

InterSystems IRIS Data Platform For IoT Applications

Solution Guide





**REVENUE OPPORTUNITY
FOR IOT TECHNOLOGY
AND APPLICATION
PROVIDERS SHOULD
REACH \$1.75 TRILLION
PER YEAR BY 2025**

Executive Summary

Every day, machines, components, containers, measurement devices, vehicles, and even people are being equipped with internet-connected sensors that transmit information, receive instructions, and even take action based on the information they receive. Today, there are more than 9 billion connected devices around the world, and that figure is rapidly growing. McKinsey predicts that the total economic impact of the Internet of Things (IoT) will be between \$3.9 trillion and \$11.1 trillion annually by the year 2025. The potential for organizations that can effectively capitalize on IoT opportunities is massive.

Traditional data management technologies and platforms are not equipped to handle the unique requirements, and the high throughput and scale, associated with IoT applications. These applications often must ingest, process, and persist the large volumes of structured and unstructured data that devices are continuously generating at very high rates, and perform intelligent programmatic actions in real time.

Consider that a typical smart energy meter application in a small to midsize city must process more than 10,000 events per second, and more than 1 billion events each day. Most traditional data-management technologies were not designed to support such use cases.

IoT applications require a different kind of data platform – one that can accommodate the challenging requirements of high throughput and scale associated with IoT applications.

"The Internet of Things: Mapping the Value Beyond the Hype," McKinsey Global Institute, June 2015, accessed October 16, 2016, <http://www.mckinsey.com/-/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/The%20Internet%20of%20Things%20The%20value%20of%20digitizing%20the%20physical%20world/The-Internet-of-things-Mapping-the-value-beyond-the-hype.ashx>

"The Internet of Things," McKinsey.



Introduction

The IoT revolution is creating unprecedented opportunities for organizations to transform their businesses, deliver new services, increase revenues, reduce costs, and delight their customers. McKinsey estimates that the total economic impact of the Internet of Things will reach between \$3.9 trillion and \$11.1 trillion annually by the year 2025.

The business opportunities for application providers that are able to service their customers' IoT requirements are correspondingly attractive. Experts forecast the total revenue opportunity for IoT technology and application providers to reach \$1.75 trillion per year by 2025. The opportunity for IoT technology providers in the healthcare industry alone is forecast to exceed \$100 billion annually by 2020.

The number and types of implementations and use cases are predicted to increase dramatically over the next few years as more organizations roll out IoT projects, and as new applications of the technology are conceived and implemented.

IoT initiatives are already delivering measurable business value in many industries:

A typical healthcare organization can receive data from hundreds of thousands of devices, including patient-monitoring devices and instrumentation. IoT applications in healthcare are improving patient outcomes as well as providing operational improvements to organizations. For example, they are facilitating predictive maintenance instead of preventive maintenance, based on historical analysis and real-time measurements. This can minimize failure rates for critical devices, thus improving device and machine utilization rates and reducing loss.

In the transportation industry, IoT implementations have already become commonplace, and some analysts forecast the total economic impact of IoT in this industry to approach \$1 trillion by 2025. IoT applications are enabling organizations to optimize fleet management to minimize delays, optimize fuel efficiency, track shipments continuously in real time, reduce accident rates, perform real-time diagnostics and corrective actions, enable predictive (rather than preventive) maintenance, and optimize the utilization rate of containers and other mobile assets. For example, one company is leveraging vehicle-based telematics to reduce accident rates in the long-distance trucking market by 87 percent. The second-largest shipping company in the world relies on IoT to optimize shipping routes and enable its customers to track their freight around the world in real time, decreasing costs and improving customer service.



A vertical decorative bar on the left side of the page features several overlapping circles in various colors: a large red circle at the top, a smaller teal circle below it, a large light blue circle in the middle, a small teal circle to its right, and a large orange circle at the bottom. A small purple circle is also visible near the bottom of the orange circle.

Retail organizations are leveraging IoT to enable real-time inventory and traceability; deliver smart, just-in-time offers and promotions to shoppers; optimize product placement; and perform dynamic pricing.

The public sector and energy companies are embracing smart meters and smart grids to balance energy supply and demand, perform real-time pricing, identify and correct service disruptions, and create customer cost savings by programmatically adjusting connected devices and turning them on or off based on real-time conditions.

In the oil and gas industry, tens of thousands of sensors on offshore oil rigs are being used to monitor operating parameters and maintain machine and overall system health.

Factories and worksites are implementing IoT applications to perform real-time monitoring, enable predictive maintenance to reduce costs, minimize failures and downtime, and prevent accidents.

