Enabling Digital Manufacturing Transformation with an Event Mesh

An event mesh enables real-time event streaming across your entire value chain, drastically improving operational efficiency and customer experience, and enabling new revenue opportunities.

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> **Events are the lifeblood of the modern enterprise. Businesses that enable events to flow freely and easily across every element and environment of their enterprise will thrive by being able to innovate faster, run their business more efficiently and offer customers a superior experience.**
>
> **-SHAWN MCALLISTER, SOLACE CTO**

WHAT IT MEANS TO BE EVENT-DRIVEN

Anything that happens in your enterprise can become a digital 'event' that travels through your distributed system, in real-time, interacting with a variety of applications in different environments (on premises, in private clouds, in public clouds), to drive operational efficiencies, to make better decisions, to spur innovation, and ultimately to serve customers better. That is the promise of an event-driven architecture.

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ENABLING IT/OT INTEGRATION ACROSS PLANTS, ENVIRONMENTS AND GEOGRAPHIES

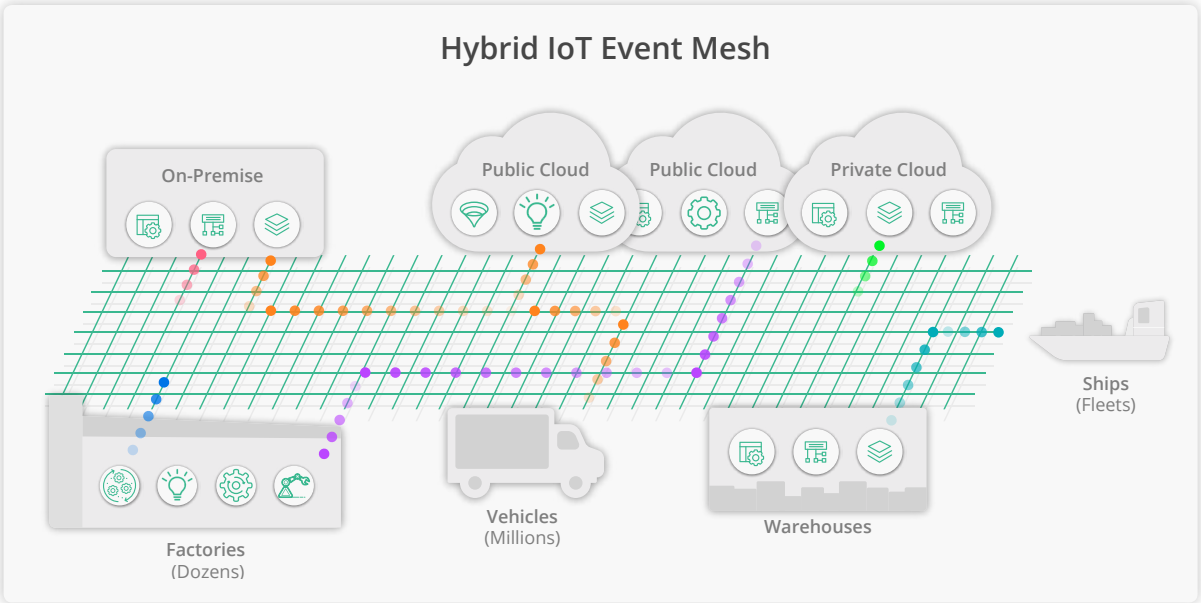
With the advent of Industry 4.0, global manufacturers have been looking for ways to automate and improve data exchange among operational and information technologies (OT and IT) to improve production processes, supply chain management, operations and customer experiences.

A variety of challenges often slow the progress of this transformation, including:

- the traditional division between IT and OT, and the people who work with these technologies;
- the increasingly distributed nature of IT and OT across plants, environments and geographies; and,
- the lack of a cohesive vision and strategy for quickly, reliably, and securely moving data across distributed IT and OT, and doing so at scale.

An event mesh can be the solution that helps you overcome these challenges. Think of it as:

- a new but intuitive concept that can help bridge the culture and language gaps between business and technology leaders across IT and OT domains;
- an architectural pattern well-suited for distributed and varied technologies that run in different environments (no cloud, hybrid cloud, multi-cloud), but that must communicate across environments; and,
- core to a cohesive strategy to move data across IT/OT in a real-time, event-driven, reliable and secure way.



