



# Beyond MQTT: How Sparkplug Transforms Raw Data Into Business Value

Business Brief



**Sparkplug**<sup>®</sup>

An Open International Standard for Increasing MQTT  
Interoperability and Enabling a Unified Namespace

# From Raw IIoT Data to Actionable Insights



Data is often likened to digital oil, representing the 21st century equivalent of the fuel that drove the technological revolution of the 20th century. Similar to raw oil, raw data has limited intrinsic value, necessitating additional efforts beyond the extraction process to unlock its full potential. Extracted data must be organised and refined to facilitate proper analysis and actionable insights. This complex effort presents numerous challenges for Industrial Internet of Things (IIoT) applications across diverse industry sectors.

While the MQTT messaging protocol has long served as a lightweight, publish-subscribe messaging transport mechanism for data collection at the edge, this transport capability alone falls short in delivering organised and refined data that businesses can effectively leverage.

Sparkplug was created to do exactly that. This open software specification provides MQTT clients the essential framework for seamlessly organising data from applications, sensors, devices, and gateways within an MQTT infrastructure. Tailored for use in IIoT architectures, Sparkplug goes further by ensuring data relevance to the entire organisation as a whole through the unified namespace paradigm.

This standardised method of contextualisation and nomenclature reflects the structure of the organisational ecosystem, from business units at the top to control devices on the factory floor, providing business applications with a single source of truth that contextualises data within the entire organisational framework.

The Sparkplug protocol can be easily implemented on any IIoT edge device to provide automatic tag generation and data organisation in the cloud on top of MQTT's lightweight and secure transport. Once integrated, Sparkplug empowers businesses with organised and refined data from IIoT edge devices, eliminating the need to grapple with raw data.

This enables organisations to analyse extracted data within hours, as opposed to weeks or months, facilitating quicker action to identify inefficiencies, enhance operational processes, or uncover new business opportunities.

## MQTT and the Data Swamp Conundrum

The unfortunate reality is that the proliferation of existing edge devices, which extract and process raw data across a variety of industries, has given rise to the creation of data swamps. These massive repositories of unmarked and indecipherable data are scattered across different silos within organisations. While substantial time and financial investments have been devoted to data acquisition activities associated with these repositories, they provide little tangible value without the ability to refine, organise, and contextualise the data.

MQTT was indeed a great starting point for making use of edge data. Initially developed in 1999 to facilitate data movement from silos within the oil and gas industry, MQTT played a crucial role in swiftly and securely extracting raw data from remote operational assets. However, it lacked a common data model necessary to organise and manage this data in enterprise environments. Its features and capabilities were tailored for its original application in the oil and gas sector where its publish-subscribe paradigm, simplicity, straightforward deployment, and built-in security via remote-originated connections addressed the need for lightweight, efficient, and highly secure data transport.

While MQTT's ability to publish any kind of data anywhere makes it easy for users to enhance business operations with remote management and monitoring of IIoT devices, the absence of a common definition and context renders the data practically unusable. To better enable use of the data requires manual definition, which impedes time-to-value and leads to the creation of data swamps.

Initially developed in 1999 to facilitate data movement from silos within the oil and gas industry, MQTT played a crucial role in swiftly and securely extracting raw data from remote operational assets.



In other words, this undermines the fundamental premise of IoT supervisory control and data acquisition (SCADA) systems, which strives not only to make data available, but also to make it usable for optimising business operations.

As the co-inventor of MQTT Arlen Nipper puts it, “The great thing about MQTT is you can publish anything you want on any topic. The bad thing is you can publish anything you want.”

## Sparkplug Builds on MQTT to Transform Data Swamps Into Data Lakes

The Sparkplug specification extends and enhances the capabilities of MQTT far beyond the original intent. Leveraging the proven framework of MQTT, it adds data refinement and organisation capabilities. This greatly improves the lightweight, edge-driven utility MQTT provides to IIoT applications, enabling day-one productivity improvements that turn data swamps into data lakes. With Sparkplug, enterprises can finally escape the quagmire of data swamps that have bogged them down for years.

As the logical extension to the MQTT framework, Sparkplug provides a common language for published data and automatically propagates information from devices. In addition, Sparkplug:

- Extends MQTT’s report-by-exception capability
- Enables implementation on any type of edge device
- Offers compatible open source implementations of its three core profiles

“Sparkplug isn’t just IIoT for its own sake: it’s efficient IIoT for business outcomes. In less than 15 minutes you can go from raw data on a machine in the field to populating an SQL database with named values and engineering units. In less than an hour you can be querying it and ready to apply that data to Machine Learning and AI algorithms.”

