Decentralised Drone Platform

Distribution and Monetisation of Drone Content

Christopher Lowe
Lead Blockchain Scientist

Marek Tlacbaba
Lead Blockchain Developer

Amir Farhand
CEO & Founder

June 6, 2018 https://soar.earth

v1.5

Abstract

Despite the rapid growth of the drone industry [1][2][3][4] there remains an absence of a fair and profitable marketplace for drone operators to distribute and monetise their content. Beyond this market gap opportunity there is a spectrum of unrealised potential and reusability of drone content that has been geospatially aggregated.

Soar intends to provide drone content providers with the platform and tools for monetising their unused or single purpose content by leveraging existing technology developed for mobile geospatial applications and the US military[5]. When a sufficient amount of aerial imagery is collected in an area, this data will be aggregate into a super-map. This super-map will far exceed the level of detail available from existing satellite maps and will allow users to cycle backwards through time to see how an area has changed from the perspective of a low flying bird.

The major challenges in crowdsourcing drone data for mapping applications have traditionally been limited by content authenticity, incentivisation and scalability.

The blockchain is a decentralised, immutable database which the platform uses to democratise the ownership and validity of data collected. To incentivise content creators, Soar will release an ERC20 compatible cryptocurrency called SkyMap Tokens (SKYM) which facilitates the sales transaction. Scalability will be achieved through the decentralised nature of the platform and by partnership with Alibaba Cloud.

1. A decentralised drone marketplace

SKYM tokens will be used to financially reward content creators for the sale of their data, however the primary role of the token is to act as a free market value calculator for drone content in a given part of the world. Particular parts of the world are more valuable to map consumers and this level of interest in an area can change over time, sometimes very rapidly. This difference in value proposition should be reflected in the financial reward for the content creator allowing the content creators to act upon in order to collect the most relevant and profitable data.

A heat map is an effect visualisation of this difference in a locations value and can be used by drone operators to optimise their data collection priorities. Each grid represents a node in the QuadTree (please refer to section 1.1 for more information).

Figure 1 - Supply and demand heat map

The value of data in a given grid in the world is based on the market forces of supply and demand:

$$P_{new} = P_{low} + (P_{old} \times (1 + log\ Q_d)) \times t_f$$

Where:

Q_d	is the demand for data from sales transactions or bounties
t_f	is the time decay interval and,
P_{low}	is the nominal market price

Initially, the nominal market price (P_{low}) will be set by Soar to ensure optimal market operations however this default or minimum value of data will eventually be determined by voting consensus.

Mathematics aside, the behaviour of the decentralised marketplace can be summarised by the following characteristics:

- Sale or bounties in a given given grid act to inflate the value of all data in that grid
- This increase in value decays over time (t_f) and trends back towards minimum (P_{low})
- Inflationary pressures are logarithmic so subsequent or ongoing sales have decreasing impact on the price

Some datasets such as aerial maps of video flybys may intersect multiple grids. In these situations the price is simply an average of every intersecting grid:

$$P_G = \frac{P_{G1} + P_{G2} + \ldots P_{Gn}}{n}$$

1.1 QuadTree and GeoHashes

To facilitate the value calculations and efficiently present raster mapping data to a client, the world will be divided into a QuadTree[6] where each grid has four child cells representing the next zoom level. The Soar QuadTree will be different from other solutions in that it requires a much greater level of zoom (hence a deeper QuadTree) to facilitate the higher ground resolution of drone maps.

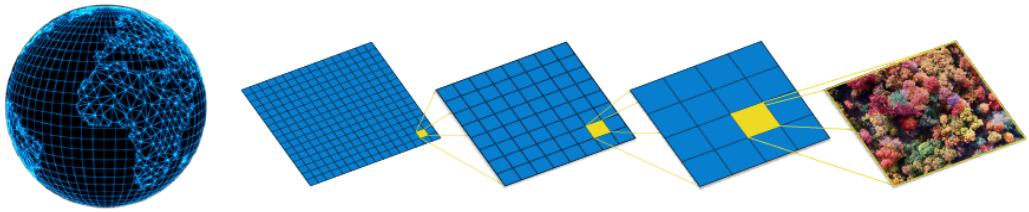

Figure 2 - The Soar QuadTree

At around zoom level 23 the coordinate space starts becoming corrupted by floating point inaccuracies[7] at which point we convert the coordinate space by simple linear matrix transformation[8]

$$T(\vec{x}) = \mathbf{A}\vec{x}$$

This transformation is possible because the location data stored in the blockchain is encoded as Well Known Text (please refer to section 1.3 for more information).

