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DRONE DISCOVERY PROTOCOL FOR ENTERPRISE DRONES VIA SMART CONTRACTS

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ABSTRACT

Techniques are described herein for targeting the Enterprise drone market where the authorization and traceability of unmanned drones for service deliveries will be necessary in the near future. Currently, the implementation of drone tracking and its end to end flight validation is still poorly defined. Therefore, a consensus mechanism tying all entities within the drone ecosystem is needed (e.g., the manufacturer, insurance companies, smart city authorities, traffic controller, etc.). Described within is a consensus based smart contract using blockchain technology within the drone application which makes it permissible to fly and be tracked by a drone discovery protocol.

DETAILED DESCRIPTION

Currently, there are fragmented ways of policing and tracking drones since the policies vary across regions and countries. Therefore, there are with very limited ways of identifying whether a drone is permissioned to take off for its actual purpose. With a rising market for specific enterprise unmanned drones to deliver a specific service, a trusted, yet decentralized validation method is required.

However, there are many unanswered questions as the single source of truth for its validation.

Figure 1 below depicts some of the unanswered questions from the entities who play part of the ecosystem today.

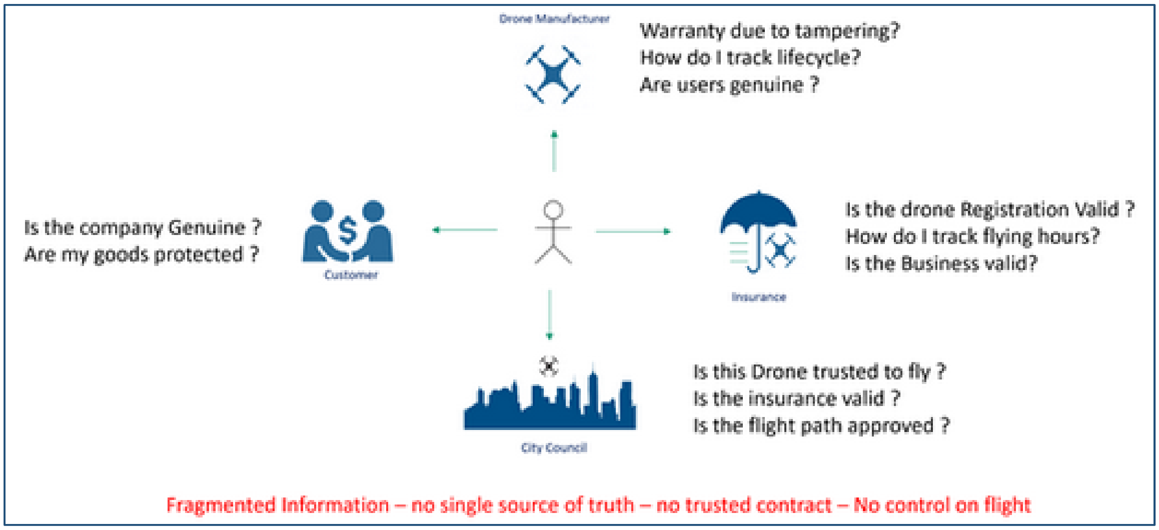

Drone Manufacturer
Warranty due to tampering?
How do I track lifecycle?
Are users genuine ?
Is the company Genuine ?
Are my goods protected ?
Customer
Insurance
Is the drone Registration Valid ?
How do I track flying hours?
Is the Business valid?
City Council
Is this Drone trusted to fly ?
Is the insurance valid ?
Is the flight path approved ?
Fragmented Information – no single source of truth – no trusted contract – No control on flight

Figure 1

Provided herein is an overview of the different areas of the ecosystem which can act as validators in the solution for tracking drones over blockchain.

The technology relies on a blockchain smart contract as a mechanism which provides uniqueness and immutability as a secure and trusted source of validation. Smart contracts are code written into a blockchain network which sets terms of agreement which when met reaches consensus and allows triggering of the terms to be executed.

The solution allows Enterprise drones to have an embedded blockchain application which participate as a node to its validator blockchain. It reaches consensus for flight through a "Trigger and Execution" smart contract algorithm. This acts as a protocol license which satisfies all the criteria to enable flight features to serve its purpose. All the criteria may be defined through the smart contract which is validated by the different participants in the blockchain ecosystem (e.g., manufacturer, reseller, insurance company, aviation authority, business provider, etc.).