— Arlen Nipper

Co-Inventor of MQTT and Contributor to the First Sparkplug Specification

- Enables straightforward device implementation of a comparatively small specification versus alternatives like OPC UA
- Provides a freely available Technology Compatibility Kit (TCK) to validate implementations

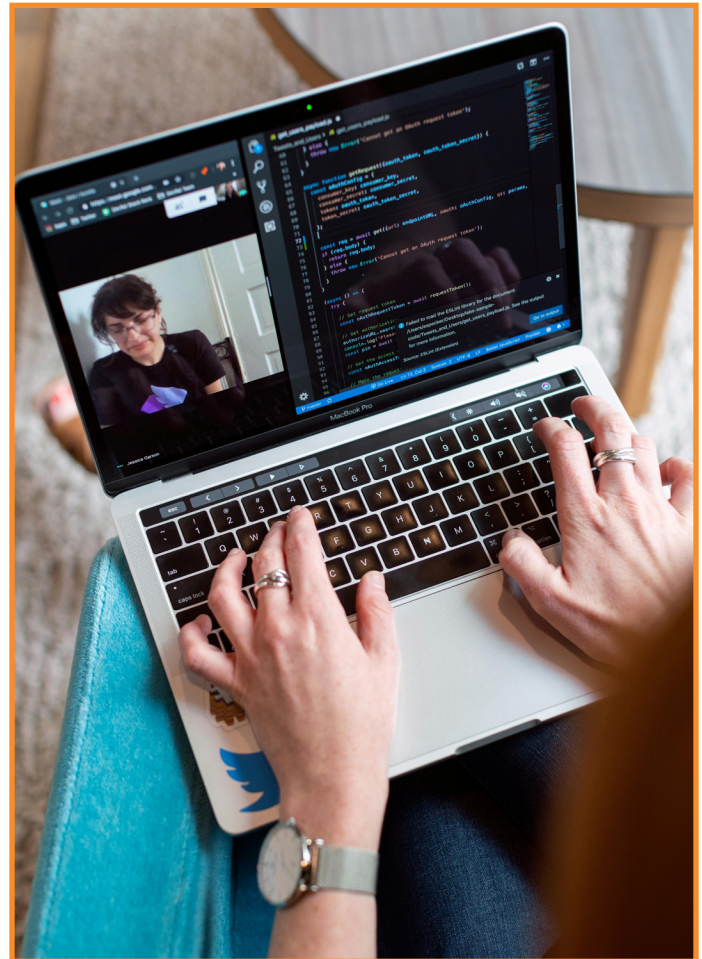
With these attributes, Sparkplug can deliver significant value to an enterprise from day one. Its lightweight design, coupled with the automated collection, labelling, and propagation of data, streamlines both the development and deployment of plug-and-play software and devices. Its ease of integration fosters increased collaboration between hardware and software components in the IIoT ecosystem, promoting innovation, encouraging partnerships, and expanding market opportunities.

Critical to Sparkplug's efficacy is its publish-subscribe model and message-oriented middleware architecture that enable direct connections from operational technology (OT) assets. This approach shifts the source of truth for network monitoring and data analysis to the edge, ensuring efficient, low-bandwidth access to accurate, real-time processed data within a highly secure framework.

## Unlocking Agile, Informed Decision-Making With Sparkplug

The technical strengths of Sparkplug directly translate into tangible business benefits, delivering on the promise of IIoT and SCADA systems for real-time data analysis that drives better decision-making. Key Sparkplug business benefits include:

- **Instant Accessibility to On-the-Ground Data:**  
Empowers timely decision-making by making on-site data instantly accessible
- **Elimination of Knowledge Silos:**  
Removes dependence on undocumented knowledge, ensuring that crucial data sources are not confined to specific groups or individuals
- **Enhanced Business Efficiency:**  
Drives ongoing improvements in operational efficiency



With Sparkplug, businesses can effectively turn raw data into organised and refined data – today's digital oil. This refined data can be available in real-time for analysis by internal or external experts, as well as by machine learning (ML) and artificial intelligence (AI) applications, expediting and improving decision-making processes due to the context of the data being preserved across all system levels. Moreover, Sparkplug's simplicity and ease of deployment position it as the natural choice for enabling a profitable plug-and-play IIoT ecosystem.

