Next-Generation Business and the Internet of Things

Opportunities and Challenges Created by a Connected and Real-Time World

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The Internet of Things Is Redefining Enterprise IT

The Internet of Things (IoT) is changing the business playing field, creating opportunities for new sources of revenue, smarter interactions with customers, and greater efficiencies. Yet IoT introduces new technical challenges. How do you securely connect intelligent devices via the Internet to your enterprise, capture data at the "point of action," and analyze huge volumes of machine-generated data in real time? The SAP® Real-Time Data Platform and the IoT solution from SAP are designed to help you thrive in a connected world.

We live in an increasingly connected world. Humans are connected to each other and to a vast inventory of information and entertainment in unprecedented ways. Almost half of the world's population now owns and uses a mobile device. In the developed world, most households are connected to the Internet. We now take for granted what our smart devices let us do almost instantaneously – work, play, shop, explore, and communicate.

In recent years, we've entered a new era of connectedness beyond the human realm. More and more objects in our physical world are now able to communicate with each other – or with us – through embedded sensors, tags, and actuators without human involvement. These "smart objects" can see, hear, feel, and smell the world around them. Intelligence embedded into personal items, household appliances, cars, clothing, factory equipment, and infrastructure generates vast amounts of valuable data that can be collected, networked, and analyzed for a wide range of business, societal, and personal advances.

Communication between mechanical or electronic devices is automated by what are collectively known as machine-to-machine (M2M) technologies. M2M is not a new concept.

Companies have been using sensors and embedded technologies for years as a way to reduce costs or improve service. Familiar uses of M2M are found in the transportation companies that track our packages, smart buildings that conserve energy use, or manufacturers that use instrumentation to control product quality.

Today's M2M implementations have evolved beyond their origins as stand-alone, proprietary systems used in specialized environments. M2M technology is accelerating at a rapid pace, thanks to advances in sensors, broader and more affordable access to high-speed mobile networks, and a maturing ecosystem of equipment vendors and infrastructure providers. Now that we are able to make objects more intelligent and Internet enabled, we can blend the physical world with the digital world of information and ideas in one vast, shared network over the ubiquitous Internet. This is the powerful, transformative concept known as the Internet of Things.

In a recent report, the McKinsey Global Institute considers the Internet of Things to be one of the most disruptive technology trends of the next decade, with sweeping implications for businesses and policymakers. The report estimates the potential economic impact of the Internet of Things to be US$2.7 to $6.2 trillion per year by 2025 through improved operational efficiencies as well as new revenue-creating products and services.[1]

As the Internet of Things moves to the mainstream, enterprises need to be ready to fold increasingly intelligent assets into the IT landscape. It is a vision that requires a technology infrastructure that can capture data securely from hundreds of thousands of end points, handle Big Data affordably, and provide powerful real-time analytics to large numbers of people. The SAP Real-Time Data Platform, based on the SAP HANA® platform, is enabling companies, communities, and countries to meet these new challenges head-on and to thrive in a connected world.
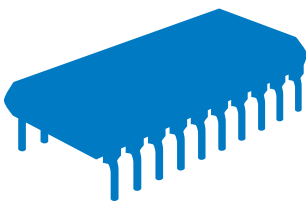
The Internet of Things will be one of the most disruptive technology trends of the next decade, with sweeping implications for businesses and policymakers.

Vision and Reality

Machines will soon outnumber humans in the digital economy. Almost any consumer product you can imagine is a candidate for embedded intelligence or RFID tagging. Smart vending machines and retail outlets will know our preferences, ply us with instant offers or coupons, and send alerts to resuppliers when inventories reach a particular threshold. Sensors in roads will be able to count passing vehicles and adjust traffic signals in real time to improve flows and reduce carbon emissions. Manufacturers already use RFID to track the flow of raw materials and goods through the supply chain to spot bottlenecks or restock warehouses.

The ability to put networked intelligence almost anywhere, at an unimaginable scale, will soon be in place as the following key drivers move the IoT vision forward.

