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IBM

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FlyWays

Using cutting edge technologies and crowdsourcing of data in aviation

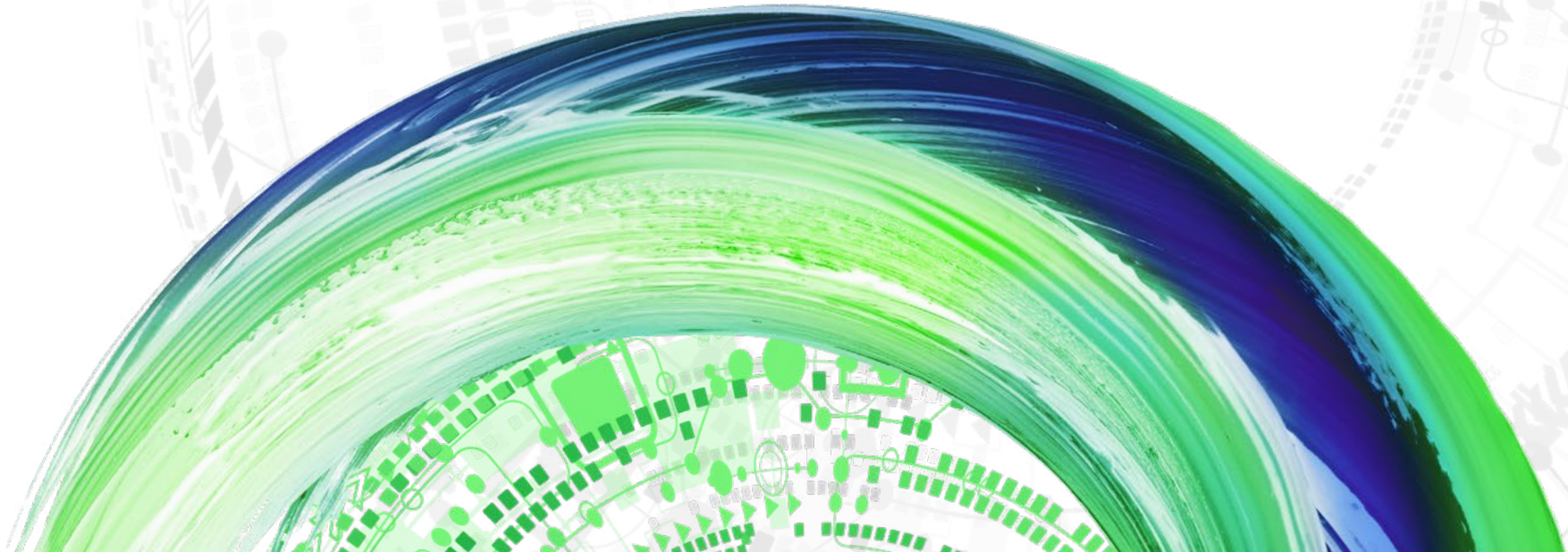
Abstract

In each flight, a commercial aircraft creates about 16 GB of data with all the metrics from its various sensors. This data is a great source of critical information for many innovative models such as creating comprehensive and cognitive manufacturing test cases or allowing upcoming flights on the same flightpath to access the crowdsourced data in real-time. Until now, there has been no such system to realize these possible system efficiencies.

Deloitte's IBM AI- and LinuxONE-based solution collects all the data from the various sensors of the flight in real-time as well as batch mode. Analyzing the data with fast turnover, the AI algorithm is able to communicate the weather patterns, the turbulence expected, and many other real-time metrics important to the pilots of other aircraft along the flight path. Additionally, the LinuxONE platform offers a cost competitive approach that also provides the security, reliability, and performance that comes from being a part of the mainframe family.

The IBM AI system, with IBM IoT Platform and the IBM Hypervisor makes possible the identification of additional manufacturing test cases and scenarios using data that has been too difficult to identify manually. The system can be built on IBM Cloud or LinuxOne servers. For complete security, the entire data set can be encrypted with pervasive encryption and IBM Data Privacy Passports.

Once built, this system can be used by airlines to improve logistics and supply chain support amongst their fleet, as well as speed communications and reduce human errors throughout the flight plan process. Airline manufacturers can add this technology to their maintenance infrastructure as an additional tool that will provide their customers a competitive advantage, while reducing human error and increasing productivity throughout the life of the airplane.