The adoption rate is forecast to grow dramatically over the next few years, and the opportunities for continued growth and innovation in IoT applications are compelling. But in many cases the growth and innovation are being constrained by the limitations of underlying technologies that were not designed to accommodate these kinds of use cases. For example, in the oil and gas industry, just one percent of the IoT data being collected is used for analysis to make decisions that can improve reliability, efficiencies, processes, and workflows. Modern technologies designed to handle the specific requirements of IoT applications can help organizations overcome these challenges.

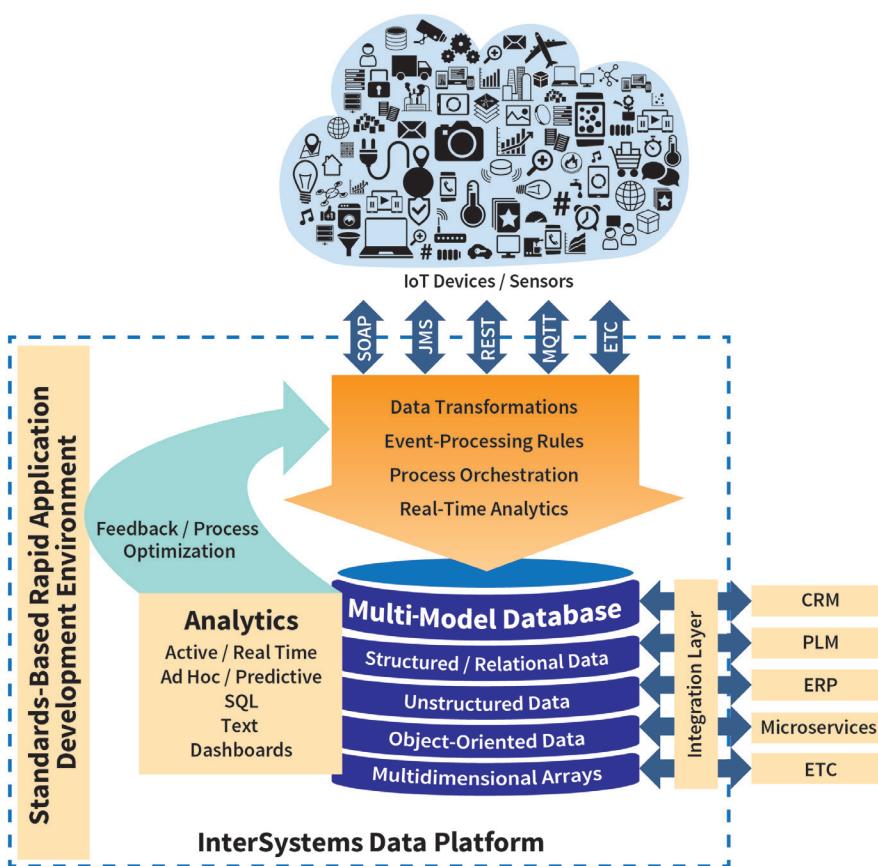
The next section explores the technical requirements of IoT applications and describes the capabilities of InterSystems IRIS Data Platform™, a functionally complete, unified platform for developing, executing, and maintaining sophisticated IoT applications.

InterSystems IRIS Data Platform for IoT Applications

InterSystems IRIS Data Platform is a comprehensive, multi-model, multi-workload data platform that is ideal for accommodating the challenging requirements of applications for the Internet of Things. It is a complete platform for developing, executing, and maintaining IoT applications in a single, consistent, unified environment. It features a distributed architecture to support massive data-ingest rates and data volumes, while providing the flexibility and durability of an enterprise-grade transactional multi-model database to ingest, process, and persist data from a wide range of devices in different formats. It features a complete set of integration, event-processing, and integrated analytics capabilities, including full SQL support and text processing, business process orchestration, and a standards-based development environment.

Connect to, ingest, and persist a wide range of disparate device data types and formats.

The data types associated with IoT applications are often heterogeneous, since they may be coming from many different devices, all with different functions, and manufactured by different vendors. The underlying data platform must be able to ingest and process a wide range of raw data types in their original formats. Many applications also require the data platform to persist all of the disparate source data to detect deviations from normal ranges, accommodate downstream ad hoc analytics, maintain regulatory compliance, and fulfill other purposes.





InterSystems IRIS makes it simple and straightforward to connect to any device, using any protocol, both to consume data from devices and to send data or instructions to devices. It provides a variety of capabilities to ensure inbound and outbound connectivity to any device or protocol. It includes a built-in adapter library that provides connectivity and data transformations for traditional industry standards, protocols, and technologies, such as REST, SOAP, HTTPS, and JMS, as well as newer, IoT-specific protocols, like MQTT. InterSystems IRIS also enables the rapid development of custom adapters (and associated business logic) by application developers to support virtually any device or environment.