The consensus is a cryptographic hash which is immutable and unique. This then becomes the fundamental unique identifier key when used across a specific drone discovery protocol on blockchain enabled devices or platforms within a networked infrastructure.

Figure 2 below illustrates various entities connected via blockchain as a single source of truth on a distributed ledger, where each party's consensus is reached via the use of smart contracts.

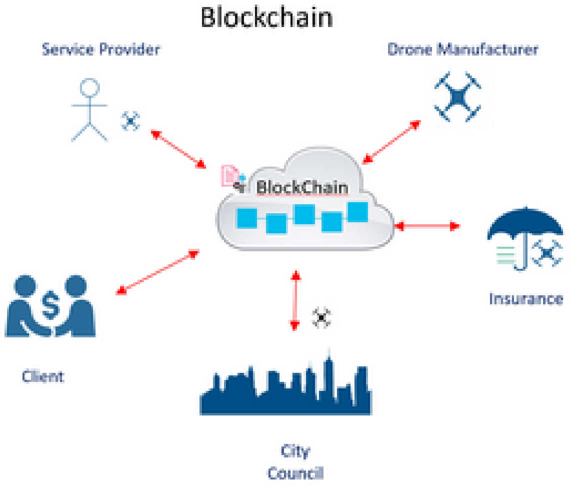


Figure 2

The concept may be deployed within a Service Provider mobility, cell towers, or a smart city networked infrastructure where drones are flying to deliver a service.

A simple proof of concept using GETH on a Raspberry PI (RPi) to control a rotor over an Ethereum blockchain can be used. Once consensus is reached based on the terms set by the validators, the application on the RPi allows the rotor to turn.

Figure 3 below illustrates how the blockchain triggers the rotor of the drone with the RPi.

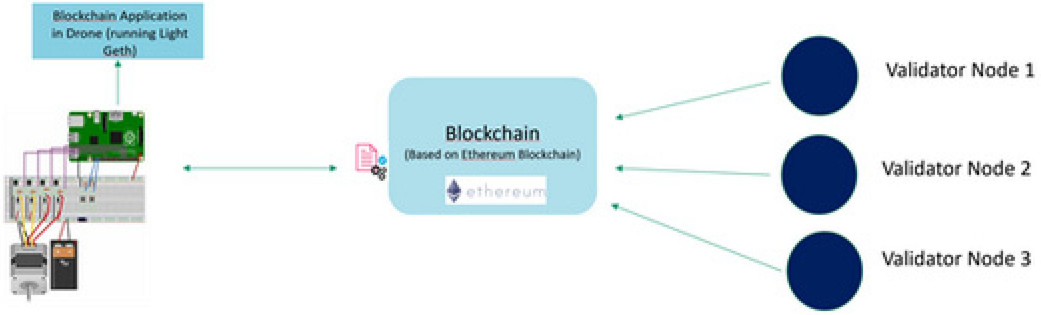

Blockchain Application in Drone (running Light Geth)
Blockchain
(Based on Ethereum Blockchain)
ethereum
Validator Node 1
Validator Node 2
Validator Node 3

Figure 3

Figure 4 below illustrates communication between the entities of enterprise drones as a proof of concept.