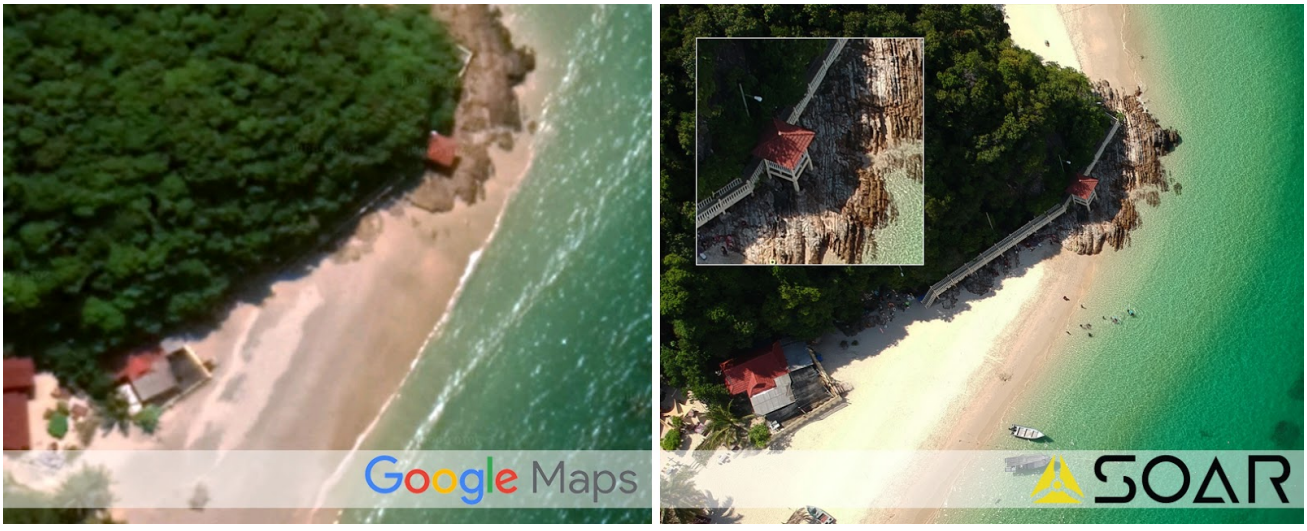

Figure 3 - Example of the QuadTree at work by comparing Google imagery with Soar imagery.

While the QuadTree allows a mechanism to value and present data to the client, it would be a geospatially complex data operation[9] when it comes to interpreting new events in the blockchain such as content uploads. Fortunately, a geoHash[10] can provide arbitrary precision to geospatial data via computationally trivial string truncation and will serve as an event index for the platform to listen, search, filter and synchronise the internal state of the client platform with the blockchain.

1.2 EXIF, XMP, Georeferencing and Metadata

When a drone camera captures an image, it automatically writes information into the file as EXIF[11] data describing the GPS coordinates, altitude, camera lens, serial numbers and a range of additional data the Soar platform can use to determine the type of data with which it is dealing.

EXIF Key	Sample value
Model	FC330
GPSLatitude	31.9189912
GPSLongitude	115.971587
GPSAltitude	61.332m
SerialNumber	ffffffffffffff095653ff2cff4123ffffffef
ModifyDate	2017:04:30 14:36:53

Table 1 - Example of a files EXIF data

Simultaneously, the drone hardware writes XMP[12] data to the file, describing the gimbal, yaw, pitch and flight speed parameters.

XMP Key	Sample value
FlightYawDegree	-11.1
GimbalPitchDegree	-90
FlightSpeedX	+0.00
FlightSpeedY	+0.00
FlightSpeedZ	+0.00

Table 2 - Example of a files XMP data

This EXIF and XMP data is used to initialise the User Interface and shortcut the georeference process. With the above sample data we can determine that the image is an aerial map (based on the gimbal pitch of -90 degrees) and with the GPS, altitude and flight yaw we can place it at the exact position, rotation and scale on a map using pythagoras. Due to GPS inaccuracies[13] we will provide the user with a mechanism to fine tune the georeferencing by manipulating an opaque view of the data over traditional satellite maps. We've proven that in over 1,000 sample images taken with a consumer model DJI drone that the EXIF and XMP is sufficient to accurately georeference the image.