Current challenges in aviation data

In the current aviation world, there are a number of technologies being used. At this time, there is no integrated system to collect all the data from the various sensors on the flights, analyze the data, and provide the valuable suggestions and decisions that can be used for maintenance of current issues and to provide shared information for re-occurring issues that need to be resolved.

Integration of the various systems to provide a holistic, forward-looking, and trustworthy system has been a challenge. The lack of interoperability between multiple platforms and their data is the major roadblock to this goal.

Data security presents another major challenge. Data and the resulting analytics are sensitive information. There needs to be a proper and fool-proof security system to hold the data and analytics so that access is restricted to the designated systems or authorities.

This paper is a technical overview of the solution Deloitte is developing, based on cutting-edge IBM software and hardware, including LinuxONE and pervasive encryption.

It addresses the afore mentioned challenges, while offering the advantages of new era technologies. Deloitte understands that companies are striving to reduce costs and improve their maintenance programs to provide a more secure, effective program that results in reducing risks to an airline's customers and the cost of maintaining the aircraft.

Using IBM technology allows not only the owning airline, but any vendors it grants access to the data, the ability to ensure their products function as expected—and when issues appear, to identify themselves as a problem while protecting the data from a breach. The solution allows airlines to be proactive and resolve issues before they become serious and expensive to resolve.

Deloitte uses AI for this type of solution to reduce the needs of humans to monitor and identify issues. AI is scalable as well. As vendors add IoT sensors to their products, the solution will be able to accept the raw data without incurring costs for expansion. Lastly, the solution will automatically create and monitor maintenance tickets inside the airline's current systems. Users will be able to monitor (in real time) any issues and repairs using the front-end management tools and dashboards.

IBM® LinuxONE

IBM LinuxONE is a mainframe series that runs on Linux created by IBM as a way of competing with cloud computing solutions. One of the key features IBM uses to increase the competitiveness of their mainframes against cloud solutions is the inclusion of dedicated I/O processors. LinuxONE offers an alternative to hybrid cloud solutions at a competitive cost. In addition, the security of the LinuxONE mainframes is a fundamental design consideration, providing reassurance for users worried about cloud leaks.

IBM LinuxONE is the platform Deloitte has chosen to build our solution. It offers three major advantages:

- **Security:** LinuxONE features advanced encryption features—all built into the system and ready at install.
- **Compatibility:** LinuxONE has the power to support almost all cutting edge technologies including artificial intelligence (AI), blockchain, and machine learning (ML). LinuxONE is compatible with almost all types of systems—and can connect them to different APIs.
- **Scalability:** LinuxONE can scale to meet the needs of nearly any enterprise or agency (i.e., number of users, I/O operations, connected devices, and overall performance).

IBM Watson AI and IoT

Watson AI

Watson is IBM's suite of enterprise-ready AI services, applications, and tooling. Faster computing, richer data, and smarter algorithms have converged to make AI powerful and practical. With Watson, we can put AI to work in any industry. Deloitte's solution augments the teams' productivity by freeing the employees from repetitive tasks and empowering them to focus on the high-value work critical to the enterprise. Deloitte uses Watson's AI capabilities to build our system making it easy to connect various I/O systems and databases with fast turnaround time and a quicker way to resolve issues on the regular BAU tasks.