InterSystems IRIS incorporates a proven enterprise-grade transactional multi-model database that is designed to work with data on a massive scale and provides the flexibility to store the incoming data in the most appropriate format, including:

- Schema-free document data models, which can be ideal for storing raw device data (temperature, speeds, etc.) and the associated metadata (timestamp, device ID, etc.) to provide maximum flexibility for performing downstream ad hoc analysis on the data
- Multi-dimensional arrays, which can be stored with any number of subscripts
- Relational data structures, for well-structured data types
- Object-oriented models, for complex data types. The data is described once in a single, integrated data dictionary and is available using object access, high-performance SQL, and multi-dimensional access, all of which can simultaneously access the same data.

Ingest, Process, and Persist Incoming Device Data at High Ingestion Rates

IoT applications must be able to handle massive amounts of data that are being continuously generated by devices, sometimes on the order of hundreds of thousands – or millions – of messages or transactions every second. Traditional databases were simply not designed to accommodate such high data-ingest rates. Consider that fewer than 10 million trades are executed on average each day on the Nasdaq stock exchange. In contrast, a typical smart energy meter application in a small to midsize city must ingest and process more than one billion transactions every day.

InterSystems IRIS is designed to handle incoming data at the extremely high data-ingest rates that are required in IoT environments, in an efficient and cost-effective manner. InterSystems has spent decades optimizing the performance and scalability of its technology to meet the stringent requirements and service-level agreements of its customers.

For example, the European Space Agency uses InterSystems technology

"European Space Agency Chooses InterSystems Caché Database for Gaia Mission to Map Milky Way," InterSystems Corporation, <http://www.intersystems.com/library/library-item/european-space-agency-chooses-intersystems-cach-database-for-gaia-mission-to-map-milky-way/>.

to process very large amounts of satellite data at very high ingest rates. Running on one 8-core Intel 64-bit processor, its application ingests and stores five billion discrete Java objects of about 600 bytes each in 12 hours and 18 minutes, at an average insertion rate of 112,000 objects per second.

InterSystems IRIS supports high levels of concurrent access and very large data volumes. Horizontal scaling is available for both on-premise and cloud installations, providing customers with flexible deployment options. Horizontal scaling, where data is shared between nodes, is available via a highly optimized caching protocol that allows the sharing of data among nodes while preserving transactional functionality and integrity.

Integrate Disparate Data, Perform Sophisticated Analyses, and Execute Real-Time Automated Processes

The underlying technology platform must accommodate a range of analytics processing types on the complete, unsummarized historical data, and enable analysts and data scientists to identify correlations among the device data as well as external data sets. This allows the information gleaned from the analyses to be incorporated into real-time programmatic workflows to perform real-time business processes and critical just-in-time actions.

In addition, research has found that between 40 and 60 percent of the business value from IoT applications is gained from interoperability between various IoT applications and systems. Realizing this value requires strong composite application features, as well as strong integration capabilities to combine and correlate data from the different sources to unlock the potential insights that are hidden in disparate data sets.

InterSystems IRIS provides functionality for developing and executing queries and ad hoc analyses on the structured and unstructured data in the database, and it provides consistent, unified access to the data regardless of the object type. The query performance on complex object data structures is extremely fast — typically much faster than relational-only databases. In addition to the inherent performance benefits of the multi-model database, bitmap indexing technology further speeds query performance on real-time data.

Analysts and data scientists are able to incorporate a wide range of analytics tools, including predictive modeling, machine learning, Apache Spark, and others, to identify patterns, trends, and correlations in the data sets. The resultant insights or algorithms can be incorporated into the real-time business processes using the graphical modeling environment, to initiate a process or action when specific criteria are met. InterSystems IRIS provides comprehensive capabilities for creating and managing real-time programmatic processes that execute close to the data, in the same engine as the database, for the



fastest performance.

In addition, patterns and anomalies in the data can be detected in real time, and programmatic corrective actions, processes, and alerting can be initiated in response.

Key capabilities include:

- Messaging and event processing
- A business rules engine with a graphical modeling environment
- Business process orchestration and management
- An adaptable workflow engine that supports automated and human workflows
- Composite application development for use (and reuse) within InterSystems applications and with external applications
- Business activity monitoring, including graphical dashboards and alerts
- Real-time business intelligence, with drag-and-drop creation of data models, real-time dashboards, and the ability to act in real time on information in transactional applications
- End-to-end management, including real-time visibility into business processes and system performance

Agility

The technology platform must be agile and developer-friendly, enabling organizations to quickly develop and deploy new applications, and to easily iterate on the applications as requirements and business demands change.

InterSystems IRIS provides a single, unified environment for developing, executing, and maintaining IoT applications. As such, it eliminates the time and work required to learn, use, and integrate multiple disparate tools, products, and open-source projects.

