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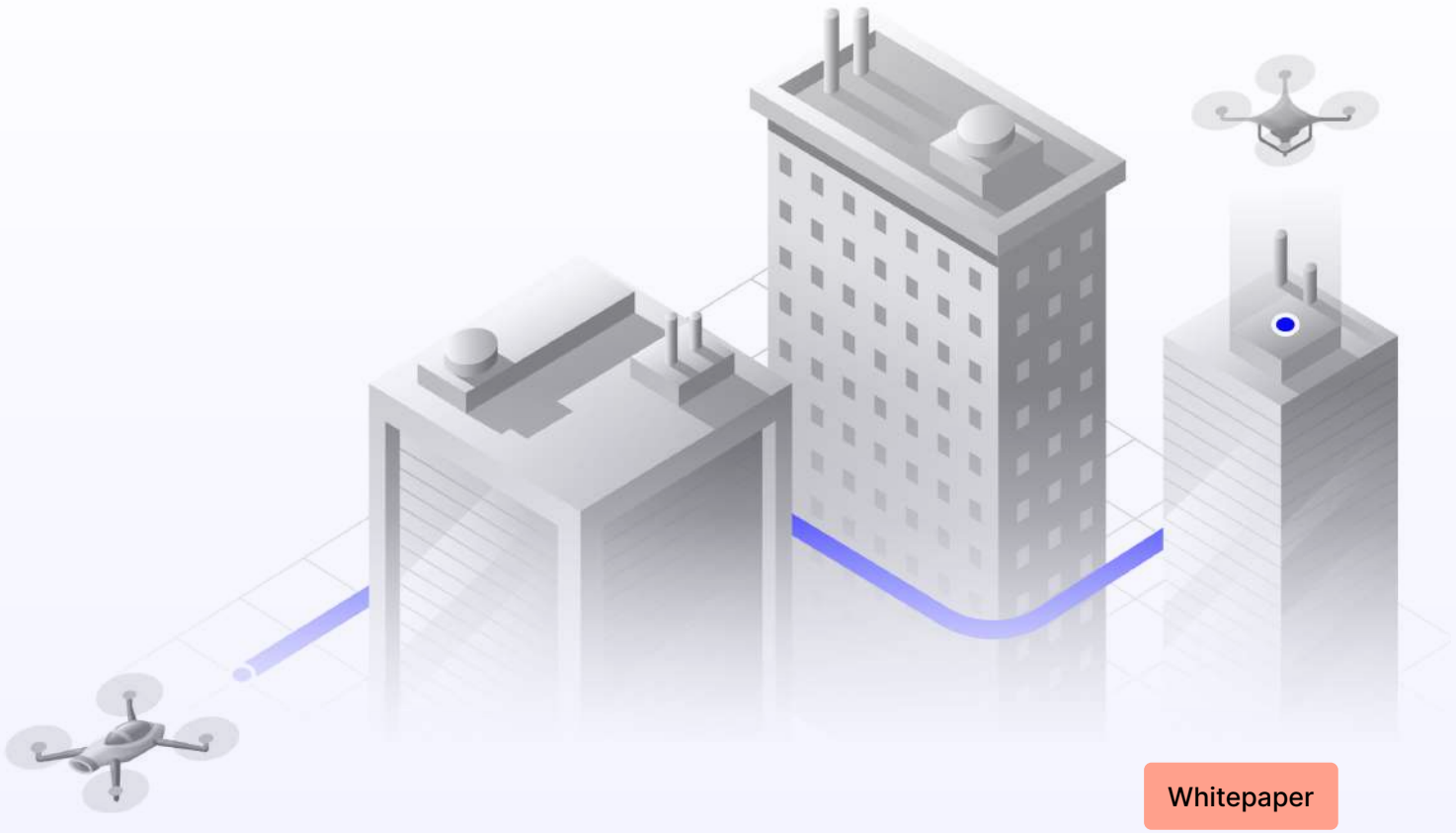
The Power of Blockchain in Unmanned Aviation



Whitepaper

Introduction

Blockchain technology: Hyped up by many, understood by few. But the truth is, this technology will have a real impact across all commercial industries from financial services and insurance to manufacturing and construction.

