



tradeinspace
FINANCIAL SERVICES IN ORBIT

#PhiWeek 2019

Robin Sampson
Distributed Ledgers, Blockchain and EO:
from Vision to Action
Part 1: Setting the stage

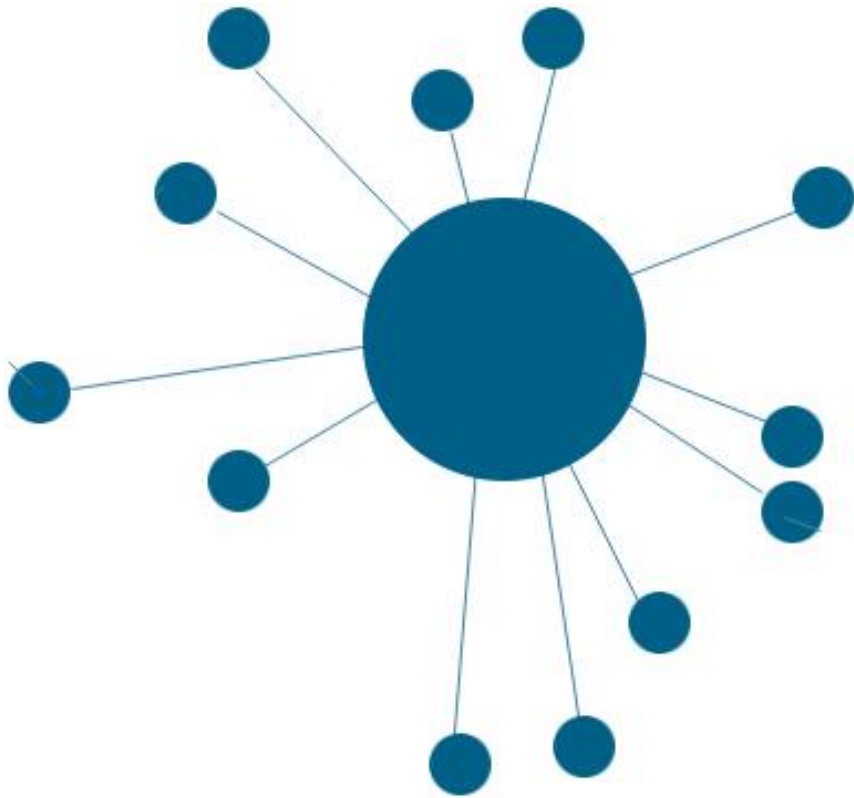
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Presentation Contents