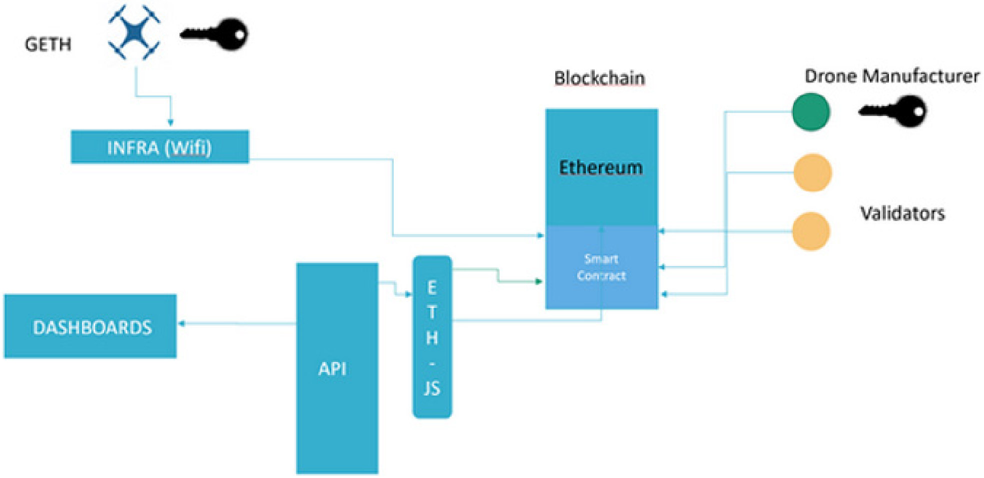


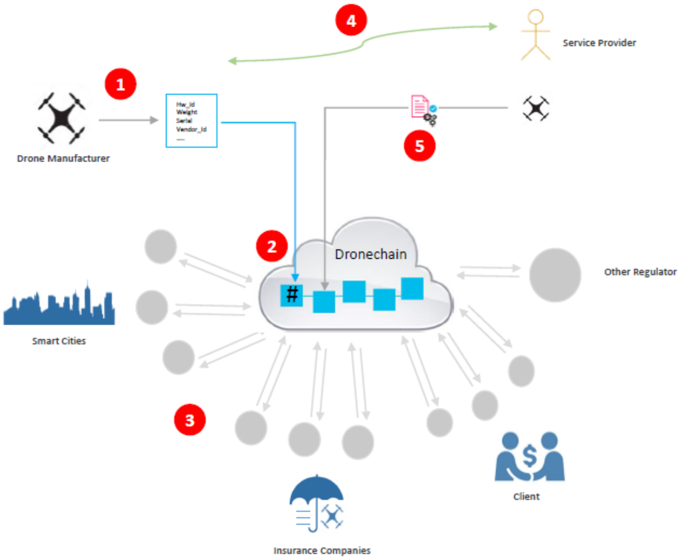
Figure 4

Defined herewith is the journey of a drone within its ecosystem from manufacturing to end of life.

The drone manufacturer creates the entry of the drone with all relevant information with a smart contract. This smart contract gets stored on the blockchain as a unique source of truth. Validators who are also part of the same blockchain validates and gets a copy of the contract. When an enterprise business owner buys a drone, the owner is required to update the relevant entries on the type of service and stores this on the blockchain.

When the drone is actioned for flight, its embedded application looks for its validator blockchain to validate its contract. Upon successful validation where all criteria are met, the smart contract achieves consensus and the "trigger and execution" code allows the drone to enable the flight feature (like a licensed feature).

Figure 5 below illustrates the journey of a drone from its purchase to deployment, empowered by blockchain.



1 Drone Manufacturer creates the entry of the Drone with all relevant info

2 It gets stored on the Dronechain and as a hash which forms the block.

3 All the validators in the Dronechain ecosystems get a copy of the information and validates the information.

4 When a service provider buys a drone, the ownership changes which creates a new hash which is then stored on the blockchain forming the next block. The SP then updates relevant entries in the smart contract on the type of service it needs to deliver which will require validation.

5 The day the Drone is being used to deliver a service, its embedded application connects to Dronechain and based on the consensus algorithm of the Smart Contract to be satisfied (valid Smartcity , regulator, Service Request, Insurance..etc), The smart contract achieves consensus and is permitted to fly.

Figure 5

The solution can be implemented at the edge network infrastructure layer which supports blockchain technology.

Figure 6 below illustrates enterprise drone communication and network layers for a drone discovery protocol within a smart city infrastructure.