The technology is already being used to improve supply chain management, advance the privacy of sensitive healthcare data, prevent identify theft, and much more. The use cases are growing every day. In fact, Gartner estimates blockchain will generate $3.1 trillion in new business value by 2030.

This business value is also extending to the aviation industry where blockchain has the potential to revolutionize the management of drones. As more unmanned vehicles take flight, this technology can help ensure compliance with the safety standards, accurately record flight data, and improve collaboration with aviation authorities.

We'll start by covering the basics of blockchain technology and then shed light on why it's critical to power safe commercial drone operations.

What's Inside?

What is Blockchain?

Let's start with what it's not. Despite the common misunderstanding, blockchain is not bitcoin. Bitcoin is just one of its many applications. In technical terms, blockchain is a **distributed** ledger of **immutable** records stored in a **decentralized** database.

Immutable

The technology logs records in a ledger that are timestamped and linked to the previous entry with cryptography. These records cannot be altered retroactively. If a record includes an error, a new entry must be added to reverse the error, and both transactions are then visible and permanent.

Distributed

The ledger is concurrently shared across all computers in a blockchain network. Every participant in the network has a full copy of the ledger that updates with new records in real time. If one machine fails, the ledger will still operate since it has built-in redundancy.

Decentralized

The technology is politically and architecturally decentralized. There's not one central governing authority responsible for it, and there's not one centralized database a bad actor can compromise.

In layman terms, blockchain technology enables safe and accurate record-keeping across a network of computers, allowing multiple parties to interact with the same universal source of truth. The ledger can be public so anyone, anywhere can join the network or private so only those with authorization can join.

"Smart contracts" are also a key component of blockchain technology. Smart contracts can be encoded on any blockchain to set rules mutually agreed upon by network members. If the rules are met, the smart contracts automatically record information onto the ledger and execute the terms without human intervention. This helps guarantee the terms are met before execution.

Brief History of Blockchain

- **2009**

  Satoshi Nakamoto, whose true identity is still unknown, released a whitepaper about bitcoin. Blockchain technology was the answer to power his vision for a “purely peer-to-peer electronic cash system.”

- **2010**

  The first Bitcoin purchase took place for two pizzas that cost 10,000 BTC (valued at more than $70 million today).

- **2013**

  The Bitcoin marketplace surpassed $1 billion. Vitalik Buterin released a whitepaper that laid the foundation for Ethereum – a blockchain platform featuring smart contracts (i.e., applications that run exactly as programmed without any possibility of downtime, censorship, fraud, or third party interference.)

- **2014**

  Ethereum blockchain is funded by crowdsale, raising $18.4 million in the initial coin offering (ICO).

- **2015**

  The Ethereum genesis block (the first block of a block-chain) is created. The Linux Foundation unveils Hyperledg-er, an open-source collaborative effort to advance block-chain technologies.