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SUCCESSFUL DIGITAL TRANSFORMATION REQUIRES A REAL-TIME, EVENT-DRIVEN FOUNDATION

Businesses that thrive both respond in a timely fashion to events that matter and can predict the events that are coming so they can avoid problems and take advantage of opportunities. This is a challenge today because customers have raised the bar on what "timely" means, and the volume and complexity of event data is increasing.

Events are coming from an increasing number of sources and can be triggered by human actions, by nature, by software systems or devices. They are occurring across multiple (even global) lines of business, and can be processed in a private cloud, public cloud, on-premises, or hybrid cloud. They can be created and consumed in a proprietary or open source system, in a SaaS, or across a mix of systems and environments.

TECHNOLOGY IS SUPPOSED TO HELP, BUT TODAY'S SYSTEMS WERE NOT DESIGNED FOR A REAL-TIME, EVENT-DRIVEN WORLD

Much of today's technology, architectures and infrastructure were designed to handle static vs. dynamic data, and batch processing vs. continuous processing. They were designed for people and systems to manually ask if an event occurred, instead of just being made aware of the event as it happens. These old systems create friction that degrade the customer experience, reduce efficiency, increase costs, and get in the way of innovation and growth.

Event-driven architectures support event-driven businesses. Many IT departments have been trying to enable event-driven design patterns and architectures, but they are running into difficulties. Making it work can require:

- a way to notify one, some or a multitude of applications about potentially billions of events that are occurring across the distributed enterprise;
- an easy way for developers to design, describe and discover events in the system; and,
- expertise and understanding of best practices in developing event-driven architectures.

Long established organizations that have had success overcoming these challenges have done so with massive investments of time and money. Some found that the benefits outweighed the costs, especially those in industries like capital markets or commercial aviation where real-time responsiveness is mission-critical.

Some younger organizations that were born in the digital age built their data architectures to be event-driven from scratch.

But for most organizations, the weight of legacy infrastructure is a barrier to their digital transformations. For many, the complexity and costs have always exceeded the benefits, making the adoption of an event-driven architecture impractical. They've needed an easier way.

That's what an event mesh powered by Solace PubSub+ delivers.

AN EVENT MESH IS A NEW WAY TO ACHIEVE THE PROMISE OF REAL-TIME, RESPONSIVE OPERATIONS.

An event mesh is a layer of infrastructure that routes events from where they are produced to where they need to be consumed—regardless of the system, cloud, or protocols involved. If you're familiar with service mesh, event mesh is a similar concept but for the event-driven world.

An event mesh is created by connecting event brokers (modern messaging middleware) within and across different environments, which enables applications in one environment to receive event notifications created by applications in any other environment—as long as both applications are connected to a local event broker.

4 WAYS AN EVENT MESH SUPPORTS DIGITAL MANUFACTURING TRANSFORMATION

We can look at digital manufacturing transformation projects through four primary use cases:

1. in-plant;

2. between plants to central HQ/private cloud(s);

3. between plants to central HQ/public cloud(s); and,

4. tracking and tracing of materials across global supply chains.