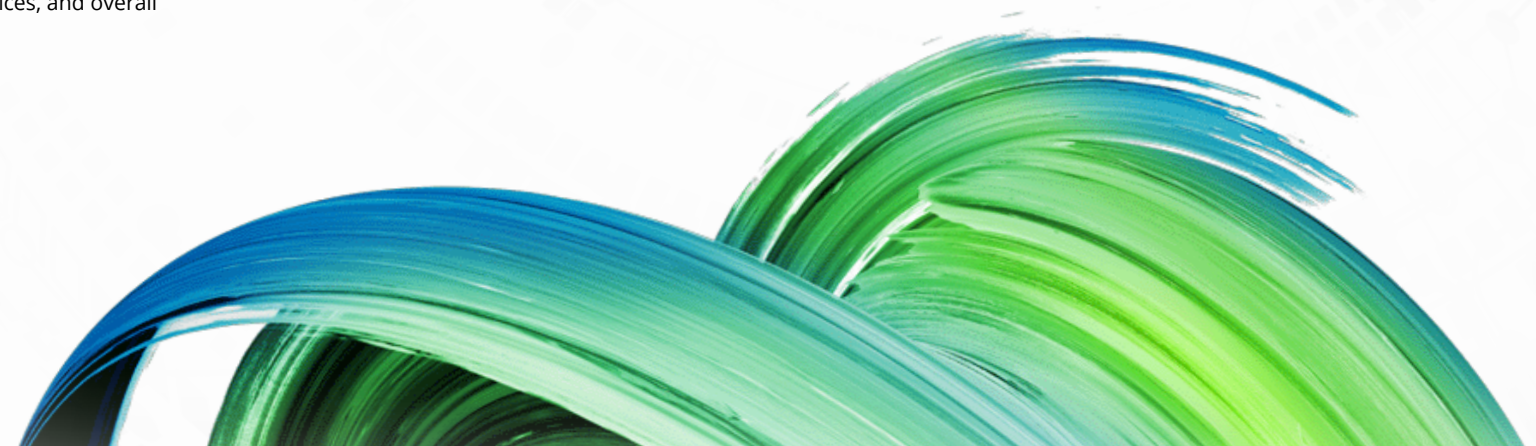
Watson IoT

The Watson IoT Platform is a fully managed, cloud-hosted service designed to simplify Internet of Things (IoT) development so users can derive greater value from the IoT data.

The platform includes cognitive computing, which enables intelligent systems that can "learn" from their environments. This helps businesses and individuals make sense of IoT data such as images, video, text in context, and data from various sensors.

Deloitte selected Watson IoT services for our solutions for the below advantages:

- **Power of cognitive:** Use the IoT data to understand current conditions and trends, comprehend unstructured data from videos and images, and extract unstructured textual data for insights.
- **Keep the IoT secure:** Manage risk and gather insights across your entire IoT landscape, using dashboards and sophisticated alerts to monitor devices, apps, and connections.
- **Efficient connection to the IoT devices:** Link the data that flows from your network of products, services, and employees into the decision platforms that support the business.
- **Maximize the IoT data:** Quickly and easily parse, filter, and transform device and performance data. Cache or archive data selectively for off-platform analytics or for integration with IoT apps.



Blockchain and Hyperledger Fabric

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets across a network. Almost all blockchains will allow access to a user only after secure identity verification of the user's access keys. There are now ample standards-based, IoT-friendly key security mechanisms available to aid with key storage and security, allowing for reliable key storage on the IoT device itself.

Although there are many blockchain platforms on the market, Hyperledger Fabric has become the de-facto standard for enterprise blockchain platforms. Supported by IBM, Hyperledger Fabric is an open-source, modular blockchain framework that provides several advantages when building an enterprise blockchain solution, such as:

- A permissioned membership structure that controls which entities can access the blockchain network
- Performance, scalability, and reliability run-time quality attributes that make a system usable
- Data on a need-to-know basis via channels between two or more specific network members, to conduct private and confidential transactions
- The modular architecture of Hyperledger Fabric supporting plug-in components

Hyperledger Fabric is a decentralized, distributed, immutable digital ledger used to record transactions across many copies of a ledger secured by cryptography. Hyperledger Fabric is managed autonomously using a peer-to-peer network and a distributed timestamping server. Mass collaboration powered by collective self-interests authenticates blockchain transactions.

Information held on Hyperledger Fabric exists as a shared and continually reconciled database. The ledger isn't stored in any single location, meaning the records it keeps are federated within the network and easily auditable. No centralized version of this information exists for a hacker to corrupt. Hyperledger Fabric, including various iterations of distributed ledger technology, can serve as the backbone to create the trusted, shared platform upon data processes transparently.

Blockchain is already helping users build trust and visibility with regulators thanks to its immutable and transparent processes—bringing visibility and control into the value chain. Establishing a verifiable, single source of the truth from digitized sensors results in conditions and provenance to build trust. Integrating this information into the distributed ledger is achieved using modern infrastructure, equipment, and IoT data.