Increasing affordability – The price of sensors and RFID tags is falling rapidly as high-volume manufacturing techniques create economies of scale. Sales of sensors have grown by 70% annually since 2010, and advances in technology are making more capable sensors more affordable.[2]

Pervasive connectivity – Widespread access to cloud computing and affordable high-speed wireless data networks extend the reach of IoT applications and support the viability of greater uses.

Rapid innovation – Technological advances improve the variety of sensors and the effectiveness of IoT applications while reducing costs. Miniaturization makes it possible to include multiple sensors in one device to perform different tasks such as detecting geolocation, temperature, or motion. Power management is allowing devices to run unattended for longer periods of time.

Regulatory mandates – Stricter regulations are spurring a faster adoption of M2M solutions, especially in industries such as energy, automotive, and healthcare. For example, the European Union has mandated that 80% of European homes must have a smart meter installed by 2020.

Maturing ecosystem – As the number of telecommunications providers, device manufacturers, consulting firms, and business software companies supplying M2M services grows, it's easier for enterprises to find the right providers with whom to partner.

As the underlying technology and ecosystem that drive the Internet of Things become broadly available and more affordable, adoption will accelerate. As it does so, we will start to see a convergence of the Internet, mobile networks, enterprise systems, and physical objects. This convergence will help enterprises exploit the true promise of the Internet of Things: the ability to combine machine-generated data with traditionally human-generated data to amplify insight, understanding, and real-time decision making.

The real promise of the Internet of Things lies in the ability to combine machine-generated data with data created by humans for deeper insight, understanding, and real-time decision making.

IMPLICATIONS FOR ENTERPRISE IT VISION AND STRATEGY

Thriving in a Connected World

The connected world creates unprecedented opportunities, but not without challenges. Compared to the current generation of process-centric business applications, IoT and M2M applications will introduce a dramatic increase in data volumes and velocity that threaten to overwhelm traditional IT architectures. These are the same challenges that companies implementing Big Data initiatives have been facing, but with some unique twists in the areas of security and fraud detection, high availability, latency, and scalability.

MORE BREACH POINTS, NEW THREATS

The connected world introduces a vast new number of intelligent devices that enterprises can tap into for real-time business purposes. Within the IoT paradigm, companies are able to collect and act on data generated by these devices – some within the enterprise and some from beyond the enterprise's traditional IT boundaries. Each of these new touch points represents a potential new security threat. As companies depend more on machine-generated data for real-time business processes, ensuring that this data can be trusted will be essential. Companies must be able to detect rogue devices trying to interact with the IoT infrastructure both from device and network vectors.

Some industries will need to take extra steps to ensure that sensitive data is secure and encrypted. Securing data captured by a home health monitoring device, for example, will likely be mandated by the Health Insurance Portability and Accountability Act (HIPAA) in the United States.

Organizations that anticipate these security-related issues from the outset and include them in the foundation of their IoT strategy will be well in advance of those that try to patch in security measures later.

INCONSISTENT NETWORK AVAILABILITY

IoT applications create value for organizations through new ways of seeing, hearing, sensing, and interpreting the world. Unlike traditional business systems that rely on data generated by people using computers in fairly controlled environments, IoT applications will collect data that comes from remote devices in remote or unlikely settings. Not every device in the IoT fabric will be online 100% of the time. Therefore, IoT applications will require technologies that can detect the absence of connectivity, and handle interruptions with ease.

And what about data that is collected by devices that are offline, whether intentionally or unintentionally? Real-time data is essential to some applications, so data collected and stored by an offline device will quickly become useless. Some applications don't require real-time data, and data will need to be stored on the device and transmitted to the IoT applications at a scheduled time or when connectivity is restored. Sophisticated data management and synchronization technology are essential for ensuring that the right data is collected even during interrupted connectivity. The devices that support IoT business applications most often will need the intelligence and local data storage capability to handle these types of scenarios.

IoT and M2M applications will introduce a dramatic increase in data volumes and velocity as well as new challenges in the areas of security and fraud detection, high availability, data latency, and scalability.