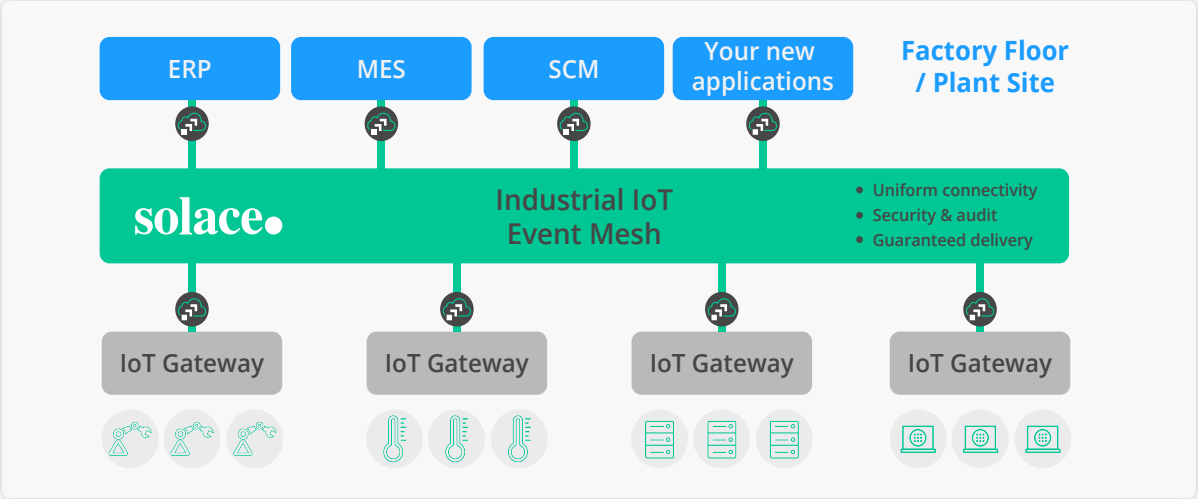
1. In-plant

In-plant, modern manufacturers are working to better integrate OT, and to integrate IT and OT, to optimize the maintenance, reliability, performance, and command & control of machines and equipment. One example is extracting the rich, raw data in machine tools and running it through applications and analytics engines to ensure optimal machine utilization and maintenance.

But a major challenge is that a plant can have a variety of equipment and machines using different sensors and IoT gateways, technology from different eras (Modbus, SCADA, PLC, DDS, OPC UA) and vendors (Siemens, Honeywell, Rockwell) all while using a variety of in-plant

applications (MES, SCM, Historians like OSIsoft PI System), none of which may communicate easily.

An event mesh will support event-driven data movement between these disparate technologies in-plant. Event brokers can be deployed to sit between IoT gateways (and in some cases put onto IoT gateways) from one or multiple vendors (such as Siemens SIMATIC, Dell Edge Gateway, and Bosch Rexroth), and they can be deployed to sit between a variety of in-plant applications (ERP, SCM, MES, PPM) to provide a unified event and data distribution layer across the disparate technologies.



2. Plants to central HQ/private cloud

Global manufacturers are also working to integrate different manufacturing sites (owned and contracted), HQ applications (ERP, CRM, SCM), and HQ private clouds for real-time analytics, to feed data lakes for data-at-rest analytics, and to monitor the quality and status of equipment and production processes—all for better business outcomes. And it's not only data ingest that needs to be supported. Data, events and commands also need to flow from back-end systems to plants to optimize the health, performance and reliability of in-plant applications, sensors and devices.

Consider a few examples, like having an HQ ERP system creating service tickets for machines in various plants, based on data that's being streamed in about degrading OT components. New machine components could be ordered and shipped to the plants, and the machine components upgraded, before the machines fail.

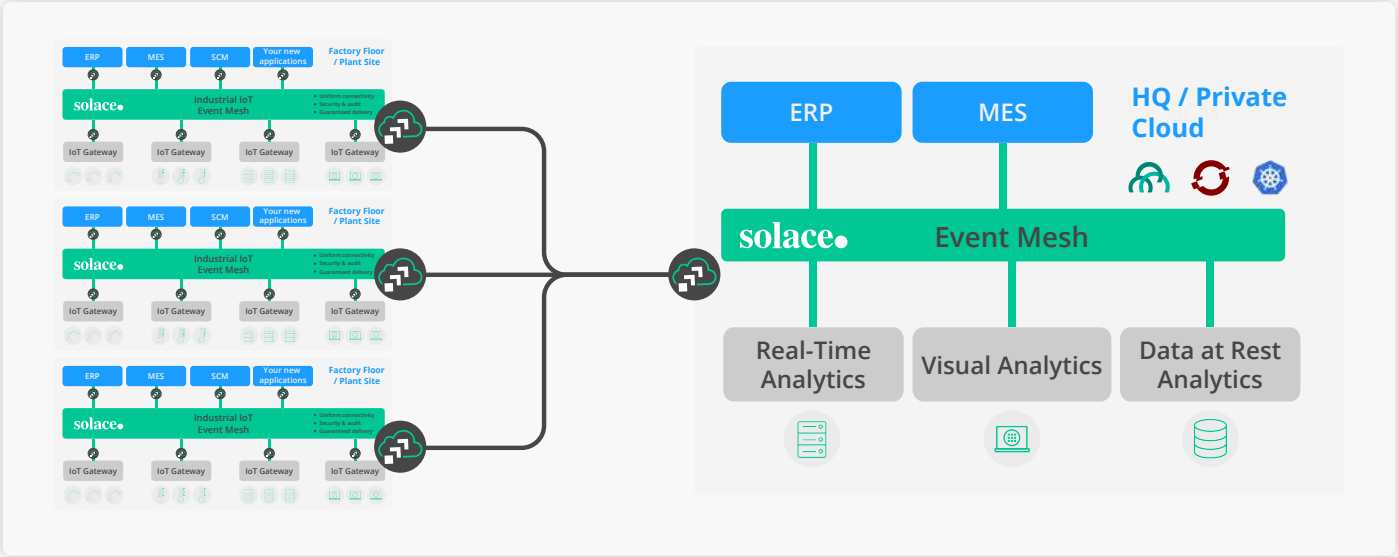
Consider the implications of being able to correlate real-time production data from various plants—you could streamline and realize cost efficiencies in warehousing, storage, shipment, and more.