IBM Cloud

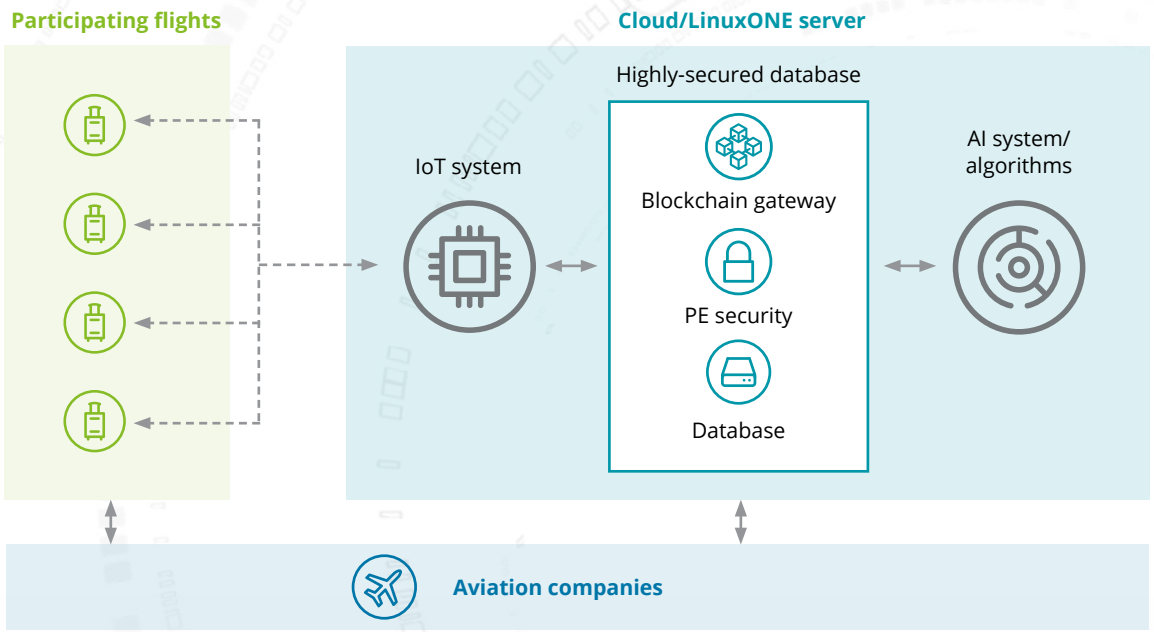
While initially the solution is built on LinuxONE, the entire system can be placed on IBM Cloud.

The IBM Cloud brand includes infrastructure as a service, software as a service, and platform as a service offered through public, private, and hybrid cloud delivery models. IBM places these offerings under three umbrellas: Cloud Foundation, Cloud Services, and Cloud Solutions.

Cloud Foundation consists of the infrastructure, hardware, provisioning, management, integration, and security that serve as the underpinnings of a private or hybrid cloud. Cloud Services is built using those foundational components, PaaS, IaaS, and backup services. Cloud Solutions consist of a number of collaboration, analytics, and marketing SaaS applications running on this cloud platform and infrastructure.

Pervasive encryption

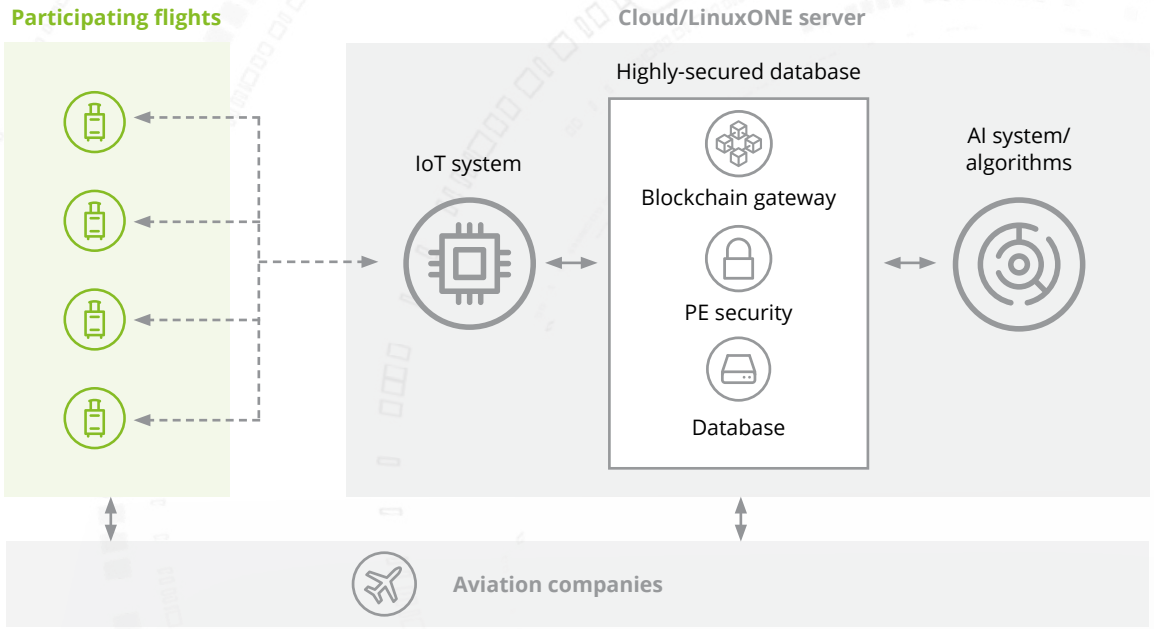
Data becomes the new perimeter of the enterprise and must be protected. Establishing a fortified perimeter around core business data using encryption is one of the most impactful ways to help protect data and prevent loss. Pervasive encryption is enabled by administrative policy controls and is designed to be application transparent, without requiring application changes. Pervasive encryption is a consumable approach to enable extensive encryption of data in transit and at rest to substantially simplify encryption and reduce costs associated with protecting data and achieving compliance mandates.