In addition to the georeferencing information, a content marketplace requires some contextual metadata concerning image contents. The User Interface will ask the content creator for basic information such as a title, description and tags to allow end users to filter and search content.

1.2 Off-chain file storage

Although blockchain based solutions to file storage do exist, we determined that both the costs and access speed for the scale of our data requirements would be prohibitive. Subsequently, we have established a strategic partnership with Alibaba Cloud services which unlike other cloud based file storage solutions will allow for truly global access to all drone content. It is important to point out that many current providers of cloud storage are limited to geographies of operation. For example, Google Cloud and Amazon can not reliably function in countries such as China, Iran and Russia.

Since the files off-chain storage location can be accessed by directly reading the on-chain data (refer to section 1.3), we require a security access layer which prevents the leaking of content that has not been purchased and bridge the gap between the off-chain file storage on the blockchain.

To achieve this a serverless function generates a security challenge prior to purchasing content. After the transaction has been verified on the blockchain an event is emitted which validates the wallet against the security challenge. This verification of (private) security challenge against (public) wallet and transaction is what gives the user read access to the file residing on an OSS (Alibaba Cloud storage container).

1.3 On-chain data

Smart contracts are immutable so to allow for new features in the platform, we will write most of the data into a JSON payload. Some information will be written directly into a data type on the smart contract as they will not change during the lifetime of the platform:

Variable	Type	Description
fileHash	bytes32	An MD5 hash of the entire file to ensure it hasn't been modified
geoHash	bytes12	The geoHash described in section 1.1
WKT	string	The Well Known Text encoded geospatial coordinate
previewUrl	string	The preview url for the data
url	string	The url for the data
metadata	string	The JSON payload which contains all other data

Table 3 - Smart contract data types

Of most interest is the metadata which contains the JSON payload. We leave interpreting this up to the client which allows the freedom for modification of its contents without requiring a new smart contract. It effectively contains all the metadata and any relevant EXIF and XMP data.

Another point of interest is the Well-Known-Text[14]. WKT is a markup language which represents spatial vector geometry. It is flexible enough to fulfil the needs of images (point), aerial mapping (polygon) and video flight paths (polyline) data.

2. SKYM Tokens

The SKYM token is an ERC20 compatible utility token that facilitates transactions and is a representation of the supply and demand of drone content at a given place in the world at any given time. It will also act as a staking system for SkySponsor eligibility (refer to section 3) and as a voting mechanism.

To be specific, the token is ERC827[15] which extends the functionality of ERC20 to add ability to execute method calls on successful token transfers. This enables the security challenge described in section 2 to be validated once a purchase has occurred.

3. SkySponsors and Staking

As with any blockchain application, the average end user will experience a considerable amount of friction when first attempting to interact with a decentralised system. The typical experience for using a blockchain application involves; setting up a wallet, purchasing ETH to cover gas costs and waiting for the transaction to be verified.

To overcome these obstacles to mass adoption we have designed a compelling sponsorship model called SkySponsor. Any entity with a stake in SKYM tokens can qualify as a sponsor. The token stake serves to ensure they have a interest in the ongoing health of the platform and also introduces token scarcity. Content is submitted to a SkySponsor for approval who cover the costs of file storage and the gas to write to the blockchain. In return for their participation and investment, they will receive a portion of the sales revenue from content they have sponsored.

In addition to reducing the barrier to entry, SkySponsor fulfil other operational requirements of the platform such as content moderation, quality assurance and regulatory compliance.

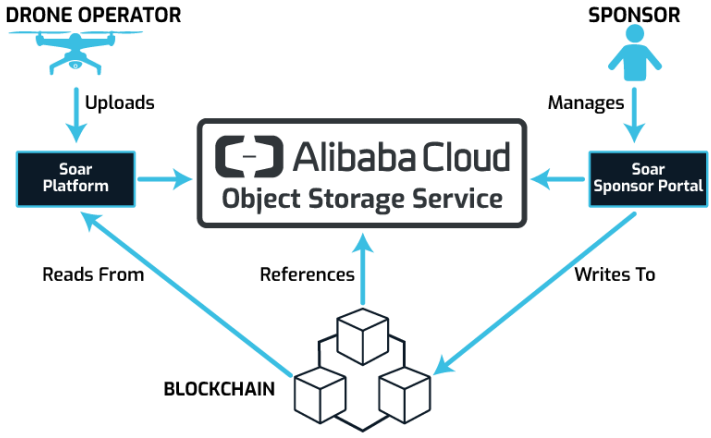

Figure 4 - SkySponsor data flow

4. SkyTasking and SkyBounty

Previous sections have described a supply driven marketplace. That is where unused or single purpose content will be uploaded for future consumption and sale. We will also introduce two new mechanism for demand driven content.