Businesses implementing Sparkplug have experienced notable reductions in costs, effective risk mitigation, and enhanced operational efficiency. This brief showcases various real-world use cases across diverse industry verticals, encompassing food and beverage (F&B), manufacturing, and wastewater management.



Real-World Use Case #1:

## Optimising Operations: Harnessing the Power of Refined Data in the F&B Industry

The food and beverage (F&B) industry has successfully leveraged Sparkplug to reduce costs and improve packaging line efficiency. Implementing Sparkplug has enabled more precise resource tracking, along with the ability to detect micro-interruptions in production lines that are too small for humans to notice.

### Challenges in Tracking Unavoidable Costs and Production Line Interruptions

Most F&B operations deploy remote sensors and devices to collect and deliver operational data that can be used to improve standard processes. Such IIoT devices employing MQTT and SCADA systems have played a vital role in production lines. However, the inability to organise and make sense of all the data has historically made it difficult to extract value that can be used to optimise processes. This is because the raw data lacks context, making it difficult to interpret.



One specific area where better use of data can make a big impact is on monitoring water and chemical usage for equipment cleaning. Many F&B companies have their own on-site wastewater facilities for that express purpose. This is a significant and unavoidable operational cost that is driven by best practices as well as regulation.

Another critical challenge for operations teams is the need to track interruptions on the production line, especially during packaging. Even micro-interruptions of less than a second can cause significant slowdowns in production. Manual tracking of these interruptions is cost-prohibitive, if feasible at all.

**“While there are plenty of standards out there, Sparkplug stands out by delivering real business benefits and unmatched applicability within the industrial landscape. It is well positioned to become the standard for everyone doing IIoT.”**

**— Travis Cox  
Chief Technology Evangelist at  
Inductive Automation**



## Turning Challenges Into Opportunities With Sparkplug

Leading F&B manufacturers are now implementing Sparkplug to automatically structure sensor data based on predefined machine models. Sparkplug streamlines data outputs based on specific requirements, enabling operators to use the data more efficiently for informed decision-making. By extracting more value from available data, management teams hope to streamline operations, reduce costs, and increase production efficiency.

Since the resulting data is being processed and analysed locally, there is a lower risk of data dropouts and the data is more secure against digital intrusion. Sparkplug's publish-subscribe paradigm and reporting by exception enable it to operate more efficiently than alternatives like OPC UA, which constantly pulls raw data from every device on the network at a prescribed time interval. Furthermore, Sparkplug's reliance on the unified namespace ensures that data is always presented in context, making it easier to extract value that leads to better business decisions.

## Simplified Oversight and Management Reduces Costs

Ultimately, Sparkplug enables better use of data to simplify the oversight and management of F&B operations. Its lightweight data gathering and automatic tag generation enable targeted data analysis, improving processes in key areas like energy usage tracking. This has empowered companies to identify usage peaks and areas for optimisation, such as the unnecessary simultaneous operation of multiple compressors.

## In Summary: Refined Operational Data Drives Efficiency

Sparkplug's ability to push data to the cloud in an organised fashion has significantly enhanced the F&B industry's ability to gather, track, and make use of operational data. It enables efficient resource usage, including energy, cleaning chemicals, and water. In addition, the ability to gather granular data allows manufacturers to identify and promptly address issues like micro-interruptions on the production line that otherwise could result in hours or days of delays.

**Sparkplug Is Now an ISO/IEC  
International Standard (ISO/IEC 20237)**



## Inductive Automation Delivers Plug-and-Play Solutions With Sparkplug

Inductive Automation provides web-based industrial automation solutions for enterprises. Its main product line, the Ignition SCADA platform, leverages MQTT and Sparkplug to provide a single pane of visibility for monitoring and controlling thousands of devices on a factory floor.

Sparkplug has provided Inductive Automation with the ability to deliver secure, fully plug-and-play solutions that greatly enhance the efficiency of data processing in a variety of industries, including the food and beverage industry.

“Sparkplug is the future of industrial data. Not only is it an International ISO/IEC standard, but it's one with so many benefits and such wide applicability that it can be the singular standard for moving and using industrial data. It's just such a robust, secure, and efficient system that's hard to beat.”

— Travis Cox





Real-World Use Case #2:

## Streamlining Efficiency: The Sparkplug Approach to Data-Driven Manufacturing Process Improvement

In manufacturing, Sparkplug plays a pivotal role in transforming raw edge data into actionable insights, driving process improvements and reducing costs. By tapping into the wealth of data generated by the sensors and IIoT devices deployed within their factories, Sparkplug ensures manufacturers have access to refined and organised data. This empowers them to pinpoint areas for improvement in their production lines.