Consider the critical ability to detect and respond to new allergens in your supply chain, at speed.

These opportunities demand real-time, bi-directional data flow, which can prove challenging. Data transport/routing can represent significant obstacles due to the variety of data formats, APIs, and protocols used by different applications and systems. Streaming data from globally distributed facilities can also be costly, especially without edge intelligence to reduce the amount of noise being sent to the cloud.

An event mesh is a solution to these problems.

Event brokers can be deployed in any or all plants, in a central HQ (data center/private cloud), and connected to form an event mesh that spans them all. Events and other data can then be pushed from local applications and gateways to local brokers where they will be broadcast to subscribing applications no matter where they live on the mesh.



If the event brokers that compose your mesh are advanced, they can also:

- Provide for standard protocol translation. For example, local brokers might receive event notifications and transmit them to regional or central HQ brokers over protocols (such as MQTT or AMQP) where they are then sent to back-end systems/apps via JMS.
- Enable edge intelligence by filtering and processing events and other data at the edge.
- Provide for WAN optimization to reduce costs and increase performance.
- Provide security and data access controls across the mesh.

3. Plants to central HQ/public cloud(s)

Another set of transformation opportunities and challenges relate to the integration of HQ and in-plant applications with public clouds and the services they offer. Many manufacturers are creating new cloud-native applications and microservices, as well as migrating existing on-premises applications to the cloud, to leverage modern tooling, maintenance, storage, operations, and pay-as-you-go pricing. Cloud data lakes and cloud services for AI and ML promise to support modern use cases, such as shifting from reactive to predictive processing, and from reactive to preventative maintenance.

Working with one public cloud is usually pretty straightforward, and that's where you're likely to start. You'll adopt a public cloud and/or an IoT platform like Siemen's MindSphere, and start developing new apps within that environment. Over time you may start migrating legacy apps to that public cloud and begin experimenting with cloud services.

