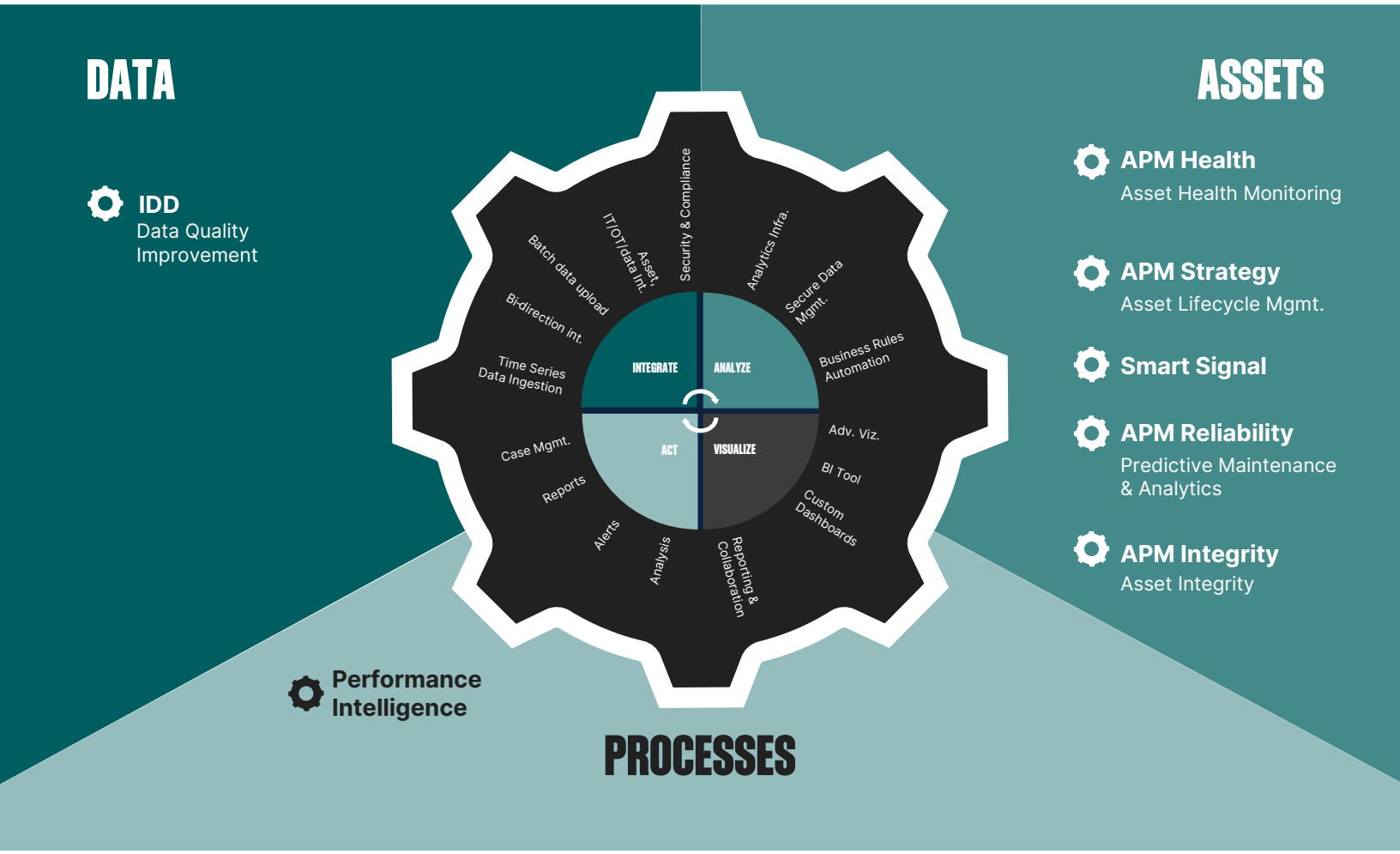
Microservices teams are free to choose the best-suited technologies for their respective services. Leveraging a microservice-based architecture gives organizations as well as their software vendors that power of choice.

For organizations that are looking for increased composability, interoperability, and time to value, the above benefits are great motivators to move towards a microservices-based structure.