FlyWays uses cutting-edge technologies and crowdsourcing of real time data in aviation

Using cutting-edge technologies and crowdsourcing of data

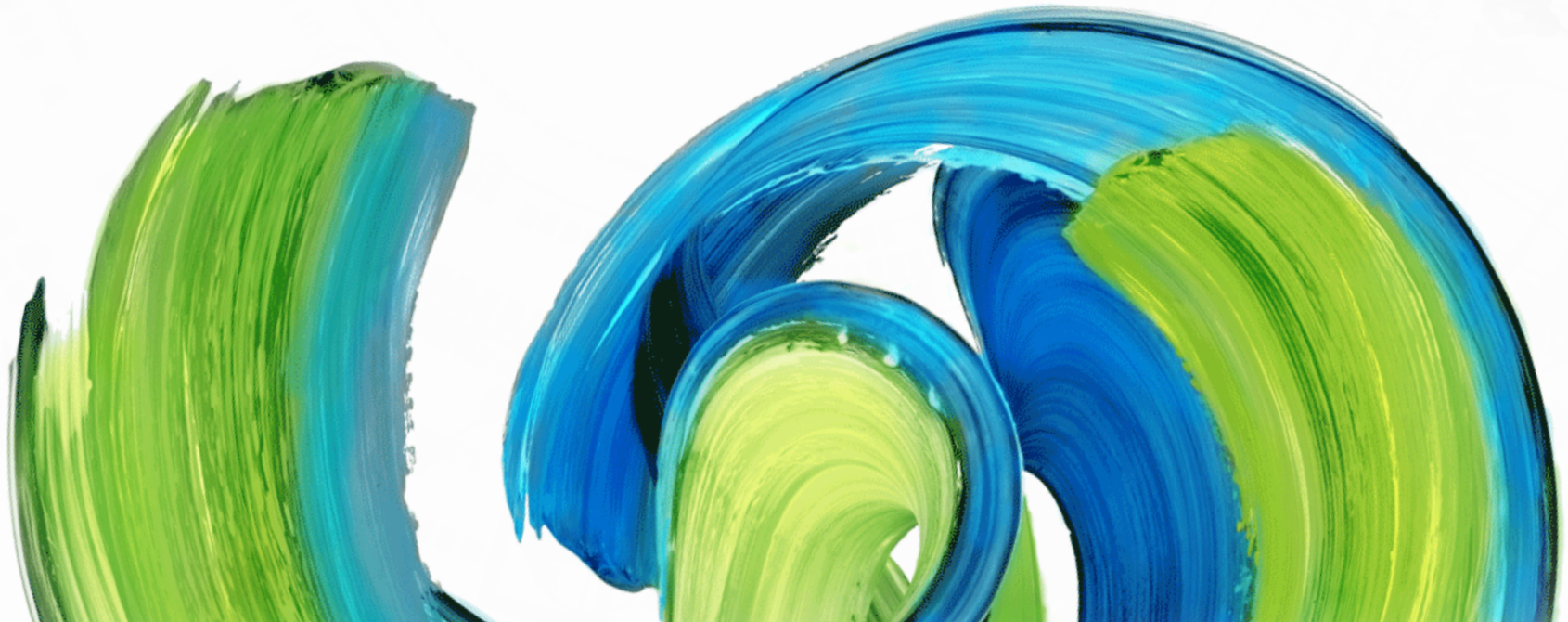
Deloitte uses innovative, highly efficient technologies to address these traditional aviation challenges, bringing a new solution/ ecosystem in aviation and incorporating multiple components as the system processes flow-in.