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DATA LATENCY VERSUS BUSINESS VALUE

The value of an IoT application will often be measured by how close to real time it can respond to incoming sensor-generated data. For example, an implanted body sensor detects a medical emergency. The latency of the system (the time between an event occurring and action being taken) will be an essential factor in the success of any life-saving actions. Figure 1 shows the relationship between latency and value, highlighting how value diminishes as time elapses between when data is first captured and when an action or decision is triggered.

Low-latency, high-volume technology capabilities will be essential to the value of real-time business applications, but there are practical considerations as well. With IoT applications, organizations will accumulate so much data that traditional approaches to batching the data and processing it at scheduled intervals will no longer suffice. With more and more organizations "following the sun," there is less time at night for long-running batch processes. The only feasible way to manage the data that is the lifeblood of IoT applications is to ensure that the systems can process it in a continual stream.

UNPRECEDENTED DATA VOLUMES AND VELOCITY

The volume and velocity of data generated within an IoT landscape involving hundreds or thousands of devices will be astronomical, even by today's Big Data standards. One telecommunications organization was swamped with so much data that its data warehouse was running 45 minutes behind real time, invalidating service-level agreements with many of its customers. The choke point for this telecommunications company, and many others, was a disk-based data storage solution. Fortunately, multiterabyte in-memory systems can now scale to perform at levels that are hundreds – and often thousands – of times faster than those of today's typical disk-based data management architectures. SAP HANA is an industry-leading example of an in-memory database that not only is revolutionizing business systems and real-time analytics but is also a very attractive solution to scalability issues presented by emerging IoT applications.

Figure 1: Business Value Versus Time, Demonstrating the Impact of Latency

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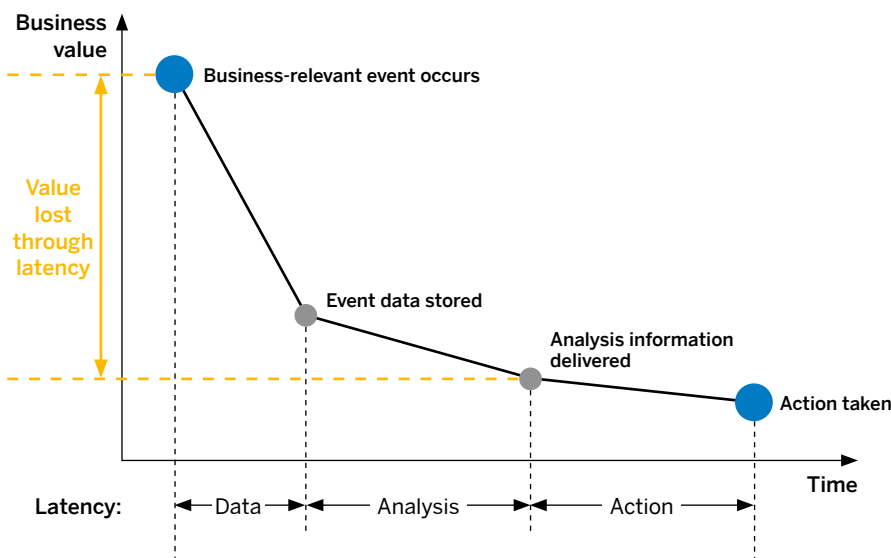
How the Internet of Things Will Challenge the Status Quo

The Internet of Things will have a significant impact on nearly every industry, opening up new business models as well as new sources of operational efficiencies. As the cost of technologies continues to fall and the ecosystem matures, the Internet of Things will shift from a hypothetical possibility to a new way of doing business.

These "next-generation" business applications must be able to capture, collect, interpret, and act on vast amounts of information. Traditional IT landscapes accustomed to information traveling along familiar and established routes can become quickly overwhelmed by the new flows of information once physical objects and places are added. Let's take a look at some of the emerging usage scenarios (and the data-related challenges to be addressed) in several key industries.