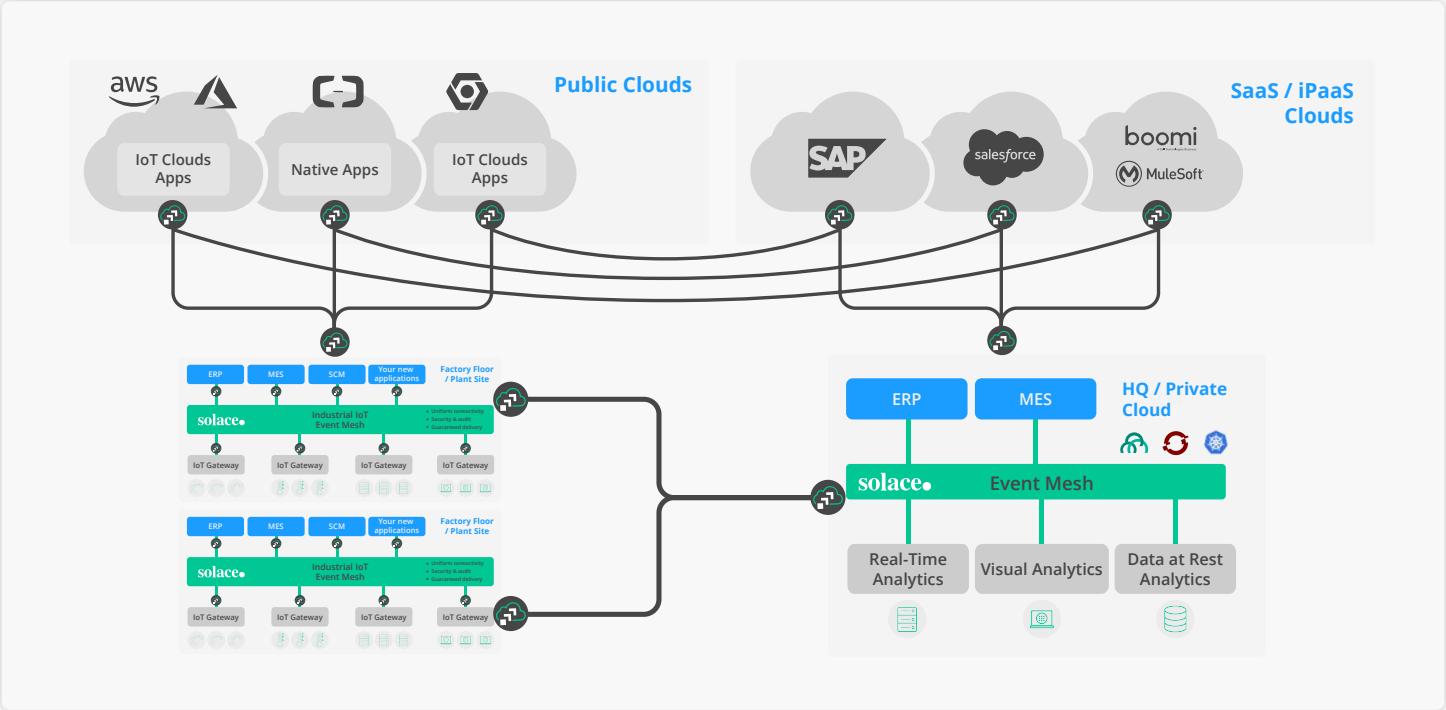
All good.

But then you'll realize that you need a feature or capability that's not offered by the public cloud you're in, or you'll want a more advanced version of a service that's offered elsewhere. You'll want more flexibility, the ability to mix and match capabilities from different cloud environments, and the freedom to move data and apps wherever you want. In short, you'll want to deploy a hybrid and multi-cloud architecture and enable data to flow easily and efficiently across it.

With an event mesh, working in and across multiple public clouds and cloud regions, and integrating cloud-native apps and services with legacy systems, is straightforward. Event brokers can be deployed natively in different public cloud environments (AWS, GCP, Azure) and on-premises, and connected to form the hybrid, multi-cloud event mesh. With an event mesh set-up in this fashion you can easily:

- leverage multiple public cloud services, from different public clouds;
- add, remove and move apps throughout your system, without disrupting the system;
- migrate to the cloud in a stepwise fashion;
- integrate IoT; and,
- set-up robust disaster recovery, leveraging your multi-cloud architecture.