HOW GE VERNOVA'S APM SUPPORTS COMPOSABILITY AND INTEROPERABILITY

DRIVING COMPOSABILITY WITH MICROSERVICES-BASED ARCHITECTURE

GE Vernova's Asset Performance Management (APM) suite comprises several APM applications that are focused on different aspects of managing and optimizing assets' performance. The cloud-based APM applications are powered by the Essentials platform[3], which employs a Cloud Foundry[4] and Kubernetes-based architecture to support microservice use and delivery. In fact, both the Essentials platform and each APM application use some form of microservice to ensure flexibility, usability, and availability.



Essentials is the cloud-based enterprise engine powering GE applications

[3]GE Vernova's APM on-premises applications are hosted on APM Foundations platform

[4]Cloud Foundry is an open source, multi-cloud Platform-as-a-Service (PaaS).

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GE Vernova's APM architecture offers organizations the flexibility to deploy APM applications separately or all together as a holistic enterprise-grade solution. This gives organizations of any size the flexibility to get started with select applications of a top-rated[5] APM solution and expand to include more applications as needed in future.

No matter the number of APM applications subscribed by an organization (from a single application to the full suite of applications), users can access and manage all of them from a single user interface. This enhances the user experience and helps them leverage the power of centralized insights from different data types and sources including CMMS, EAM/ERP, sensor, timeseries and others.

The composable APM architecture enables different APM functionalities to be split into self-contained services. Each service focuses on a specific APM capability, such as data collection and integration, analytics, visualization, reporting, security and so on. Some of the key services available under GE Vernova's APM are focused on:

DATA COLLECTION AND INTEGRATION

Includes EAM integration, file-based ingestion; Open Data Protocol, and API-based ingestion for interoperability

DATA MANAGEMENT

Includes Timeseries data management, PostgreSQL database, Blobstore, Asset Management