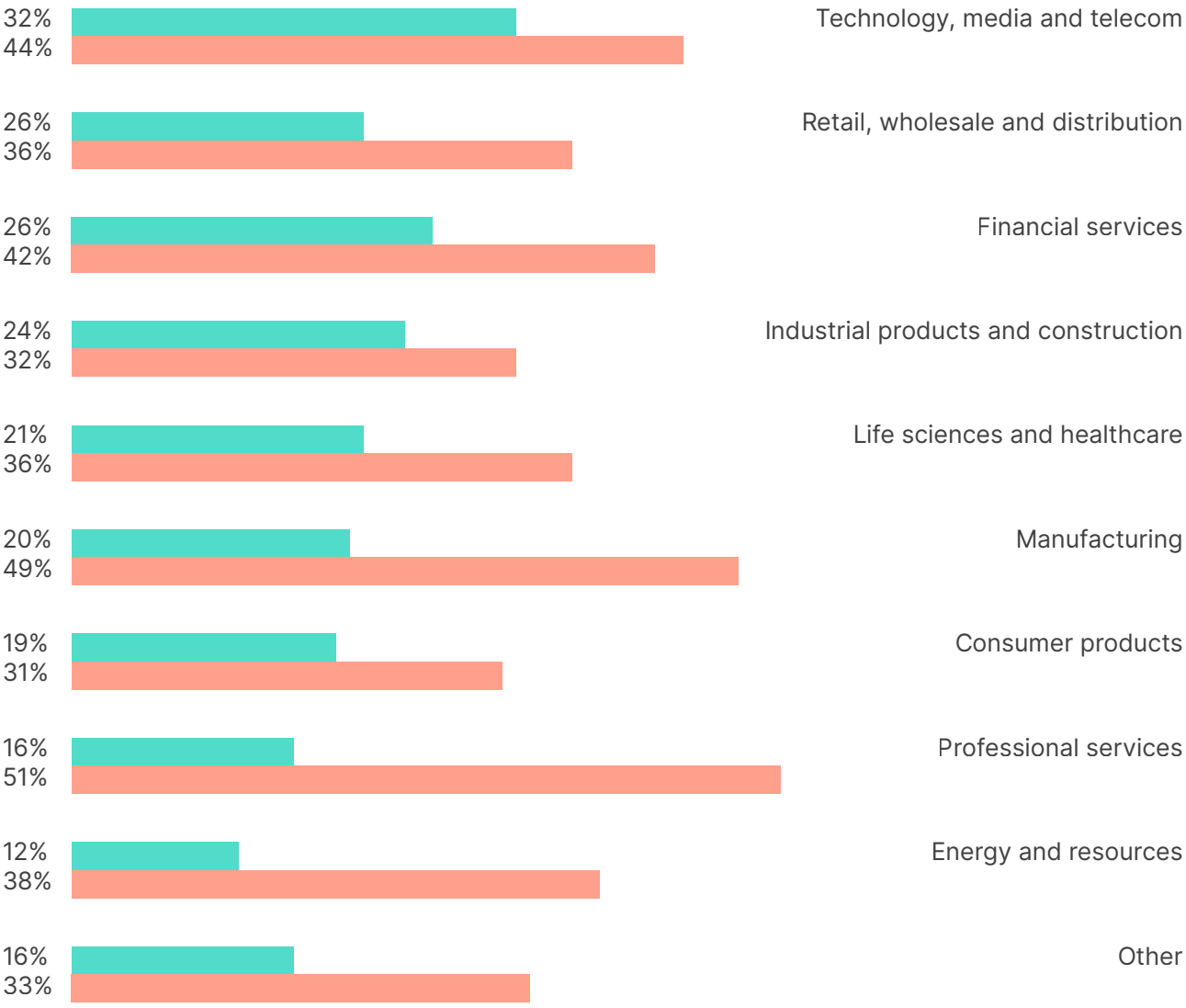
- **2018**

  Block.one closes the largest ICO raise in blockchain history: $4 billion. They develop and release version 1.0 of the open source EOSIO blockchain software, enabling businesses to rapidly build and deploy high-security, blockchain-based applications.

Business Applications for Blockchain

Today, blockchain technology is beginning to see wider, more practical adoption as businesses grasp the technology's long-term potential. According to Deloitte's 2019 Global Blockchain Survey, business adoption rates have reached nearly 30% in many industries and are expected to grow significantly over the next 12 months.

Blockchain Adoption Rates



- *Already has blockchain technology in production*
- *Plans to bring blockchain into production within 1 year*

Source:
Deloitte's 2019 Global Blockchain Survey

Blockchain Applications

Research shows the benefits of blockchain are real. It can serve as a pragmatic solution to business problems across all industries. Some of the most common applications can be found in financial services, supply chain, and insurance.

Financial Services

JP Morgan recently created the JPM Coin, a digital coin that uses blockchain technology to enable instant transfer of payments. When one client sends money to another over the blockchain, JPM Coins are transferred and instantaneously redeemed for the equivalent amount of U.S. dollars, reducing the typical settlement time.

Supply Chain

IBM and Walmart partnered to monitor food safety using blockchain technology. They created a permissioned, permanent, and shared record of food-system data to cut the time needed to trace produce from farm to store.

Insurance

The American International Group (AIG) partnered with IBM to develop a “smart” insurance policy that uses blockchain to manage complex international coverage. The real-time system allows companies, employees, and insurers to simultaneously share all data and documents about their policies.