### Complex Data Infrastructures Create Data Swamps

Manufacturing encompasses a wide range of sectors, from OEMs and auto parts suppliers to technology, chemical, and pharmaceutical companies. In recent history, this sector has adopted IIoT sensors and devices alongside MQTT for remote monitoring, asset management, predictive maintenance, and process improvement.

Manufacturing operations are inherently complex, often comprising multiple nested subsystems and a plethora of devices from various vendors, all gathering different types of data. Contextualising the data from each IIoT device, including payload model definitions, topic name, and structure definition, is crucial to avoid the creation of unusable data swamps. Sparkplug enables a unified namespace (UNS) that can be applied across all devices and OEM equipment so the network is not bogged down performing poll/response I/O driver calls to different devices with different protocol I/O servers on the same network.

State management is also critical in dynamic manufacturing environments where subsystems are frequently added or retired. Automatic propagation of tags is equally important to making cost-effective use of data, as manual configuration of data from thousands of devices would be prohibitively time-consuming and costly. State management and automated tag propagation are built into Sparkplug.

## Streamlining Processes With Refined Data

Sparkplug meets the manufacturing industry's data management requirements and drives better business outcomes by:

- Delivering real-time data with context through a unified namespace
- Enabling increased efficiency
- Reducing downtime
- Providing key data to improve product quality

**“You want to maximise the efficiency of your equipment. You want to reduce costs. You want to increase your profitability. Sparkplug can help make all that happen by providing a single source of truth and context around your data so it can be easily interpreted.”**

**— Ravi Subramanian  
Director of Industrial Solutions  
for Manufacturing at HiveMQ**



Sparkplug is also highly scalable. It can effectively manage data across operations of any size, while its store-and-forward capability guarantees data reliability. Plus, Sparkplug's automatic tag discovery helps manufacturers focus more on their business outcomes, and less on how they'll get to those outcomes.

In a notable case, Ravi Subramanian, director of industrial solutions for manufacturing at HiveMQ, underscores how Sparkplug played a central role in assisting a parts manufacturer to consolidate and analyse data from multiple factory floors. Sparkplug provided the manufacturer with the capability to identify best practices from the most efficient operations and implement them universally, resulting in heightened efficiency and reduced overhead across the entire organisation.

## A Single Source of Truth Unlocks Manufacturing Efficiency

Sparkplug empowers manufacturers to effortlessly collect, organise, and analyse data across multiple locations, offering a single source of truth at the network edge. With automatic tag generation and a lightweight structure, Sparkplug elevates remote monitoring processes and supports predictive maintenance efforts, minimising costs linked to equipment repairs and downtime. Additionally, Sparkplug's store-and-forward capabilities ensure seamless data flow, even backfilling data collected locally during a network interruption once the connection is restored, improving remote monitoring and management processes.

Ultimately, Sparkplug allows manufacturers to focus on outcomes rather than processes. By using real-time data to optimise operations, reduce costs, and increase profit margins, Sparkplug drives immediate improvements in manufacturing efficiency and effectiveness.

## HiveMQ Solves IIoT Challenges With Sparkplug

HiveMQ provides Industrial IoT solutions, such as the HiveMQ platform, which extends the MQTT protocol to provide a complete production-IoT deployment solution.

The company has taken an opinionated approach to solving IIoT challenges. Rather than trying to be all things to all players by supporting any and every protocol, it has homed in on MQTT for its lightweight and secure structure. Sparkplug makes that approach even more valuable by enhancing MQTT's utility to HiveMQ's manufacturing customers.

"Data contextualisation is something the manufacturing industry has taken a 'less-is-more' perspective on. Sparkplug's simplified and ground-up framework enables us to provide everything manufacturers need and nothing they don't — using data to enhance their operational efficiency."

— Ravi Subramanian



### Real-World Use Case #3:

## Sparkplug in Action: Efficiency and Scalability in Wastewater Management

Wastewater management operations have experienced significant cost reductions and improved scalability by implementing Sparkplug. Through accurate tracking of resources, they can minimise operating costs while also leveraging Sparkplug's day-one usability to support growth aligned with the evolving needs of the communities they serve.