For utilities – Smart grids are an important development that will lead to greater energy efficiency. Automated meters generate data that can help consumers to make smarter decisions around their energy usage but can also enable utilities to develop more profitable business models, including progressive rate structures that will incentivize more efficient consumption and customer loyalty. Real-time usage information enables power generators to manage supply and demand more efficiently.

Utility providers are dealing with more sophisticated consumers who are now armed with an explosion of personal technologies. These consumers have come to expect that the environment around them will act in intelligent ways – recommend the right destinations or movies, generate shopping lists, adjust thermostats automatically, and so on. In the Internet of Things, household energy consumption will be measured and controlled down to individual appliances, enabling customers to take advantage of progressive rates. For utilities, this represents vast new opportunities to better manage capacity through demand shifting and create real-time interactions with customers that deliver value and increase loyalty. This will have profound implications for operational systems – not just in terms of handling torrents of incoming data from the smart grid but for integrating this machine-generated data with traditional data (marketing, sales, support) to deliver a 360-degree customer experience.

For healthcare providers – It's becoming harder to deliver quality healthcare in both developed and emerging economies. Demand for healthcare often outstrips available resources. In this context, a technology that can both cut the costs and expand the reach of preventive, curative, and palliative healthcare is an essential investment for governments and providers that will save lives, improve health, and have far-reaching effects on social and economic well-being.

Most of the devices in today's medical facilities operate on a stand-alone basis. Many hospitals have begun to recognize the value of connecting these devices to a larger network. As some high-profile medical Big Data projects have shown, the ability to detect patterns from deep historical analytics can lead to medical and procedural breakthroughs. As hospitals and healthcare organizations participate more fully in the Internet of Things, they will need to implement technologies that can secure and encrypt sensitive medical data beyond what they are currently familiar with. They will also need significant computing power to collect vast amounts of incoming data from many sources and act on it in real time – particularly when health-related decisions are at stake.

In transportation and logistics – Traditional supply chains typically stop once the goods are shipped. Smart goods allow the extension of the supply chain so that monitoring services, updates, content, and other digital services extend beyond the shipment of the goods and into the customer's environment, transforming a logistics operation into a smart supply chain.

The opportunities for deep insight into supply chains will require access to data in remote sites. Some advanced logistics departments in very large organizations are collecting parts information not just from their suppliers but from their suppliers' suppliers. Much of this data in the future will be RFID data streams, and the ability to collect large amounts of RFID data and analyze it in real time will not only allow the detection of potential interruptions in the supply chain but also enable issues to be reprioritized and addressed before they become material. In fact, some competitive suppliers are already working together to help each other meet their common customer's supply chain needs, even at short-term expense to themselves. Again we expect that the role of security and fraud detection will become more important as more and more vital business decisions are based on data coming in from the Internet of Things.

In industrial operations – The Internet of Things has its origins in factory automation. We have long made use of computer technology to embed intelligence into manufacturing and industrial processes to reduce human error, save time, increase efficiency, conserve resources, and generally optimize the performance of a physical system.

We are seeing some very imaginative advances in the use of the Internet for "things" in manufacturing environments. One organization created a Facebook page for its large production line machines so operators could communicate issues and changes between shifts using Facebook postings. It's not clear whether this is a scalable solution, but we see this ability to collect information from, and about, production machinery as helping to increase the efficiency and robustness of manufacturing lines. Also, collecting lots of detailed historical information about a production machine, and all the other activities taking place at any time in a manufacturing plant, will allow for deep analytics to identify further efficiencies or investigate and correct root causes of production issues.