4. Track and trace materials across global supply chain



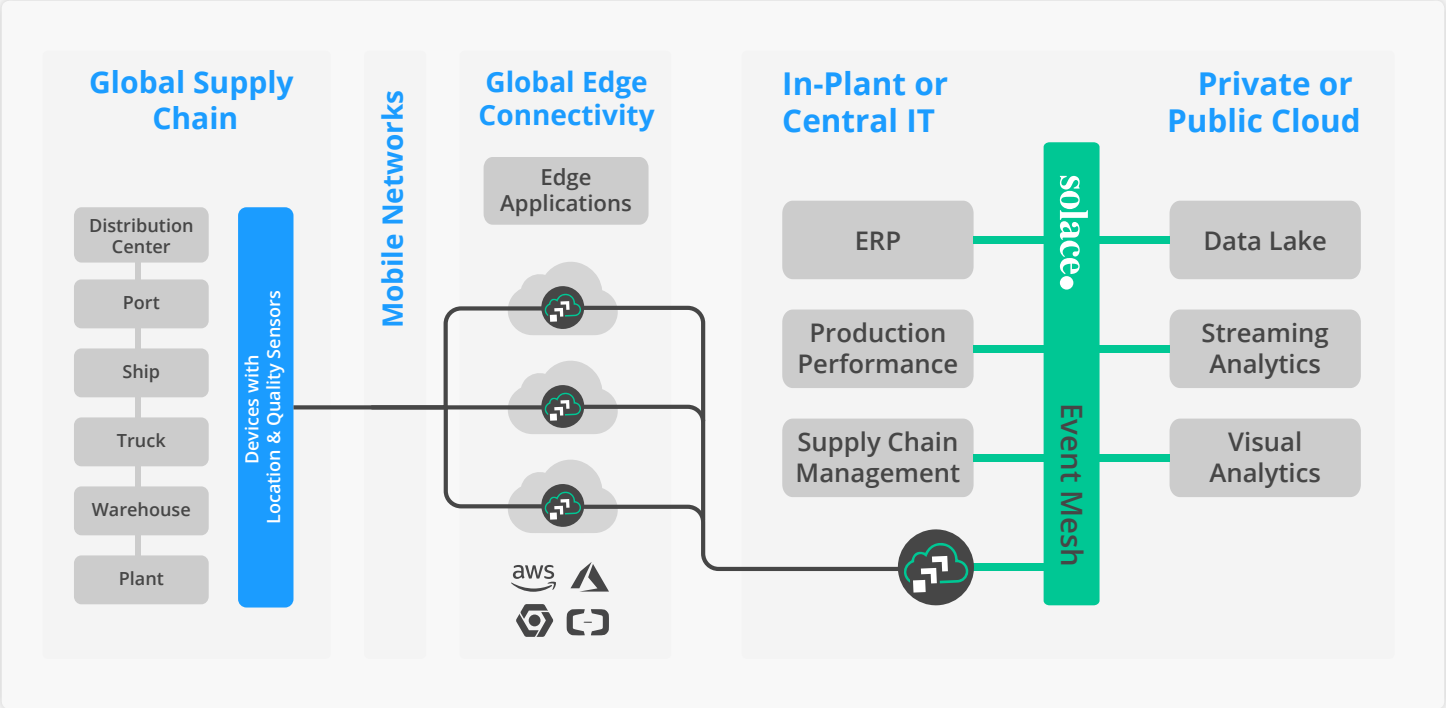
Another important objective of digital manufacturing transformation is to support the tracking and tracing of materials across global supply chains. We are seeing scenarios today where sensors are being deployed on every container or palette on ships, trucks and planes to follow materials and products in transit, monitor the environment and condition of the material in transit (measuring humidity and temperature, for example), and modify the speed, direction and timing of the transport itself.

Think about the ship that will slow down to save fuel when it receives a notification that its berth will be too busy to receive it at its original arrival time. Or the packaging manager who can efficiently allocate staff and equipment to receive a new shipment the moment it arrives at the facility. Or the CIO or CSCO who can lead a strategy conversation with real-time, historical and predictive views of the company's global logistics. Millions of sensors are being deployed with these outcomes in mind.

But there are challenges. A major challenge is ensuring data delivery despite intermittent connectivity. After all, sensors deployed in this fashion will travel through multiple and often erratic mobile networks (as well as various WiFi-networks); sometimes they'll be online, and sometimes they'll be offline. This can risk the loss of events and other data before they are delivered.

With advanced event brokers and an event mesh deployed, this challenge can be overcome. Event brokers can be deployed on a truck or ship or plane, and connected to receive all of the event notifications from the sensors on the transport. When the broker is connected to a mobile network, these events will be published to the event mesh. When mobile connectivity is unavailable, the events will get buffered by the broker and sent whenever connectivity is restored.

And with an event mesh enabling events to be routed efficiently between these transports (and plants, warehouses, HQ, and public clouds), not only will digital manufacturers be able to track and trace their materials through global supply chains, they will gain a better understanding of the choreography of their supply chain so they can test it and improve it to meet rising customer expectations (for example, lot-size-one production).