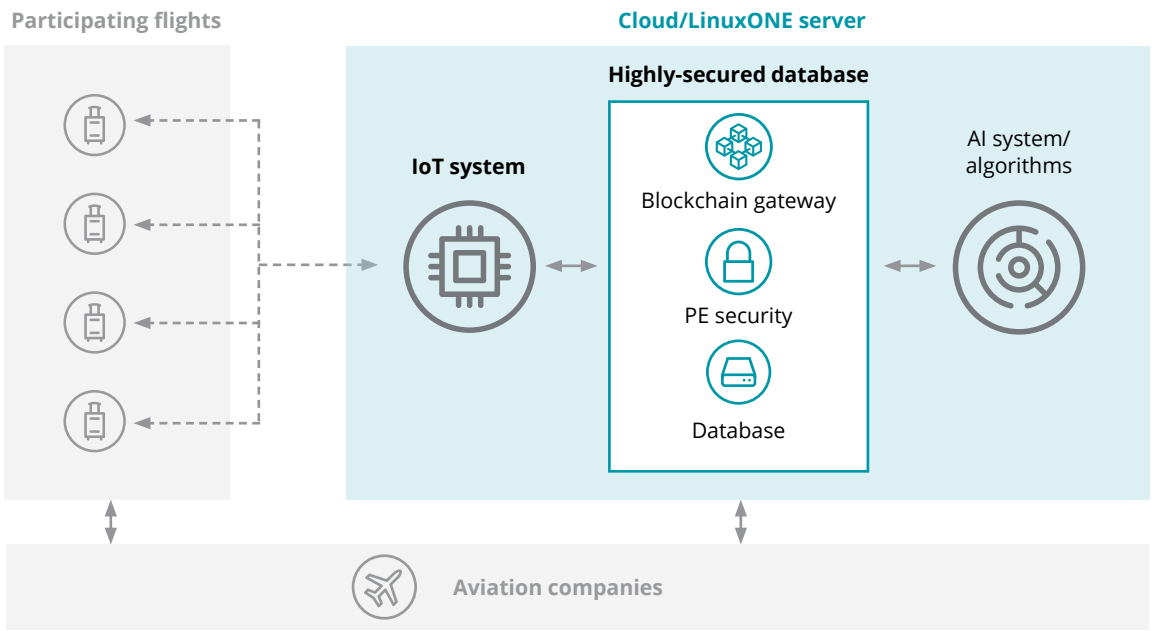


FlyWays uses cutting-edge technologies and crowdsourcing of real time data in aviation

Participating flights

- The first part of this ecosystem starts with the registration of the participating aviation companies for the participating flights.
- While these companies are registering, a one-time set up will sync all the sensors in various functionalities, which are already mounted in the participating flights.
- With the help of custom built IoT gateways and Watson IoT, these sensors are now connected to the ecosystem and at the same time the feed from the aircraft to the aviation companies will be intact.





FlyWays uses cutting-edge technologies and crowdsourcing of real time data in aviation

IoT system

- We take advantage of Watson IoT capability with its scalability, monitoring, and governing mechanism in our solution.
- Various sensors deployed in various functionalities of the flight are now connected to the IoT system in our solution system.
- At this point, continuous, real-time feeds from the sensors are available to the system.
- The raw sensor data is also available to the aviation companies in parallel.
- The IoT system formats the data so it can be stored and is accessible to the AI system.

Highly-secured database

This database contains sensitive real-time data as well as analytics for future solutions and therefore needs to be highly secured. There are 3 layers of security built in to ensure protection of the sensitive data.