The Internet of Things will have a significant impact on nearly every industry, opening up new business models as well as new sources of operational efficiencies.
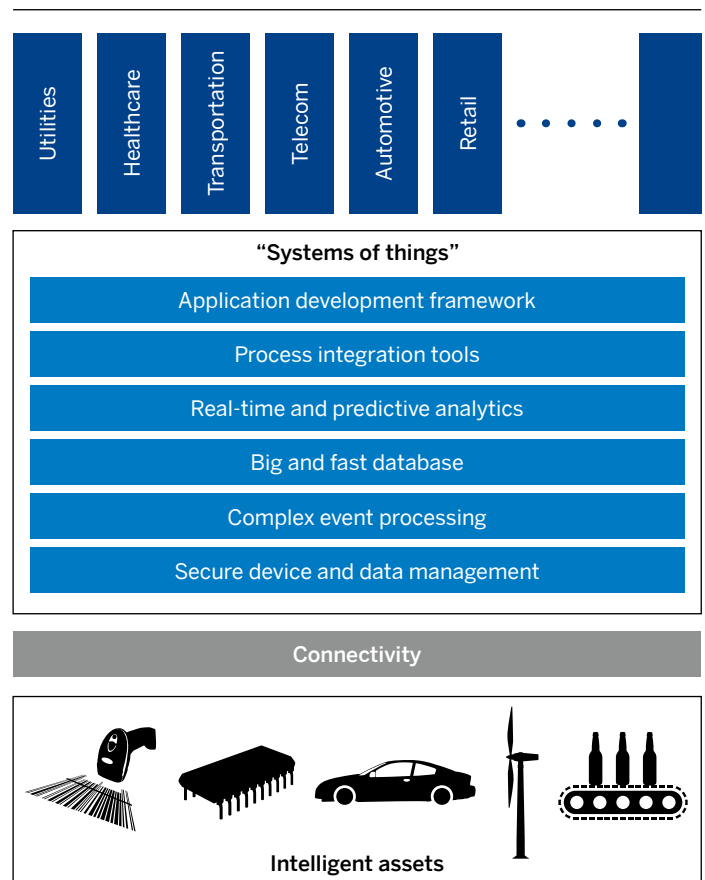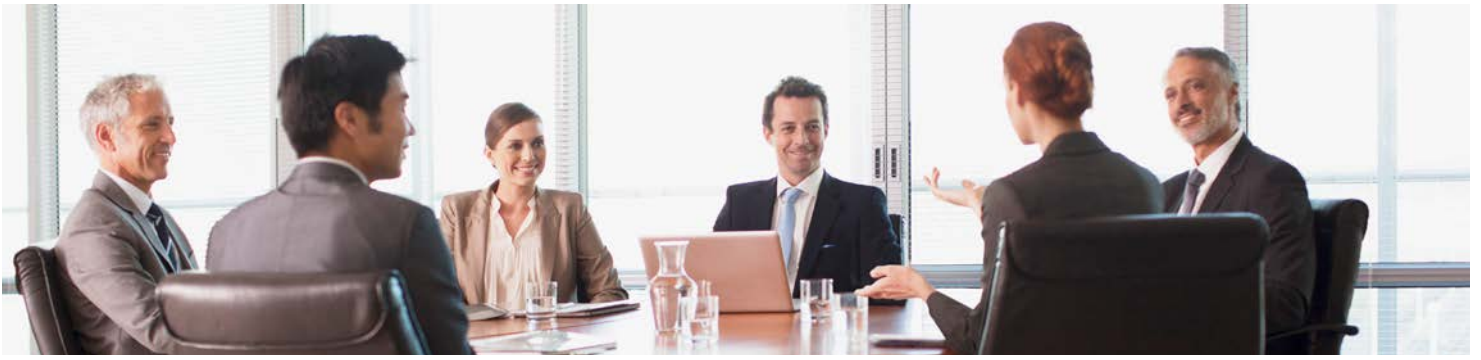
Reenvisioning IT Infrastructures

SAP has spent the last 40 years helping businesses, enterprises, and governments run better. We have done this by providing the software and technology described by Geoffrey Moore as "systems of record."[3] These are the systems that capture everything businesses need to run smoothly – from financial transactions to human resources, order processing, inventory management, customer relationship management, and so on. SAP is, in fact, the systems-of-record market leader, with more than 60% of the world's GDP flowing through SAP software.