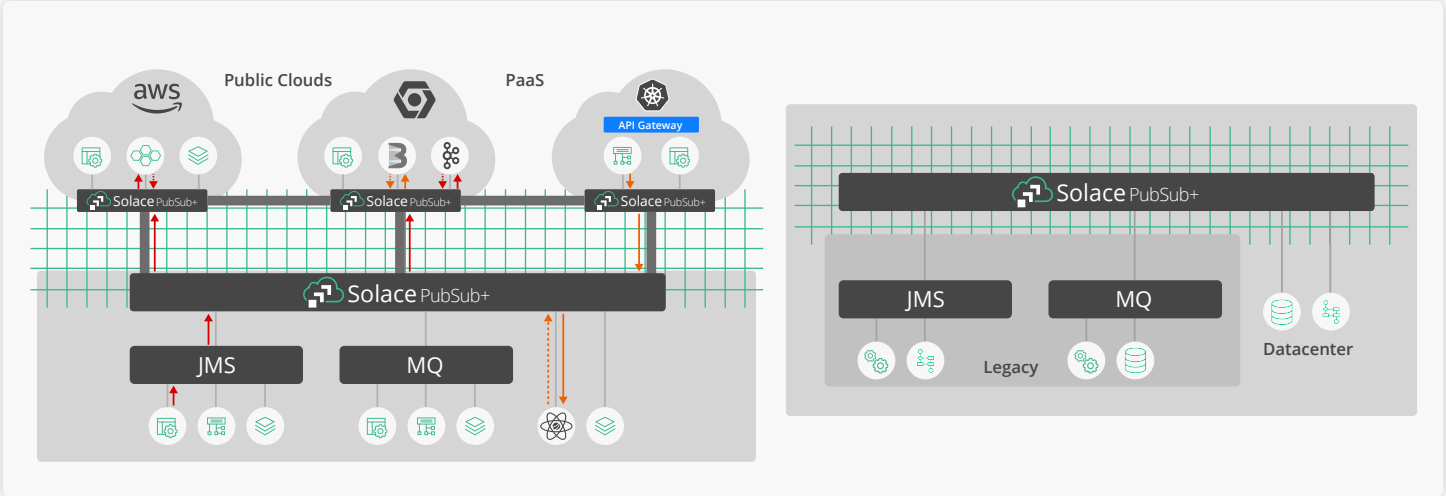


Global manufacturers are innovating to meet rising consumer expectations; an event mesh is the architectural layer critical to enabling global manufacturing innovation and transformation.

AN EVENT MESH BUILT WITH PubSub+ IS DYNAMIC, OPEN, SIMPLE AND EVERYWHERE

Solace PubSub+ Event Broker is an advanced event broker in that it supports the "publish-subscribe" messaging pattern (along with the traditional queuing and request-reply patterns), dynamic event streaming, and a host of additional features that ensure enterprise-grade

performance and reliability no matter the demands of load and scale. Importantly, PubSub+ event brokers can be deployed anywhere (as software, SaaS or as an appliance, and whether on-premises, in private/public clouds, or in containers). All to say: an event mesh powered by PubSub+ can be everywhere.



An event mesh created with PubSub+ event brokers is:

- Dynamic: self-routing, self-learning and self-healing for automated and efficient event streaming between event producing and consuming applications wherever they run.
- Open: natively supports multiple open protocols and APIs, for an open ecosystem.
- Simple: provides a single management console for event mesh creation and management.
- Everywhere: can be deployed on-premises, in private clouds, in public clouds (AWS, Azure, GCP), and in containers.

IN SUMMARY, AN EVENT MESH BUILT WITH PubSub+ CAN HELP GLOBAL MANUFACTURERS MOVE EVENTS AND OTHER DATA:

- between applications, devices, assembly lines, buildings, fleets, containers and more;
- across hybrid cloud and multi-cloud architectures;
- in an event-driven fashion;
- at IoT scale; and,
- with industrial strength reliability, performance and security.