Blockchain gateway for access

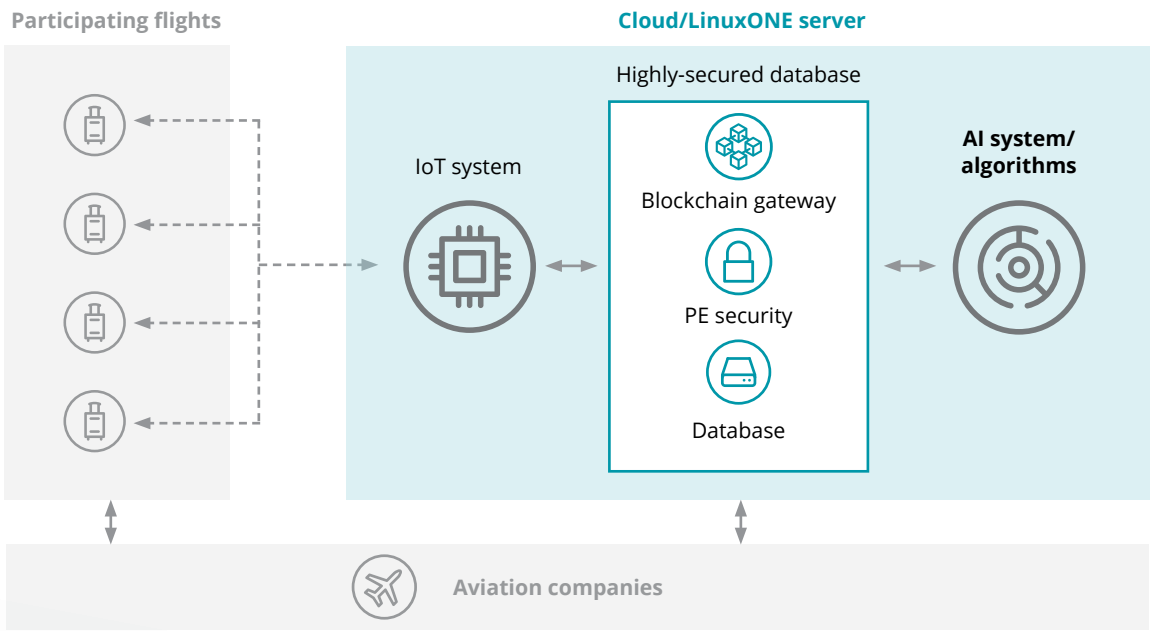
- Any user or system that needs to access the database should first contact the Hyperledger Fabric blockchain and request access.
- With the help of the membership service provider facility in Hyperledger Fabric, one blockchain network can be used by multiple aviation companies using multiple channels without compromising the data.
- After running the chaincode, the request will be approved or not approved.
- Upon approval, the blockchain network will update the ledger with the request transaction and the requestor will be given the access key.
- Using this access key, the requesting system now will be able to reach the second stage of the database which is an encryption system.

Pervasive encryption for data security

- With the access key obtained from the blockchain network, the requesting IoT system will be able to access the pervasive encryption data stored in the system database.
- The entire set of application data will be encrypted by the pervasive encryption application. Both the LinuxONE and cloud can access the pervasive encryption data stored in the system database using either the crypto cards, which are able to store and manage the keys or the pervasive encryption application.
- This gives a faster and more cost-effective encryption method for the entire data set along with additional security.

Columnar database for cost effective and quick access

- The encrypted data will be stored in the database.
- We chose a columnar database to support high performance.
- This also gives faster access on premise, as well as cloud access.



FlyWays uses cutting-edge technologies and crowdsourcing of real time data in aviation

LinuxONE Server or Cloud

- The entire system can be built on the new age LinuxONE server.
- The server can be purchased and customized or the system can be built and maintained by the offering company—IBM.
- Alternatively, this system can be built on a highly secured cloud and can be offered as a service to the participating aviation companies.

AI system/algorithms

The innovative part of the solution is the analysis of the real-time data providing immediate solutions/routes. This is performed by various AI algorithms running in the AI system. Once a decision is made by the AI system, it will be immediately available in the dashboard.

The dashboard shows the important decisions and solutions provided by the algorithm processing of the flight data.

The dashboard operates in three modes:

- **Auto Mode**. In auto mode, AI decisions are pre-approved by the authorities. Once the decision is made by the AI, a message is sent to the flight using encryption, blockchain network, and IoT system.
- **Manual Mode**. In manual mode, all decisions are shown in the dashboard, notifications are sent to the authorities, and the system waits for approval. Only upon approval does the system message the solutions/ideas to the participating flights. The turnaround time for approvals is critical for these situations.
- **Hybrid Mode**. In hybrid mode, small decisions are pre-approved and messages are sent immediately to participating flights. Bigger decisions are handled the same as manual mode.