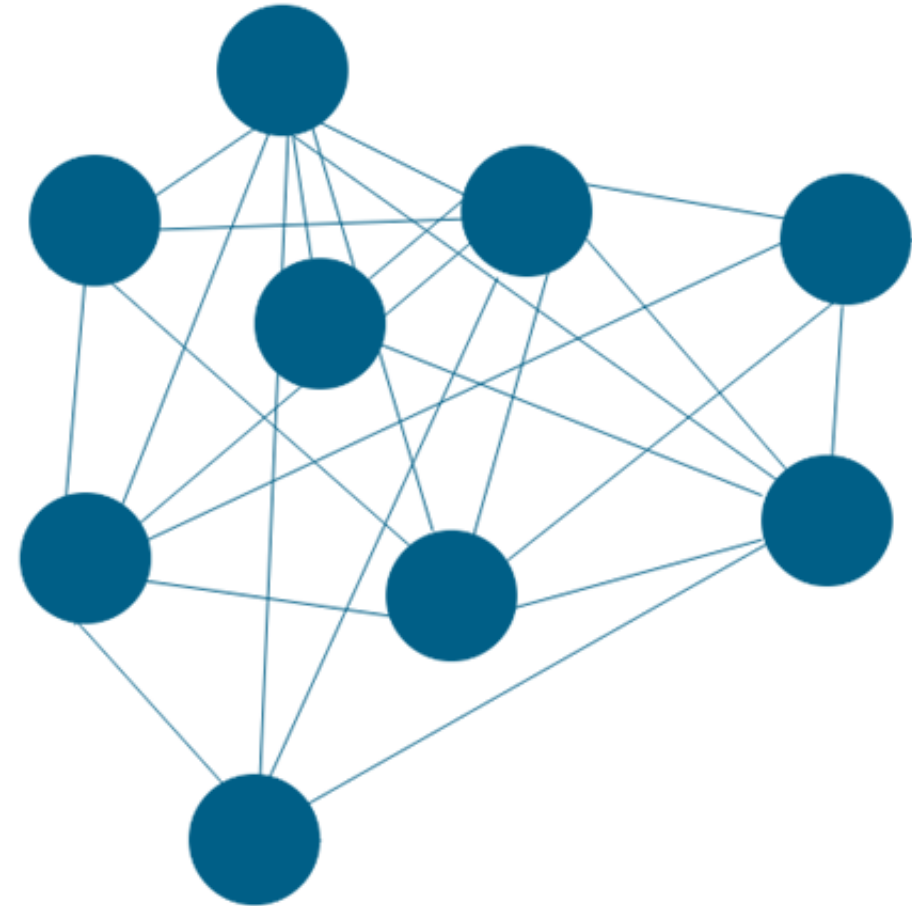


- Basic Description of Distributed Ledger Functionality.
- “Proof of Observation” as a means of Consensus.
- “Proof of Location” as a mean of Consensus.