Aviation

Blockchain is also being applied to the aviation industry as several airlines and their partners begin experimenting with the technology to create verified audit trails and streamline frequent flyer points. In unmanned aviation, SkyGrid is using blockchain augmented with smart contracts to accurately record drone data and ensure compliance with the safety standards.

The Need for Blockchain in Unmanned Aviation

Why use blockchain in unmanned aviation? Let's first examine the current landscape and some of the challenges the industry is facing.

Research shows commercial drone shipments will reach 2.9 million units by 2023. These drones will perform real business tasks. They'll deliver packages, conduct industrial inspections, provide emergency assistance, and even transport people. However, navigating low altitude airspace is complex.

Commercial drone operators are expected to monitor weather changes, avoid buildings and temporary objects, factor in risks on the ground, and maintain separation from other aircraft. The burden falls on them to manually plan, execute, and adapt flights as conditions change. At the same time, airpsace authorities are expected to monitor the growing volume of drones and enforce the airspace rules, but they're already experiencing maximum overload. Their infrastructure isn't equipped to scale and support millions of unmanned flights.

"Blockchain will undoubtedly be an integral aspect for drones. With millions of drones in the air, a means to record billions of pieces of information about where each drone is, tasks completed, and hundreds of other aspects will be vital. The use of smart contracts in blockchain, which will dictate thresholds for rules-based actions, will also be incredibly important."

@joerazz

Joseph Raczynski
Technologist & Futurist at Thomson Reuters Legal

Bottom line: It's simply not feasible for operators and authorities to safely manage unmanned flights with the current technologies available to them. A new airspace system is required to integrate drones in controlled airspace. This system must remove the burden on operators and authorities by enabling more autonomous workflows. We'll explore how a system powered by blockchain technology can provide a solution to these challenges.

Blockchain Benefits for Drones

01. Accurate Flight Data
02. Automated Compliance
03. Maintenance Guarantees
04. Systemwide Auditability
05. Industry Collaboration

01. Accurate Flight Data

Real-time awareness of all unmanned flights is critical to ensure the safety and equity of our airspace.

This requires drone operators to share their intended flight paths, position tracks, and any route changes with airspace authorities. These flights plans must be accurate and up to date to optimize the airspace and pre-empt unnecessary deconfliction with other aircraft.

An airspace system built on blockchain simplifies the process of sharing accurate flight data by removing the burden on drone operators. Blockchain technology can assign a unique ID to every unmanned aircraft and maintain a real-time record of each drone's status, flight details (e.g., altitude, coordinates), operator, and maintenance history.

The distributed nature of a blockchain system has built-in redundancy and updates with new records in real time. This approach enables flight awareness for airspace authorities and provides situational awareness to other aircraft operators so they can maintain safe separation.