The Internet of Things will introduce data management requirements that go far beyond what systems of record were originally designed to manage. M2M-generated data streams provide companies with new sources of data that were traditionally not available. To derive intelligence from it, this data needs to be captured, secured, analyzed, and delivered at a previously unimaginable scale.

That is why SAP is focused on extending systems of record to embrace what is becoming a "system of things." The IoT solution from SAP provides everything enterprises need to translate IoT opportunities into business value – M2M connectivity, cloud platform, device management, Big Data processing, event stream processing, predictive analytics, and industry applications. (See Figure 2.)

Figure 2: Internet of Things Solution Architecture from SAP

Utilities · Healthcare · Transportation · Telecom · Automotive · Retail · · · · ·

"Systems of things"

- Application development framework
- Process integration tools
- Real-time and predictive analytics
- Big and fast database
- Complex event processing
- Secure device and data management

Connectivity

Intelligent assets

NEXT-GENERATION APPLICATION ENABLEMENT

The IoT solution from SAP leverages the SAP Real-Time Data Platform, allowing companies to turn massive amounts of IoT data into meaningful insights and decisions – securely and affordably.

Next-generation applications require a fundamentally different approach to data management. Systems of record and early M2M applications traditionally relied on centrally based transaction processing and analytics architectures; data is captured, then sent to a central location for processing or analysis, with results then returned to a user's screen. This approach is impractical for IoT applications. For example, IoT business applications need to be fast and nimble. Sending data from thousands of sensors and machines to a centralized analytics server consumes massive bandwidth and introduces unnecessary latency. Instead, IoT applications can be designed to perform streaming analytics as close to the data as possible, delivering insights or answers in a highly localized and targeted way.

However, there are many scenarios for which centralized analytics will still make sense. Collecting and analyzing machine-generated data alongside operational or historical data will provide companies with a 360-degree view of the business.

The SAP Real-Time Data Platform is a unified data management framework capable of addressing a wide range of scenarios like these. It is designed to bring traditional IT landscapes into the IoT era without disruption. It provides the necessary technologies for addressing the challenges associated with next-generation applications, from the device to the data center.

SECURE, STREAMLINED DEVICE MANAGEMENT

The SAP Real-Time Data Platform helps ensure that data stored and transmitted by connected sensors and intelligent assets is secure. It provides unified control of connected devices through a single console, helping to keep devices up-to-date with zero disruption. These capabilities are enabled primarily by the market-leading SAP Afaria® mobile device management solution.

The IoT solution from SAP can back up data and content on devices. To protect sensitive business information, it can delete data if a device is lost or stolen. With SAP software, administrators can control connected devices through a single console so that IT can remotely install, update, or remove applications and content on the devices and make sure that the devices are up-to-date. In addition, all this device management activity is performed in the background so that there is no service disruption.

RELIABLE DATA CAPTURE

One of the great advantages of the IoT-M2M paradigm is the ability to collect valuable data from many new sources – from within your enterprise and from beyond your traditional IT boundaries. The SAP Real-Time Data Platform provides technologies necessary to protect this data and to prevent fraudulent devices from attempting to interact with your organization.

SAP Sybase® SQL Anywhere® solutions include mobile and remote data management and synchronization software that can replicate data securely, as well as encrypt data both on the device (if the device is compliant with SAP Sybase SQL Anywhere) and also as it moves between the device and the enterprise.

SAP Sybase Event Stream Processor (SAP Sybase ESP) is a complex event-processing engine that can examine data that is being streamed into the enterprise from a large number of devices simultaneously. SAP Sybase ESP can look at the values for a single device and determine if they are unusual and thus potentially fraudulent. This can be done either using fixed boundaries or moving averages.

In addition, SAP Sybase ESP can look at values coming in from multiple devices and determine if there are any unusual values in the stream, or it can look at multiple devices measuring the same thing and select the most common or average result from the stream.

FLEXIBLE ANALYTICS FOUNDATION

Many next-generation applications will require near-real-time response times to live up to the promise of the Internet of Things, but not all applications will. The SAP Real-Time Data Platform addresses a variety of data latency requirements within the same unified framework. This allows enterprises to deploy the technologies that make the most sense in different business scenarios.