CUSTOMER SUCCESS STORIES

Creating the "Internet of Elevators": How a world leader in elevator and escalator manufacturing, maintenance, and modernization is using an event mesh

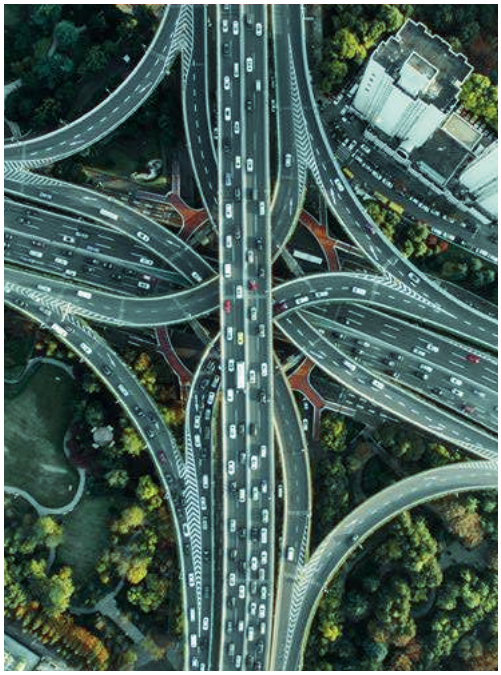
A world leader in elevators and escalators is rolling out the "internet of elevators," which is powered by a PubSub+ enabled event mesh. The event mesh will enable IoT events to flow to and from elevators and escalators in various countries (including a large number in China), as well as to cloud applications and the company's data centers, where their core ERP is SAP. They're using ASAPIO to stream events from their on-premises ERP to an event mesh powered by PubSub+.

Future-Proof Shipping & Logistics: How one of the world's largest shipping and logistics companies is leveraging real-time data from 20,000 vessels, 800 ports, and 1,700 terminals to predict and optimize logistics

A world leader in container transportation, logistics, supply chain and terminal operations wanted to give customers the ability to manage their shipments with multiple carriers online. This meant tracking and predicting the movement of 20,000 vessels from 100 different carriers operating across 800 global container ports and 1,700 terminals. Vessel schedules, route deviations, weather patterns, port operations and vessel speeds were all event factors that needed to be accounted for. They used a PubSub+ powered event mesh to enable event-driven data movement between vessels, containers, control centers, and applications running in the cloud and on-premises. This enabled them to replicate/model the real-world data to create a "digital twin" that could be analyzed and modeled with advanced analytics to predict and optimize logistics.

The Future of Connected Cars: How one of the largest car manufacturers in the world is creating a digital backbone for real-time data movement across 27 manufacturing sites

A leading car manufacturer is using a PubSub+ enabled event mesh as their digital backbone across 27 manufacturing sites to improve asset tracking and customer experiences. The backbone will enable real-time information flow between diverse assets (car parts, websites, cloud applications, back-end systems, etc.) across their entire business, helping the company leverage cutting-edge technology more quickly and effectively so they can deliver valuable and differentiating services to their engineering teams, lines of business and customers.



7 BUSINESS BENEFITS OF AN EVENT MESH

1. Better decision-making: get the right data to the right place at the right time for better and faster analytics, and enhanced situational awareness.

2. Continuous innovation: leverage on-demand access to every event produced in your system for continuous intelligence and improvement.

3. IoT ecosystem integration / data silos elimination: integrate old and new IT and OT across data centers, clouds and geographies.

4. Better business & IT collaboration: bridge the culture and language gap between business and technology leaders.

5. Deliver superior customer experiences: eliminate disruptions & reduce customer wait times.

6. Maximize agility and flexibility: as the market unfolds, you'll avoid vendor and technology lock-in, integrate disparate technologies, and migrate to the cloud in a stepwise fashion.

7. Realize cost efficiencies: only move data that needs to be moved, when it needs to be moved. Avoid the cost of unnecessarily moving data to the cloud.

ABOUT SOLACE

Solace helps large enterprises become modern and real-time by giving them everything they need to make their business operations and customer interactions event-driven. With PubSub+, the market's first and only event management platform, the company provides a comprehensive way to create, document, discover and stream events from where they are produced to where they need to be consumed – securely, reliably, quickly, and guaranteed. Behind Solace technology is the world's leading group of data movement experts, with nearly 20 years of experience helping global enterprises solve some of the most demanding challenges in a variety of industries – from capital markets, retail, and payment processing to space, aviation, and automotive. Established enterprises such as SAP, Barclays and the Royal Bank of Canada, multinational automobile manufacturers such as Renault and Groupe PSA, and industry disruptors such as Jio use Solace's advanced event broker technologies to modernize legacy applications, deploy modern microservices, and build an event mesh to support their hybrid cloud, multi-cloud and IoT architectures. Learn more at solace.com.

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