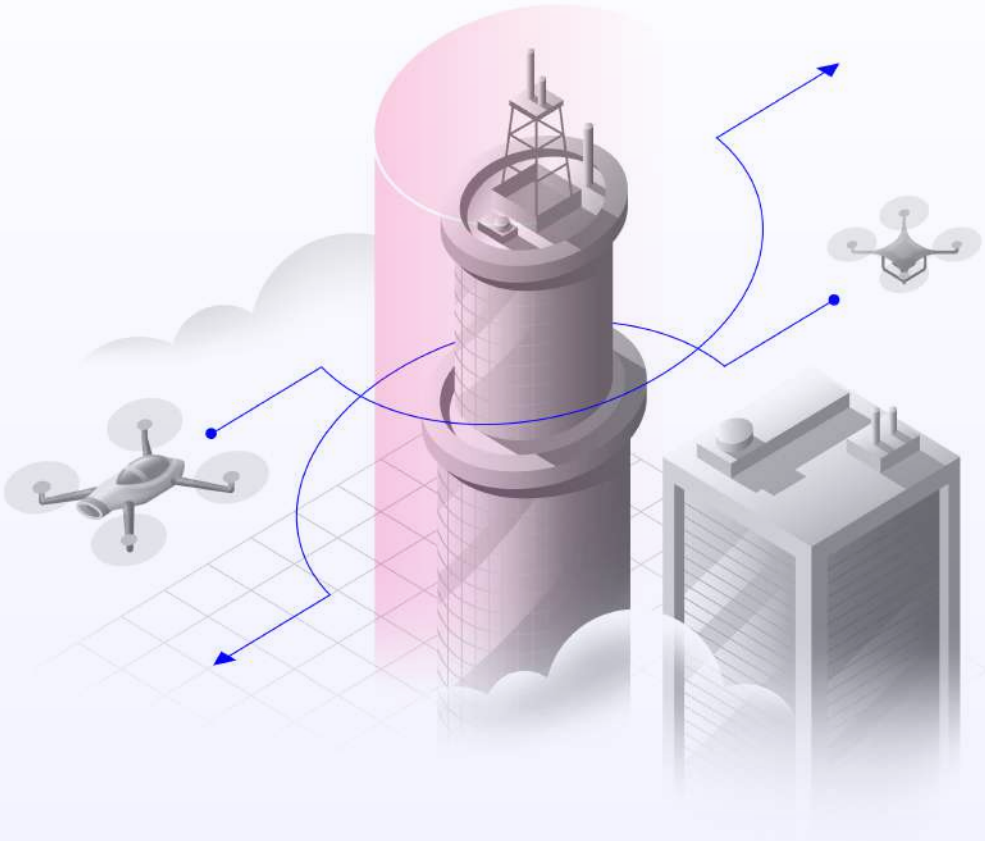
02. Automated Compliance

Recent drone sightings near airports and critical infrastructure have exposed how drones can put lives at risk and cause major disruptions to operations.

Oftentimes these incidents occur when drone operators unintentionally fly too close to an airport and too high in altitude. To avoid future incidents, we need a way to minimize the potential for human error.

Blockchain technology augmented with smart contracts will be critical to ensure all unmanned flights comply with the rules and regulations. A blockchain-backed system can mandate the defined airspace rules set by local and national authorities, such a flying below 400 feet and avoiding a set radius around airports. These rules can be encoded into an airspace system to automatically plan, execute, and adjust unmanned flights based on the specified airspace boundaries and safety standards.

Enterprises can also use this system to set additional safety parameters based on different types of missions, payloads, vehicles, and environment conditions. For example, company-wide parameters could include a rule to operate drones with at least 20 percent battery life under 25 mph winds. Blockchain technology will mandate compliance with the rules before flight authorization and during flight as airspace conditions change.



03. Maintenance Guarantees

The safety of our airspace also relies on the health of every drone, air taxi, or other unmanned aircraft in flight.

A blockchain ledger with smart contracts can help ensure drones are safe to fly. For example, if a maintenance request is created to replace a drone's battery, a smart contract can ensure the request is resolved and signed off by a technician's private key before the drone can operate again. This will prevent operators from choosing a drone that's not equipped to compete a mission safely and securely.

Blockchain technology can also be used to require regular system checks. For example, based on insights from a drone fleet, an organization might determine that drone performance is likely to degrade after flying for 24 hours under specific weather and usage patterns. Using smart contracts, the business can encode a system check as a rule once these conditions are met. The drone will then be ineligible to fly until the system check is complete and logged in the blockchain.

04. Systemwide Auditability

In the wake of an incident, authorities need assurances flight logs haven't been tampered with by the drone operator or a third party.

This requires the industry to ensure the security and integrity of data exchanged between drone operators, authorities, and service suppliers.

Blockchain technology is the key to maintain high standards of auditability by providing a verified data source of all unmanned flight records and service logs. In a blockchain-backed airspace system, each flight log is linked to the previous log with cryptography so they can't be altered retroactively. That means authorities can analyze flight data and determine the sequence of events with 100% certainty.

The decentralized nature of a blockchain system also provides more security than traditional, centralized storage since there's not one database a bad actor can compromise. This gives commercial operators a secure, accurate record of their fleet data and maintenance history to evaluate performance and optimize their operation.

05. Industry Collaboration

Storing flight data and service logs on a distributed ledger also eliminates the need for paper records and opens the opportunity for collaboration that hasn't existed in the past.

There are still many paper documents used in manned aviation today that simply can't be relied on as unmanned air traffic grows.

Blockchain technology can enable the industry to access a common operating picture recorded securely, accurately, and permanently on a private ledger. Authorized parties, such as airspace authorities and law enforcement, can access the private ledger to ensure operators are compliant with standards and hold operators accountable in the wake of an incident.