ANALYTICS

Includes Common Analytics Framework, SmartSignal analytics

VISUALIZATION AND APPS

Advanced Visualization, Alerts, Cases and Analysis

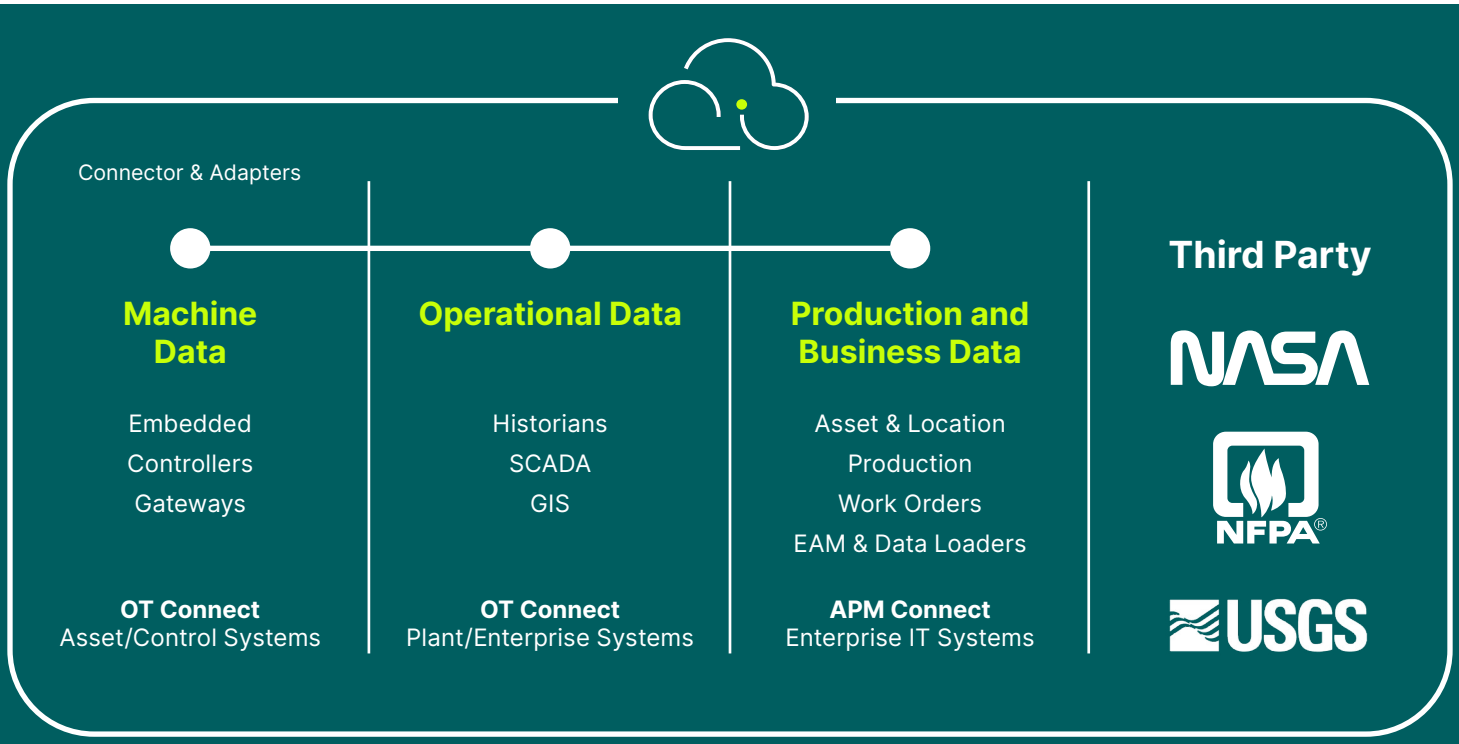
SECURITY

Includes User Management, Tenant Management, User Authorization and Authentication, and Audit Service

[5]Per independent analyst firm Verdantix's APM Green Quadrant 2022 Report

DRIVING SEAMLESS INTEGRATION AND INTEROPERABILITY

One of the key capabilities of GE Vernova's APM is its ability to create an integrated and interoperable environment or platform where different types of data, including the organization's internal IT and OT data as well as external data, could be consolidated, processed, and shared seamlessly.



To enable integration of Enterprise IT data that may exist in data stores, systems, and applications throughout the enterprise, an APM Connect integration framework has been designed. The framework delivers data transformation engines to convert data to their appropriate forms, a modular integration engine to handle complex routing scenarios, and other engineered components to create a unified integration solution. Numerous adapters built on the APM Connect framework can meet many integration needs by either pulling data from or pushing it into other sources in the data ecosystem.

For integrating OT systems data (from MES, HMI/SCADA, Historian, etc.) and Machine data (from controllers, sensors, etc.) OT Connect proves helpful. It allows users to connect to and synchronize Tag metadata from an OPC[6]-compliant historian. This also allows them to enable Tag subscriptions to view, analyze, and act on real-time process data, such as temperature or pressure.

The use of Open Data Protocol and API-based ingestion drive interoperability and ensure that data could be shared seamlessly. Also, bi-directional integration of APM data with Enterprise Asset Management (EAM) systems from SAP and IBM is made possible.

OT Connect: Connect and Collect Machine Data from Central Data Aggregation Systems

APM Connect: Connect and Collect Structured Data from Plant and Enterprise Systems

[6]Open Platform Communications (OPC) is an interoperability standard for the secure exchange of industrial automation data

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REINFORCING COMMITMENT TO SCALE WITH AWS COLLABORATION

By working with Amazon Web Services (AWS), GE Vernova further reinforces our commitment to deliver cloud-based solutions, which are composable, integrated, and highly scalable. AWS has an industry-leading comprehensive microservices platform and building blocks to support any application architecture, regardless of scale, load, or complexity. Through the AWS collaboration, GE Vernova APM users gain access to microservices such as Redis, EC2, SageMaker, S3 and many more.

CONCLUSION

GE Vernova's modern, microservices-based APM architecture favors modularity, scalability, and agility. It offers an integrated environment with tools, services, and frameworks to support seamless flow of data across the enterprise and drive interoperability. Our composable and interoperable APM solution adapts well to your dynamic business needs and helps you maximize value on your data and asset investments. Further, it constantly keeps getting better with the latest enhancements from GE Vernova and the elastic scalability of AWS Services.

THE FOUNDATION FOR NEW HEIGHTS OF OPERATIONAL EXCELLENCE

Experience the strength of the APM platform with an interactive demo of our interoperable applications.

Explore demo hub