Conventional system architectures

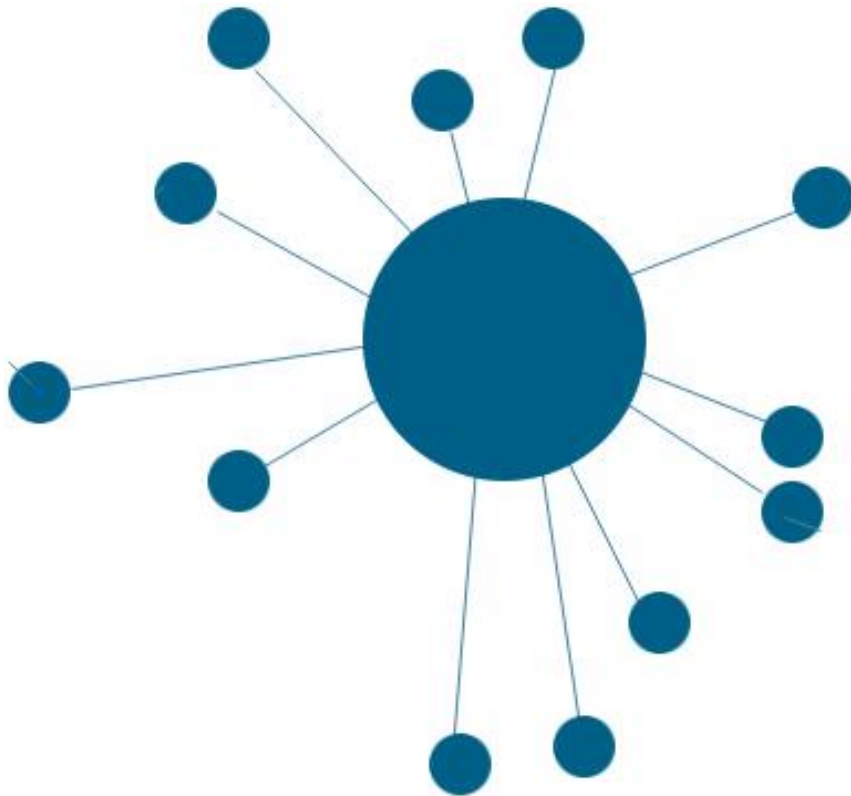


Centralised

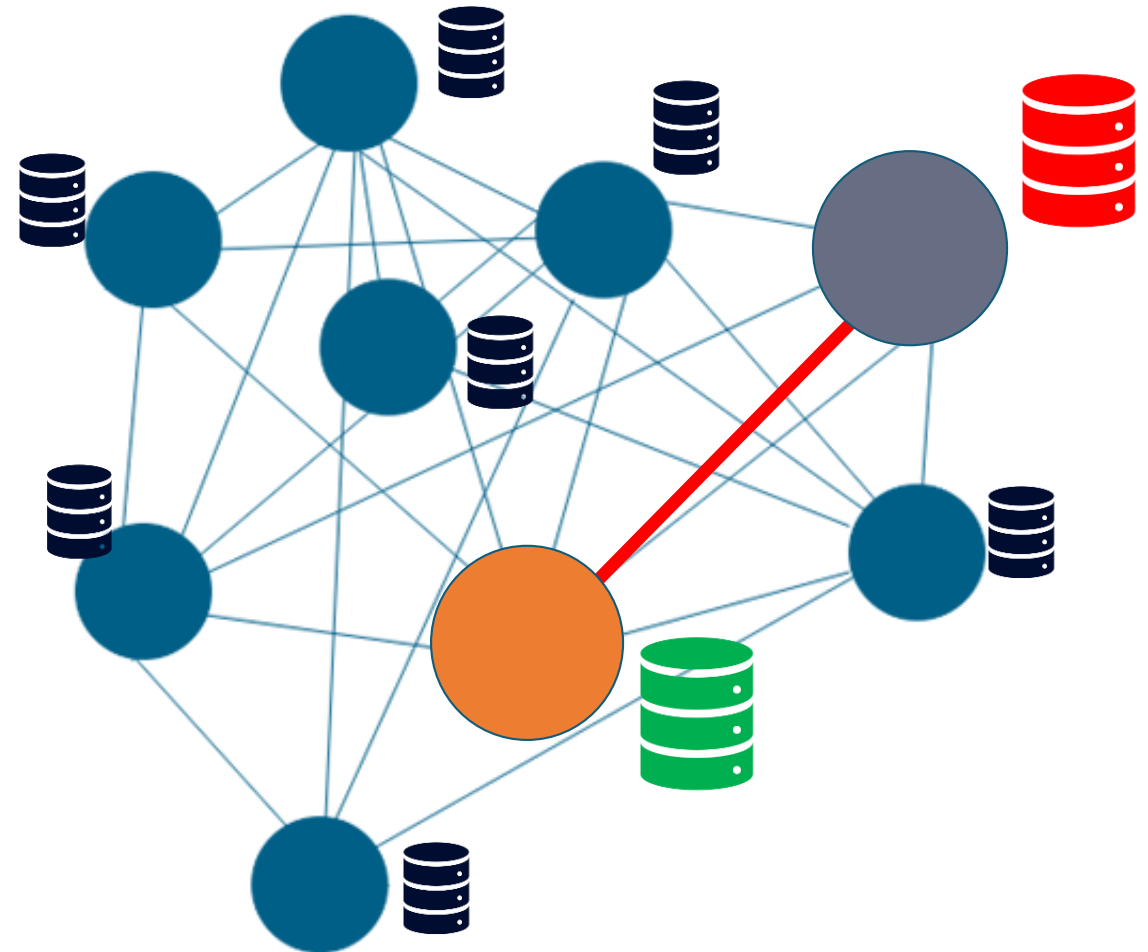


Distributed

Characteristics of a distributed ledger

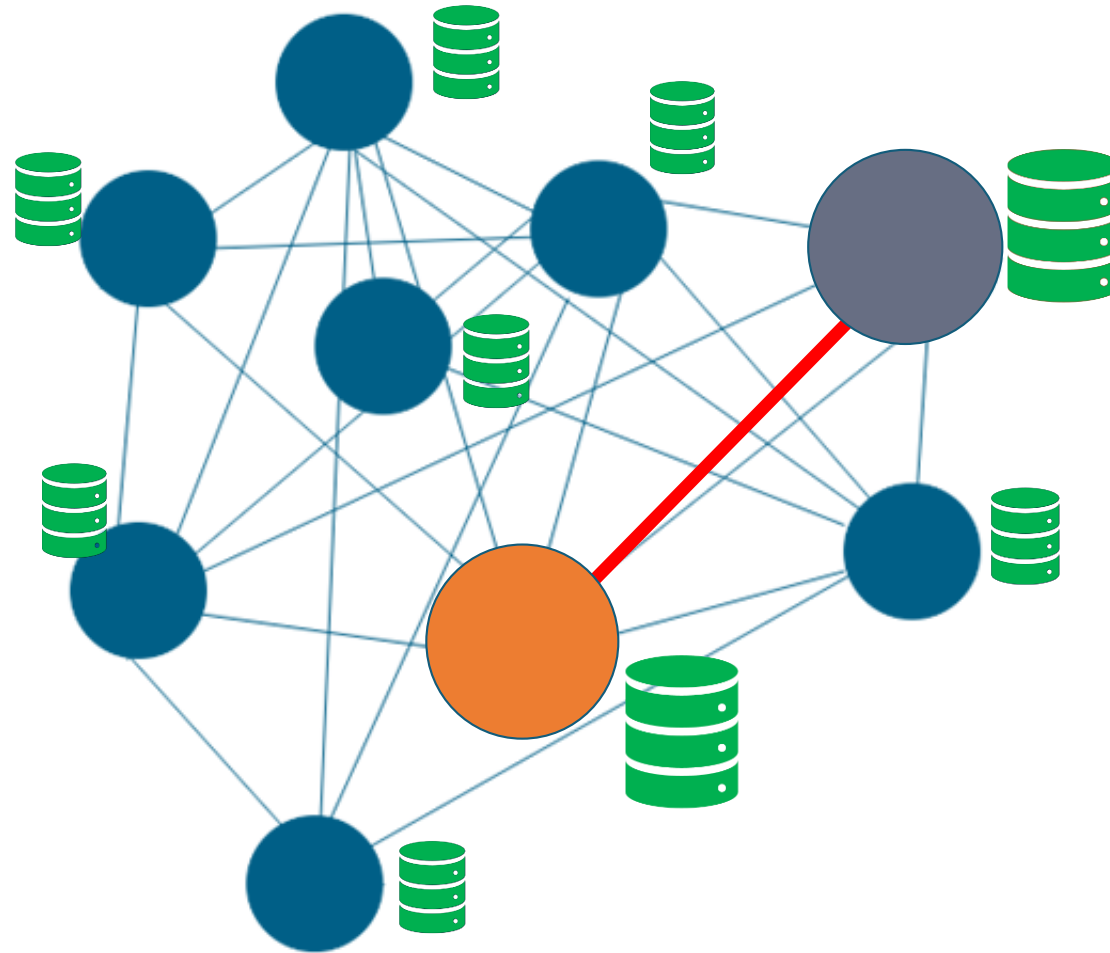


Centralised