SAP HANA and SAP Sybase ESP combine to help ensure that systems can handle the volume and velocity of data that is expected from the Internet of Things. For example, a telecommunications customer addressed its high availability issue by adding SAP Sybase ESP into its environment to act as a "data shock absorber" for its analytics infrastructure, because the in-memory storage allowed the system to handle sudden bursts in traffic.

SAP Sybase SQL Anywhere can be used as a feature-rich local database. It has sophisticated batch and replication technology that allows a device to go offline but still collect data, and then synchronize the data when the connection is reestablished. Because SAP Sybase SQL Anywhere is a complete data management solution running on the device or at the local level, the device can still be active even without a connection to a centralized analytics server.

SCALABILITY FOR MASSIVE DATA

The volume and velocity of data generated within the Internet of Things will be orders of magnitude larger than what traditional systems can practically handle. The SAP Real-Time Data Platform, based on the groundbreaking in-memory technology of SAP HANA, is up to the challenge.

SAP HANA, and in particular the SAP HANA Enterprise Cloud service, is ideally suited for IoT applications. In-memory technology provides real-time integration of business processes and analytics at a degree and scale not possible until now. It enables you to analyze operational, analytical, and text data in real time, without delays caused by the need to move or replicate data from multiple sources. This is a fundamentally new approach to data processing that enables you to supercharge core business processes or next-generation business applications with deep business insight delivered with near-zero latency.

Complementing the in-memory access that SAP HANA provides, SAP Sybase IQ software used as near-line storage (NLS) offers rapid access to massive volumes of less-critical data stored cost-effectively on disk. It enables you to analyze vast quantities of data faster than a traditional relational database and is therefore very useful when combing IoT-generated data with historical data for pattern detection or trend analysis.
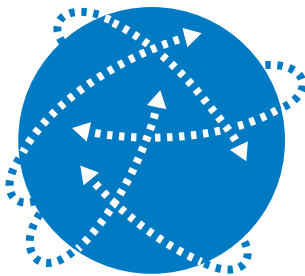
The SAP Real-Time Data Platform provides a flexible foundation capable of integrating increasingly intelligent devices securely and reliably into existing IT landscapes.

SAP and the Internet of Things

The Internet of Things will have a dramatic impact on the way companies interact with customers and streamline operations. To fully exploit these opportunities, enterprises need to start considering how they will address new technical challenges as they fold increasingly intelligent devices into their existing IT landscapes. How do you securely connect intelligent devices via the Internet to your enterprise, capture data reliably at the "point of action," and analyze massive volumes of machine-generated data alongside traditional data sources in real time?

The SAP Real-Time Data Platform is designed to help you thrive in a connected world. It is a transformative, modern technology infrastructure capable of capturing data reliably from hundreds of thousands of end points, analyzing Big Data more efficiently, and providing powerful, real-time analytics to larger numbers of users and consumers. Using this platform, companies can integrate massive amounts of IoT-generated data into next-generation business applications – securely and affordably.

For more than 40 years, SAP has been helping companies of all sizes and industries to run better by building powerful systems of record. Today, more than 60% of the world's GDP flows through SAP software. As we move forward into an increasingly connected world, the IoT solution from SAP, based on the SAP Real-Time Data Platform, will allow you to exploit new opportunities and unlock new levels of productivity.

LEARN MORE

To create and maintain a competitive advantage, IT must extend systems of record by embracing transformative new technologies. The complete Internet of Things solution from SAP, based on the SAP Real-Time Data Platform, offers game-changing innovation through unprecedented speed of transactions and analysis at the lowest total cost. Transformational technologies from SAP can help you create next-generation applications for the Internet of Things era, with a unified platform that allows you to securely connect intelligent devices to your enterprise, capture data reliably at the "point of action," and analyze massive volumes of machine-generated data in real time.

To learn more, visit us at www.sap.com/IoT.

FOOTNOTES

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