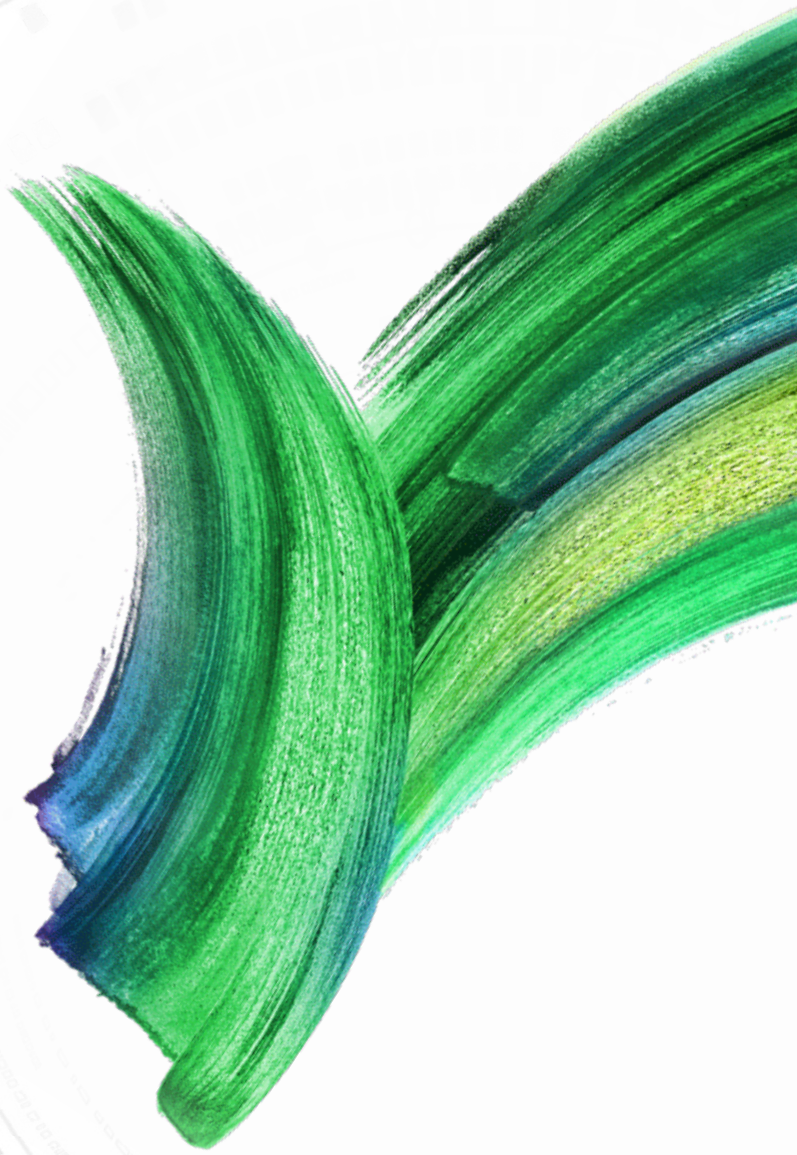
Benefits and features

Once built, there are multiple benefits from the system.

Aviation companies say that they experience an average of $9 billion per year loss due to flight delays. The system can reduce this loss through path improvements in real-time.

Using crowdsourcing data in real time allows bad weather, turbulence, and many other factors to be immediately communicated to the following flights and allows them to take corrective action.

Once built, this solution could be leveraged in other sectors, including automotive manufacturing, locomotive manufacturing, and discrete manufacturing. With the help of real-time data from connected cars, trains, or ships and embedded AI capabilities, manufacturers can get a large set of scenarios and test cases to improve product quality. This has the potential to become a norm for manufacturing companies.



Conclusion

We have demonstrated the need for a platform in aviation industries which monitors and gives intelligent results derived from real-time data. We have seen the various challenges and shortfalls to get this done in real-time.

We have also demonstrated the proposed platform with Watson IoT, Hyperledger Fabric, pervasive encryption, and AI and various functionalities. The technology company that creates the platform can either configure and maintain the platform or it can own the platform and can be an advisory board to the aviation companies. This solution has multiple options for its business model, including receiving revenue for every transaction performed. As we mentioned, the entire system can be built either on-premise with LinuxONE or on IBM Cloud.

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