Distributed, PEER-TO-PEER
Information Exchange

Characteristics of a distributed ledger



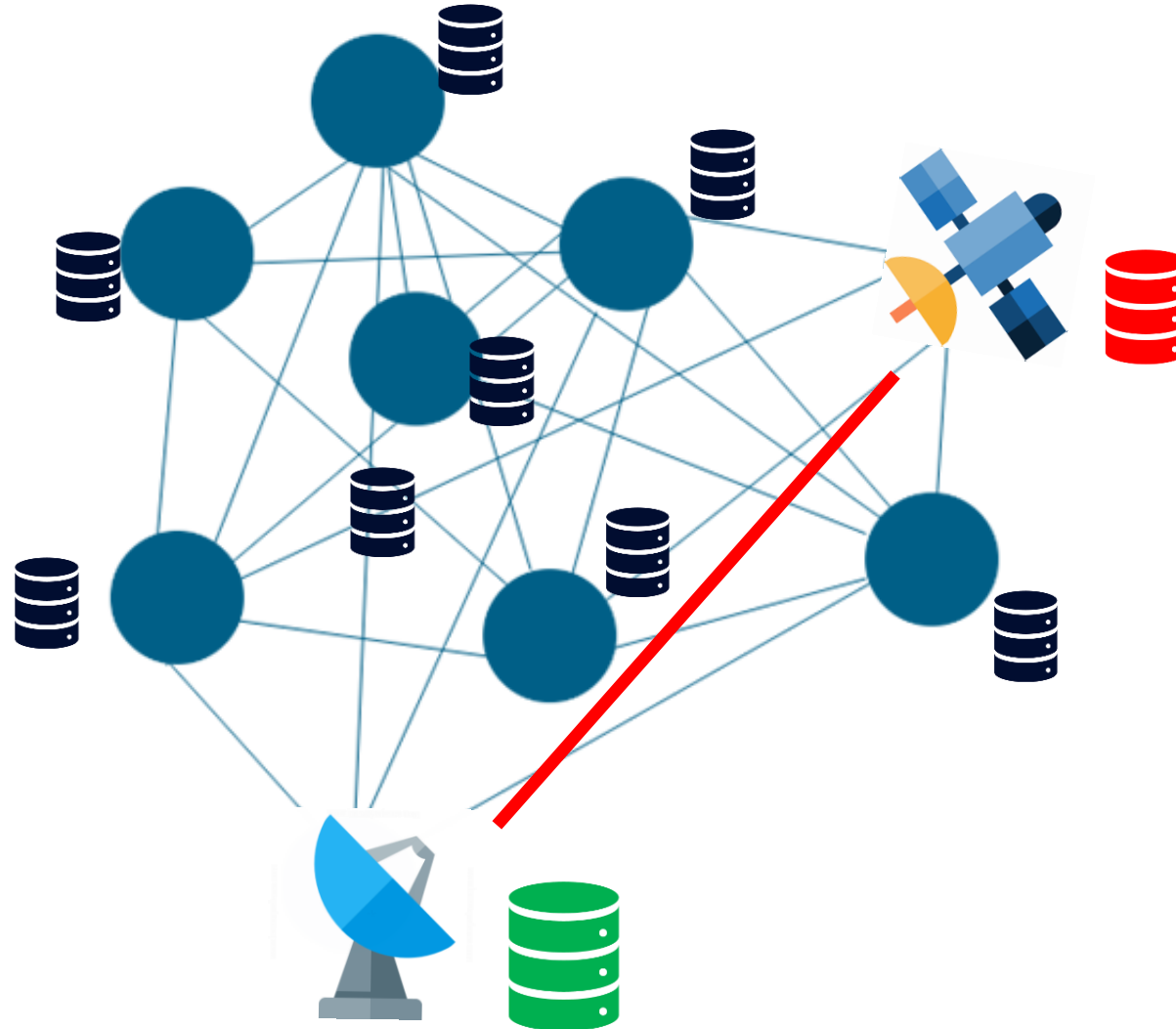
Information is exchanged via a 'CONSENSUS MECHANISM'

Satellite data in a distributed ledger