### Overcoming Traditional Constraints for Technology Adoption

The wastewater management industry, a cornerstone of public infrastructure, has traditionally been cautious in adopting new technologies, primarily due to concerns about security and service reliability. Despite facing infrastructure challenges, such as facilities dating back 200 years, the industry is gradually embracing innovative solutions.

While the industry's conservative approach to new technologies has created some reluctance to adopt cloud-based or integrated IIoT solutions, this is beginning to change. In addition to increasing pressure associated with regulatory issues, there is

both a desire and need for technologies that enable more cost-effective oversight, as well as more operational efficiency.

Still, adoption hurdles remain, including the need for devices with small data payloads to efficiently manage transmission and data costs. Security also remains a significant concern, especially given the vulnerability of radio networks operators have used in the past.

A significant cost factor for these facilities involves the utilisation of chemicals to treat wastewater. While these chemicals play a mission-critical role for operators and the communities they serve, they also pose a substantial financial burden for organisations operating within tightly constrained budgets.

Therefore, optimising the efficient use of these resources becomes paramount.

Finally, wastewater management operations must also be able to scale as the communities they service grow, both in population and in geographic area. Consequently, any IIoT solutions that are adopted must be similarly scalable. This means that ease of use and deployment are of great importance.

“You’re not just storing the data. You have a whole new way of visualising it and accessing it. There’s suddenly much more value in doing analytics because the data is formed in a cohesive way that wouldn’t have been possible without Sparkplug.”

— Jason Hamlin  
Operations Manager  
at InstruLogic

## Lean, Automated Data Processing Reduces Costs and Enables Growth

Sparkplug provides wastewater operators with a proven, highly secure, and cost-efficient data management solution. With Sparkplug, it’s easier to integrate previously inaccessible technologies into existing infrastructures, particularly cloud computing — a technology that provides the ability to manage and



analyse massive amounts of refined and organised sensor data quickly and efficiently.

Sparkplug’s automatic templates and lightweight, secure structure streamline data management for maintenance and monitoring operations, ensuring scalability without added costs or complexity. By eliminating the need to integrate or clean the data manually and by simplifying its acquisition, Sparkplug saves time, reduces costs, and enhances security.

## Improved Monitoring and Cost Reductions: A Case in Point

In Purcellville, Virginia, Sparkplug resolved challenges faced by the wastewater plant in gathering, analysing, and effectively using data. The plant's remote tank, which needed to be actively monitored via a radio network, was experiencing signal interference due to forest growth. Connection losses and data drops were becoming more frequent.

To resolve the issue, the operator had an MQTT Sparkplug device installed by InstruLogic. The combination of an extremely lightweight signal, a publish-subscribe reporting method, and access to refined and organised data proved to be just what the operator needed.

The utility also realised it could easily and cost-effectively deploy more Sparkplug-based remote devices to solve different problems far beyond the scope of the initial requirement and decided to install additional devices at its reservoirs. These reservoirs require monitoring during heavy rain events in case of flooding. This previously required personnel to drive out and physically monitor them, both a safety concern and a significant added cost.

The operator strategically deployed remote devices for monitoring turbidity, chemical feed pumps, and power status in the reservoirs. Sparkplug significantly enhanced the operator's capacity to efficiently use remote sensor data, leading to more prompt and effective responses during emergency situations, while also resolving its oversight and operations management challenges.