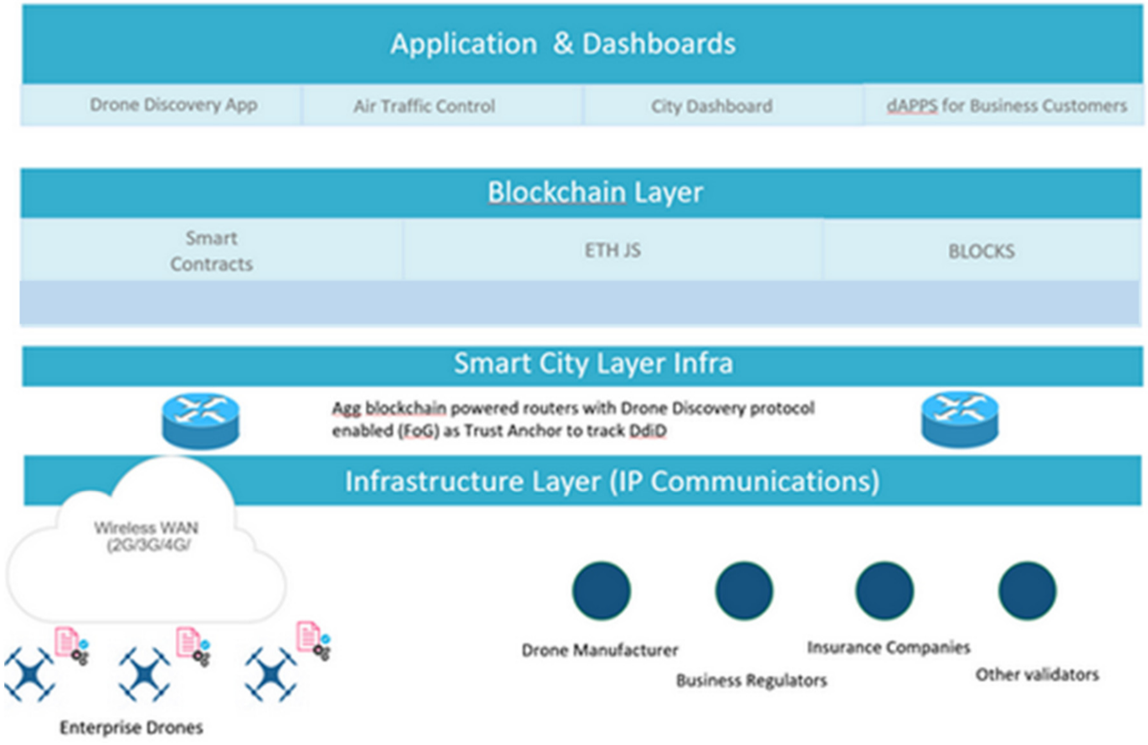


Figure 6

The network edge devices act as trust anchors that discover requests from drones broadcasting Drone Discovery Identifiers (DDiDs) via cryptographic public keys / smart contract signatures.

Figure 7 below illustrates an example flow chart of drone discovery protocol.