*-How can this ADD VALUE
TO satellite applications?*

*-What consensus
mechanisms are most
useful?*

*What do the nodes they
operate on look like?*

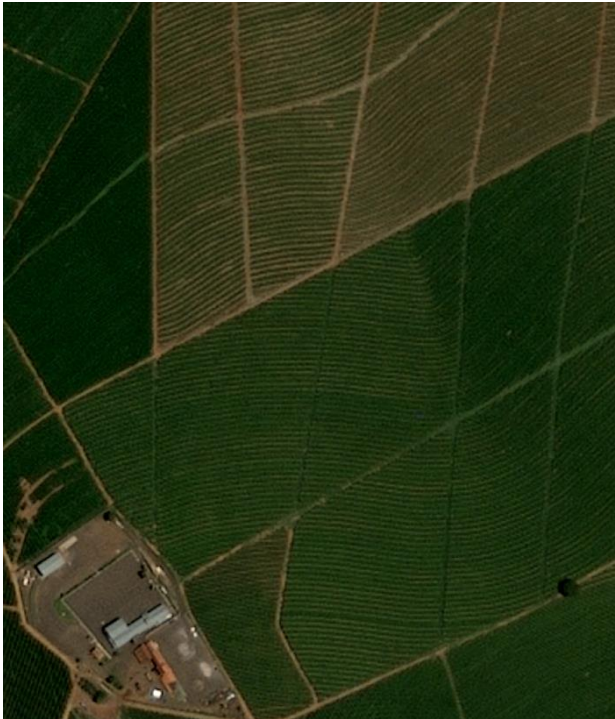


What additional value do satellite data sources add?...