The use of private keys ensures only authorized parties have access to confidential data, such as flight plans, operator details, and payload information. This gives businesses assurances their operational data isn't accessed or intercepted by a malicious actor.

Blockchain Use Cases for Commercial Drones

01. Package Delivery
02. Industrial Inspections & Surveillance
03. Emergency Assistance

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01. Package Delivery

The opportunities for drone deliveries are endless across retail, logistics, food and beverage, and more.

In fact, we're already seeing trials of drone-delivered groceries, ranging from hot coffee to freshly baked bread. We're also beginning to see organizations test drone deliveries of pharmaceuticals to patients.

The challenge is some payloads are more dangerous than others, especially when flying over a crowd of people or a busy highway. In these instances, organizations can use blockchain technology to mandate safety parameters based on the type of payload.

For example, a pharmaceutical company delivering biohazardous materials could mandate rules to avoid flying within a set radius around airports, stadiums, or event venues. Drones carrying this payload will then be ineligible to fly near those areas, eliminating room for human error.

02. Industrial Inspections & Surveillance

Drones are also enabling more efficient inspections and surveillance within agriculture, energy, construction, and more.

Farmers and agriculture workers can use drones to better understand their potential harvest and ensure food production is up to code. Builders can use drones to survey land and collect real-time data on the progress of their construction sites. And oil and gas operators can use drones to inspect offshore rigs and minimize the risk of environmental damage.

Within these industries, a blockchain-powered system can provide a secure, accurate record all of inspections. That means, if an incident occurs, such as an oil spill, authorities can analyze the shared ledger to examine the last inspection, determine when the incident took place, and know with 100% certainty the logs haven't been altered by the operator.

"With the infusion of a distributed ledger like blockchain, we can achieve a new way to link drone operations and business processes, adding more value to the entire organization. This also opens the door to smart contracts that can manage all transactions in a transparent, secure, and immutable manner. In my view, blockchain technology will enable a paradigm shift in the way drone operations are performed and linked to business processes."

Antonio Grasso

@antgrasso

Digital Transformation Advisor

03. Emergency Assistance

Within the healthcare industry, drones can deliver urgent medical supplies to patients being cared for at home or quickly transport blood and organs to hospitals in rural areas.

However, the stakes are much higher when the mission could determine the fate of someone's life.

Augmented with smart contracts, blockchain technology can help ensure emergency drones are safe for flight. For example, the technology can mandate a system check after vehicles have logged 10 flight hours. It can also ensure any maintenance needs are resolved and signed off by a technician's private key. That way, only healthy, high-performing vehicles will be eligible for emergency missions with critical payloads.

Blockchain technology can also ensure the privacy and accuracy of sensitive health-care data. Patients and doctors need assurances that the correct blood type and organs are being delivered. Blockchain technology can enable a verified data source that securely and accurately records all details about the payload, such as when it departed, where it came from, and who it's intended for. The data will only be accessible to authoritied parties with a private key.

Conclusion

We're entering unchartered skies as more drones take flight. There's no doubt unmanned aircraft will have a tremendous impact on business operations and advanced air mobility at large. But there are still major safety and security concerns that must be addressed. How do we protect the integrity of flight data? How do we create a common operating picture across the industry? And how do we ensure compliance with the airspace rules and regulations?

Blockchain technology can provide solutions to these challenges. With its ability to enable safer operations and protect data integrity, blockchain is critical for the airspace systems of tomorrow.

Learn more about airspace management powered by blockchain.

Enterprises Authorities

About SkyGrid

SkyGrid, a Boeing, SparkCognition company, is powering the next generation of aviation. As the only airspace management system built on AI and blockchain, SkyGrid is solving the industry's biggest challenges integrating unmanned aircraft in the global airspace and executing autonomous operations. SkyGrid's AerialOS™ monitors, predicts, and adapts to changes in airspace traffic, environment conditions, and vehicle health to intelligently route, synchronize, and manage unmanned aircraft. Based in Austin, Texas, SkyGrid is enabling a wide variety of commercial drone operations from package delivery to emergency assistance.