### InstruLogic Maximises SCADA System Utility With Sparkplug

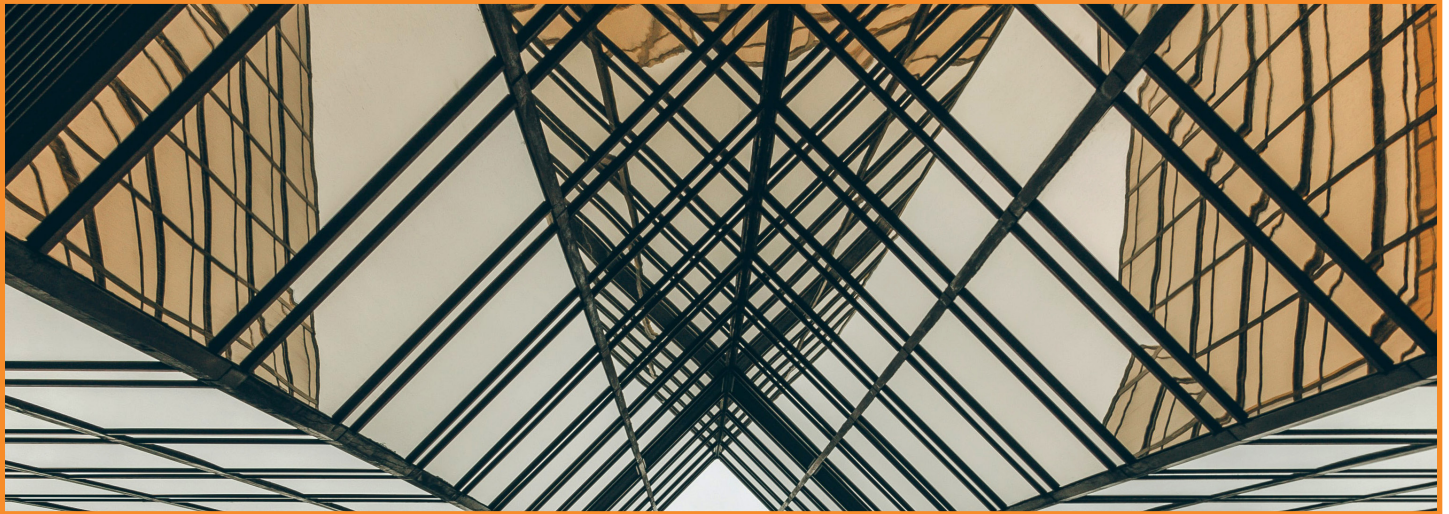
InstruLogic designs, builds, and services SCADA systems for a variety of industries, especially wastewater management.

To ensure it is delivering the best product and ongoing service for its clients, InstruLogic uses Sparkplug to maximise the utility of its solutions while minimising their footprint and complexity.

"Sparkplug aligns exceptionally well with that need. We can standardise exactly what we're doing and how we deploy devices, and Sparkplug's powerful automated features allow us to quickly and easily build out any edge device after we bring it online."

— Jason Hamlin

# Shape the Future of the Sparkplug International Standard at the Eclipse Foundation



## Unlock Business Value With the Open Sparkplug Specification

These industry use cases underscore the tangible benefits of the open Sparkplug specification. Sparkplug drives business value by improving operational efficiency, eliminating reliance on unwritten knowledge, and providing secure, real-time access to on-the-ground data for informed decision-making.

With Sparkplug, users have access to organised and refined data – the digital oil of the 21st century. This valuable resource can be harnessed to expedite problem-solving and optimise business operations through advanced technologies like AI, ML, and robust data analysis applications.

## Accelerate Business-Relevant Application Development

For application developers, Sparkplug is a game-changer, substantially reducing the cost, time, and effort involved in application development. It facilitates the creation of plug-and-play solutions and offers peace of mind through its built-in security features.

Because Sparkplug is an open standard hosted at the Eclipse Foundation, there's an opportunity for businesses in any industry to collaborate with the open source community. This collaborative effort can enhance Sparkplug further, tailoring it to meet specific industry needs.



## Benefit From Vendor Neutrality and a Rigorous Intellectual Property Process

The Eclipse Foundation is a member-driven, open source foundation. As such, the most effective way for users to drive additional business value from Sparkplug is to have a say in its development by joining the Eclipse Sparkplug Working Group. The Eclipse Foundation provides vendor neutral governance and a rigorous intellectual property process via the Eclipse Public License to ensure that every member has a voice and every product of the process has a strong basis for commercialisation.

Industry adoption of Sparkplug has been growing in no small part thanks to this process. Development of the Sparkplug Technology Compatibility Kit (TCK) and the recent transposition of Sparkplug to an international standard (ISO/IEC 20237) are driving increased confidence and adoption of the specification in a variety of verticals.

**Ensuring that the Sparkplug specification is an international standard increases industry confidence that it works well, will be supported in the long term, is interoperable with other devices, and, therefore, easy to integrate with existing systems.**



## Ensure Sparkplug Supports Your Needs

Many of the most valuable Sparkplug deployments are in Operational Technology devices managing data flows in mission-critical applications. Ensuring that the Sparkplug specification is an international standard increases industry confidence that it works well, will be supported in the long term, is interoperable with other devices, and therefore, easy to integrate with existing systems. This is crucial to driving greater adoption, which will in turn result in a more powerful, flexible, and useful specification.

Membership in the Working Group and participation in the compatibility program are the best ways to ensure Sparkplug continues to serve your business needs as it grows and adapts in the future.

Learn more about the specification and how to get involved:

- Check out the [project page](#)
- Join the [working group](#) or [compatibility program](#)



## About the Eclipse Foundation

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