- GEOGRAPHICAL CONSENSUS 
- IMMUTABILITY and AUDITABILITY 
- INTEGRATION 
- GENERATION OF DIGITAL ASSETS based on CONSENSUS PROTOCOL 

'Integration Methods of Satellite Generated Data in Commercial Distributed Ledger Systems'

Funded by
Innovate UK

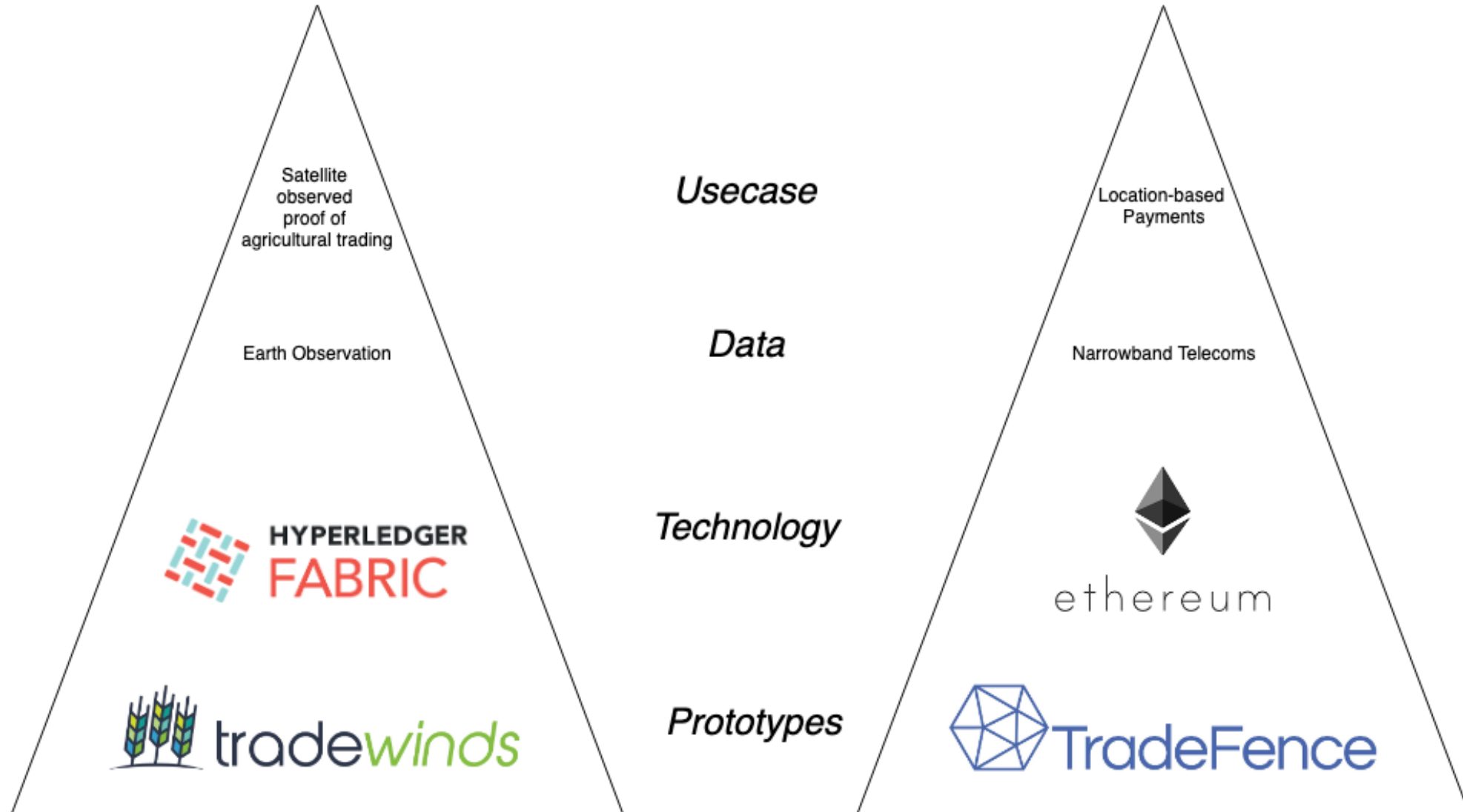


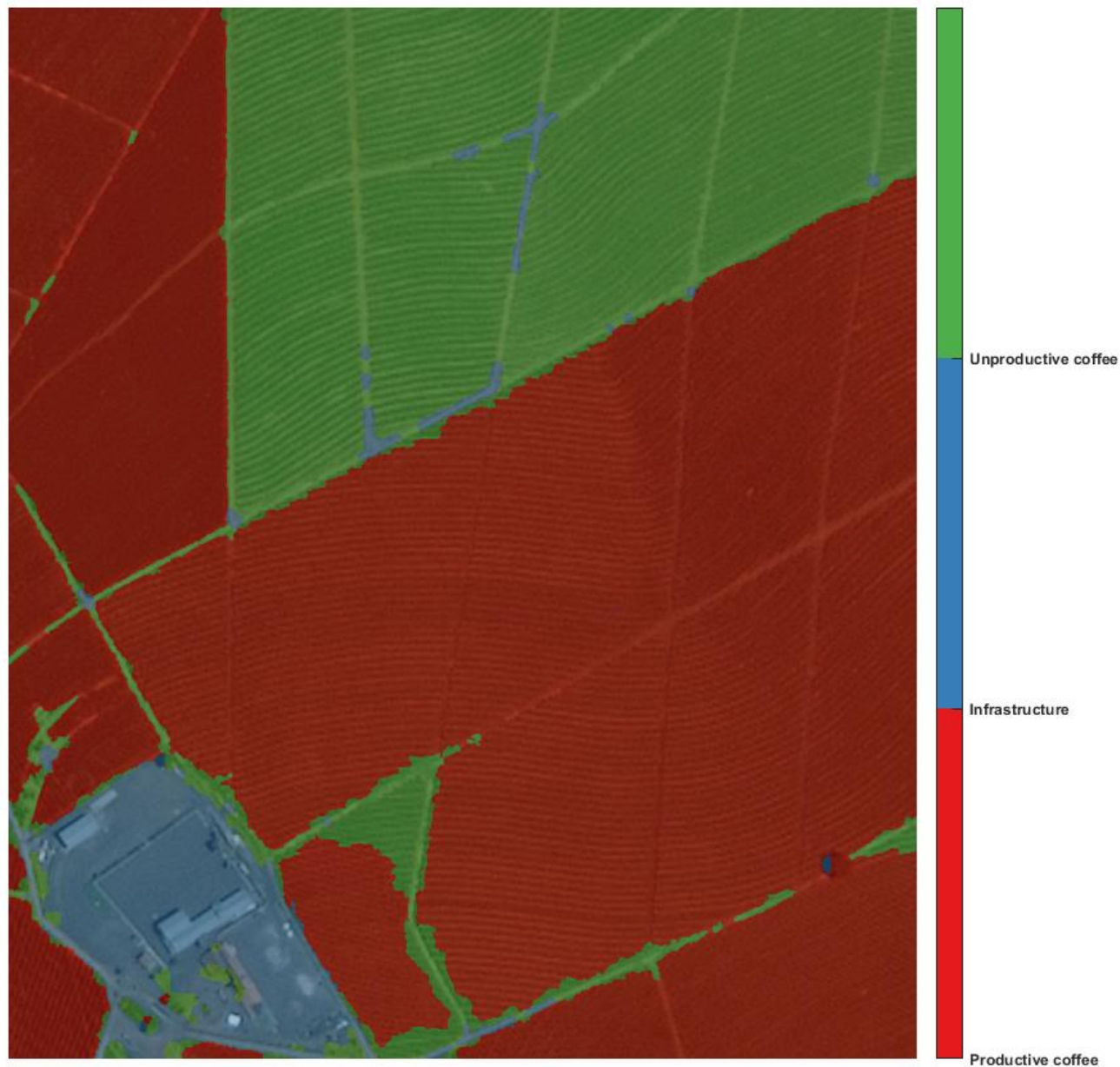
Sentinel-2, ALOS-2.