The SkyTasker model will facilitate the matching of drone operators with users who require drone footage. The SKYM tokens for the task will be held in a escrowing smart contract where funds are released once a content creator has fulfilled the request. Should either party be dissatisfied with the transaction and automated resolution fail a third party arbitrator can be employed to adjudicate.

SkyBounty is a market intervention tool that allows SKYM tokens to be placed over a section of the QuadTree with funds released immediately to any content creators who submit content in that area. SkyBounties will be used to bootstrap content creation and to advertise the desire for content for any given place in the world.

References

[1] McKinsey & Co. 2017. Commercial drones are here: The future of unmanned aerial systems; [Online] Available at: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/commercial-drones-are-here-the-future-of-unmanned-aerial-systems [Accessed Februray 2018]

[2] PwC. 2017.Clarity from above: PwC global report on the commercial applications of drone technology [ONLINE] Available at: https://www.pwc.pl/pl/pdf/clarity-from-above-pwc.pdf [Accessed Februray 2018].

[3] Research & Markets. 2017. Commercial Drone Market: Global Industry Analysis, Trends, Market Size and Forecasts up to 2023 [Online]. Available at https://www.researchandmarkets.com/research/nsd2cx/commercial_drone?w=4 [Accessed Februray 2018]

[4] Global Market Insights. 2017. Commercial Drone/Unmanned Aerial Vehicle (UAV) Market Size. [Online]. Available at: https://www.gminsights.com/industry-analysis/unmanned-aerial-vehicles-UAV-commercial-drone-market

[5] Financial Review. 2018. Finding a way to link to the platoon by smartphone | afr.com. [ONLINE] Available at: http://www.afr.com/news/special-reports/finding-a-way-to-link-to-the-platoon-by-smartphone-20170620-gwv7ug. [Accessed 05 June 2018].

[6] Maptiler.org. 2008. Tiles à la Google Maps: Coordinates, Tile Bounds and Projection. [ONLINE] Available at: http://www.maptiler.org/google-maps-coordinates-tile-bounds-projection/ [Accessed February 2018].

[7] David Goldberg. 1991. What every computer scientist should know about floating-point arithmetic. ACM Comput. Surv. 23, 1 (March 1991), 5-48. DOI=http://dx.doi.org/10.1145/103162.103163

[8] W., G., 1989. The Foundations of Celestial Mechanics. Pachart Publishing House.

[9] Jiajun Liu, Haoran Li, Yong Gao, Hao Yu and Dan Jiang, "A geohash-based index for spatial data management in distributed memory," *2014 22nd International Conference on Geoinformatics*, Kaohsiung, 2014, pp. 1-4. doi: 10.1109/GEOINFORMATICS.2014.6950819

[10] Geohash - Wikipedia. 2018. Geohash - Wikipedia. [ONLINE] Available at: https://en.wikipedia.org/wiki/Geohash [Accessed 05 June 2018].

[11] Mansorov, N (2018)What is EXIF data? [Online] Available at: https://photographylife.com/what-is-exif-data [Accessed June, 2018]

[12] ISO 16684-1:2012, 2017. Graphic technology -- Extensible metadata platform (XMP) specification -- Part 1: Data model, serialization and core properties

[13] L. Thin et al, 2016. GPS Systems Literature: Inaccuracy Factors and Effective Solutions. International Journal of Computer Networks and Communications Vol. 8, No. 2.

[14] Roger Lott, 2013. Geographic information - Well-known text representation of coordinate reference systems. [ONLINE] Available at: http://docs.opengeospatial.org/is/12-063r5/12-063r5.html [Accessed June, 2018]

[15] Augusto L, 2018. ERC827 Token Standard (ERC20 Extension). [ONLINE] Available at: https://github.com/ethereum/EIPs/issues/827 [Accessed June, 2018]