It also provides a plug-in to the popular Eclipse integrated development environment, enabling rapid and open development of IoT applications.

Finally, InterSystems IRIS provides flexible deployment options, supporting both cloud and on-premise deployments.

Proven

In many IoT applications — such as monitoring and controlling devices in vehicles, ships, factories, or traffic systems — failure or downtime can have severe consequences. InterSystems technology is proven and successful in mission-critical environments, with high availability and minimal downtime.



Customer Examples

Navantia (Shipbuilding)

Navantia, a leading military shipbuilder in Spain, is differentiating itself by developing and deploying the next generation of ship management systems, an integrated platform management system (IPMS). Key to its IPMS is an IoT software application, COMPLEX, that the company and its development partner, Arisnova, created using InterSystems technology. COMPLEX integrates standard functions like ship control and supervision with advanced functions such as damage control, maintenance, and onboard training.

Navantia looked to InterSystems as an alternative to traditional relational databases and SCADA systems because it provides more-complex data models, more flexible architectures, and higher performance levels for an IPMS that must accommodate a wide variety of sensors, shipboard equipment, systems relationships, process workflow, and types of information (static, dynamic, real-time, active, and historical).

Built on InterSystems technology, COMPLEX is managing 65,000 different signals. Navantia has reduced the development time for additional IPMS projects by 80 percent thanks to powerful application reuse capabilities.



OptAlert (Transportation)

Fatigue is a major cause of industrial accidents, especially in road transportation and mining. According to Australian Government figures, over half of major crash insurance claims are fatigue related, and almost two-thirds of truck haulage accidents in the surface mining industry are directly related to operator fatigue.

OptAlert, a world leader in fatigue management technology, is using InterSystems technology to reduce commercial trucking accidents by monitoring the eye and eyelid movements of drivers. A key challenge the company faced with the development of the application was the amount of data collected. To record raw data about eye movements and other events, such as the vehicle engine being turned on or off, the storage requirement is around 2MB per user per hour; this figure is expected to increase with the future recording of additional information such as cabin temperature or altitude. With live data feeds to and from vehicles, the application can generate real-time alerts when a driver might be getting fatigued.

InterSystems technology successfully handles the current requirements and scale, and OptAlert is confident that it will continue to be able to handle the increasing data ingest rates and storage requirements as the company continues to develop and grow the application.



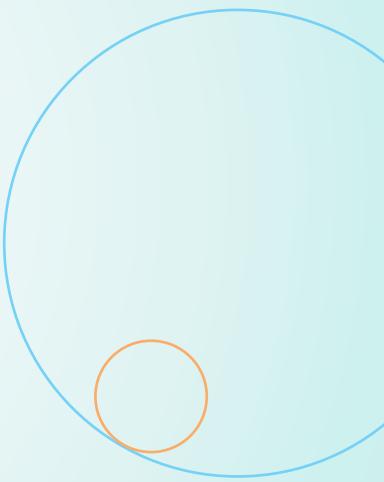
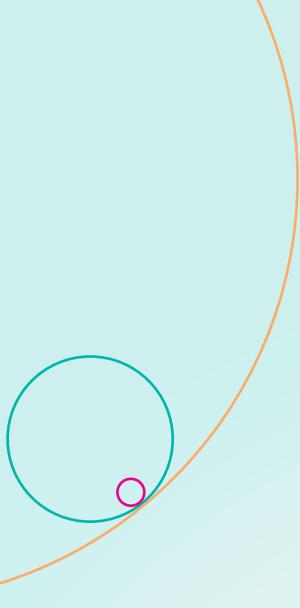
Conclusion

The Internet of Things is creating unprecedented opportunities for organizations to transform their businesses. But traditional data management technologies and platforms are not equipped to handle the unique requirements, including the high throughput and scale associated with these kinds of applications.

InterSystems IRIS is a comprehensive, multi-model data platform that is ideal for IoT applications. It is a complete platform that provides critical capabilities required to develop, execute, and maintain high-performance IoT applications in a single, consistent, unified environment. It features a distributed architecture to support massive data ingest rates and volumes while providing the flexibility and persistence of an enterprise-grade transactional multi-model database to work with data from a wide range of devices in different formats. It provides a complete set of integration and event-processing capabilities; integrated analytics capabilities, including full SQL support and text processing capabilities; and a standards-based development environment.

InterSystems is the engine behind the world's most important applications. In healthcare, finance, government, and other sectors where lives and livelihoods are at stake, InterSystems is the power behind what matters. Founded in 1978, InterSystems is a privately held company headquartered in Cambridge, Massachusetts (USA), with offices worldwide, and its software products are used daily by millions of people in more than 80 countries.

For more information, visit **InterSystems.com/IRIS**.



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