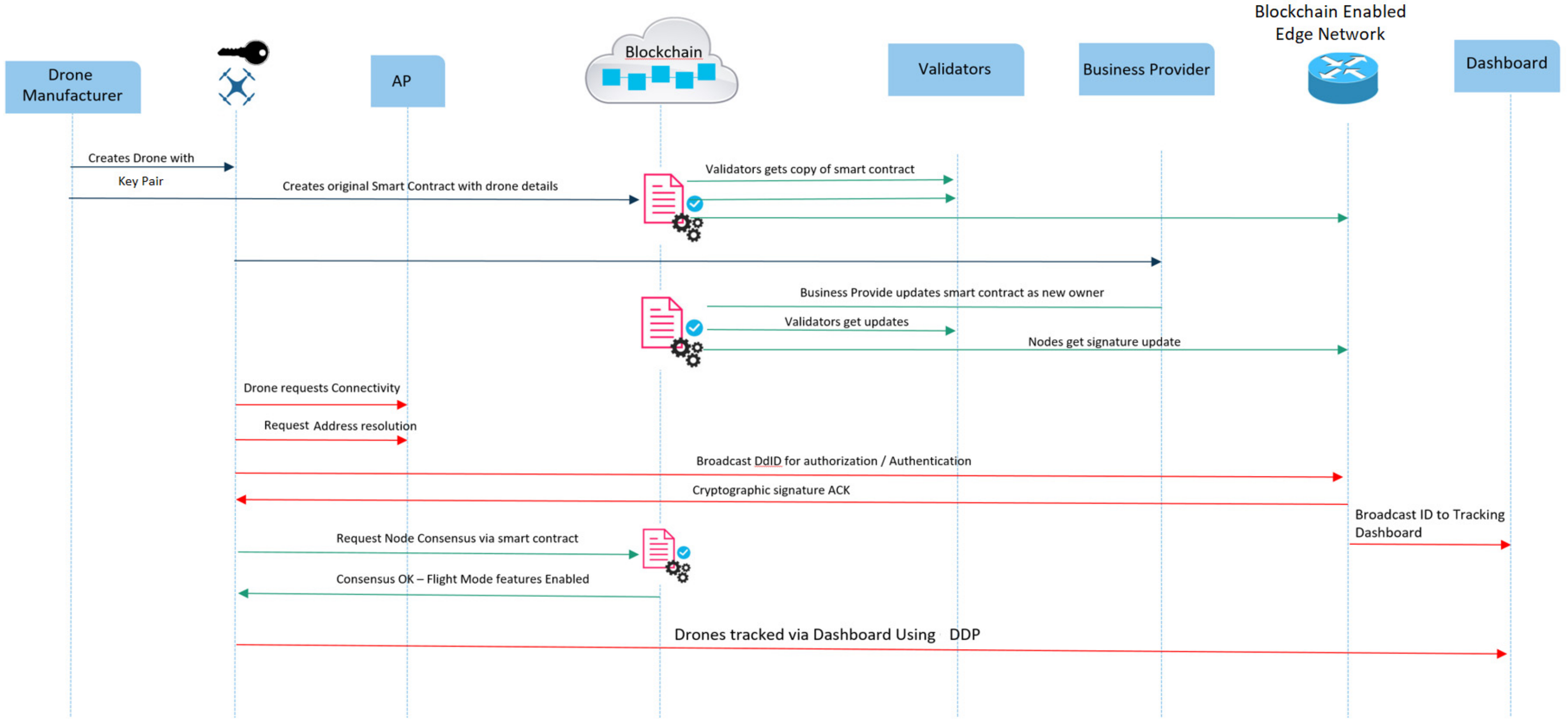

Drone Manufacturer
AP
Blockchain
Validators
Business Provider
Blockchain Enabled Edge Network
Dashboard
Creates Drone with Key Pair
Creates original Smart Contract with drone details
Validators gets copy of smart contract
Business Provide updates smart contract as new owner
Validators get updates
Nodes get signature update
Drone requests Connectivity
Request Address resolution
Broadcast DdID for authorization / Authentication
Cryptographic signature ACK
Broadcast ID to Tracking Dashboard
Request Node Consensus via smart contract
Consensus OK – Flight Mode features Enabled
Drones tracked via Dashboard Using DDP

Figure 7

The drone flight process is described herein. At power on, the drone initiates a Power On Self Test (POST) which then triggers Access Point Discovery (APD) to have wider area connectivity to its nearest blockchain. The drone receives the connectivity information and nearest router resolution addresses as part of an APD Acknowledgement (ACK) message. The drone broadcasts an immutable secure DDiD which is made up of a crypto-key pair. Since the nodes participate as validators in the blockchain, they have a secure hash to validate the DDiD. The drone gets a DDiD ACK for the valid tracking ID via the discovery protocol from the router. The drone requests for consensus (DCON) to fly via validation through the blockchain smart contract trigger algorithm. On valid authorization (DCON ACK), the flight features are enabled on the drone for the flight.

The techniques described herein provide added security for drones and a solution that can ground tampered drones. The complete lifecycle of the drone can be tracked from production to end-of-life. This enables an end-to-end solution to provide orchestration for deploying drones for an enterprise. This may provide a platform for licensing, upgrades, or microservices to be pushed to drones.

In summary, techniques are described herein for targeting the enterprise drone market where in the near future the authorization and traceability of unmanned drones for service deliveries will be imminent. Currently, the implementation of drone tracking is still too poor to validate end to end flight. Therefore a consensus mechanism tying all entities within the drone ecosystem is needed (e.g., manufacture, insurance, smart city authorities, traffic controller, etc.). Described is a smart contract algorithm within the drone application which makes it permissible to fly and be tracked by a drone discovery protocol.