ADS-B, AIS Signal Data.

Example Satellite Service Concepts





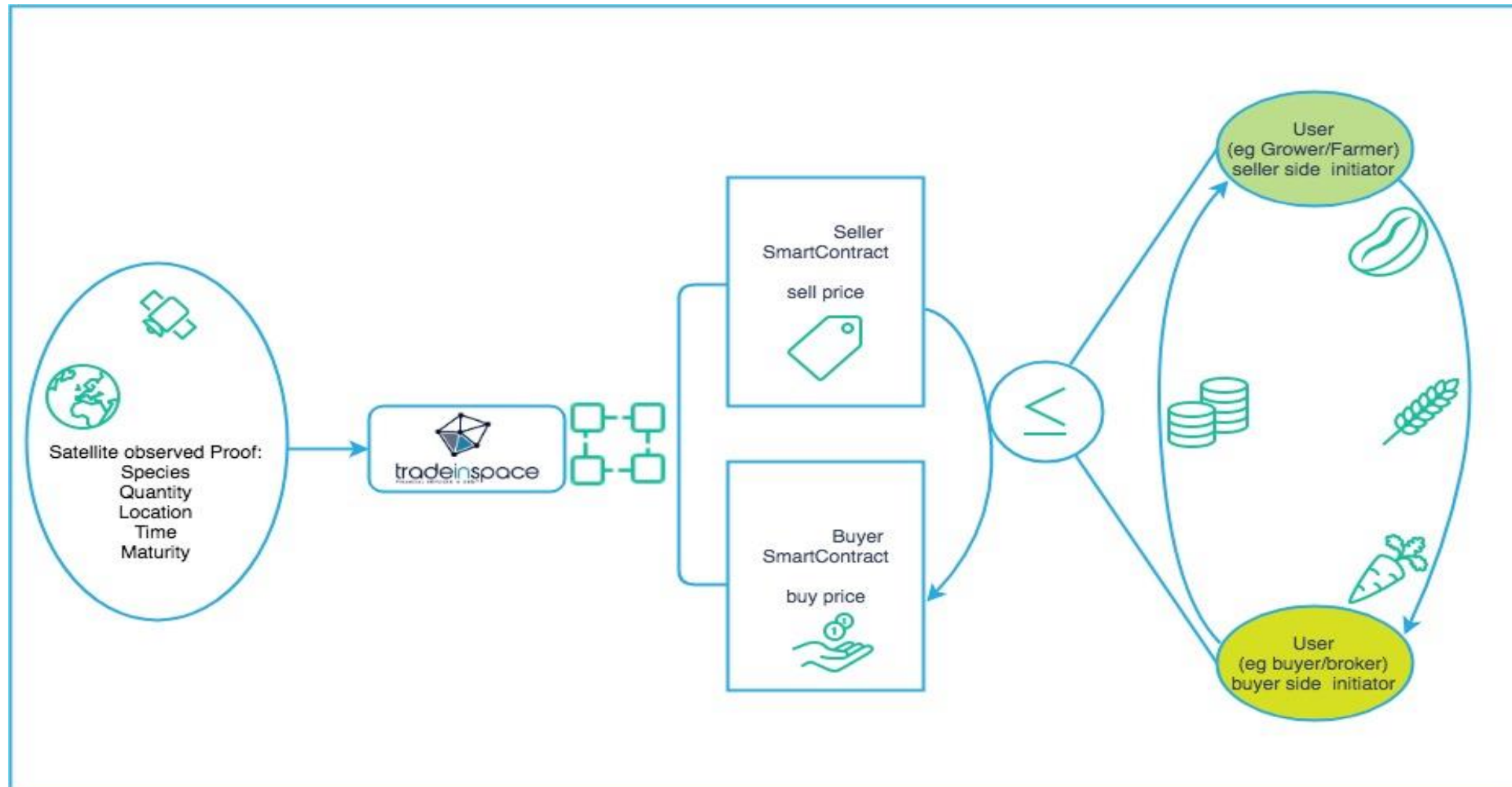
'Proof Of Observation'

Sat EO

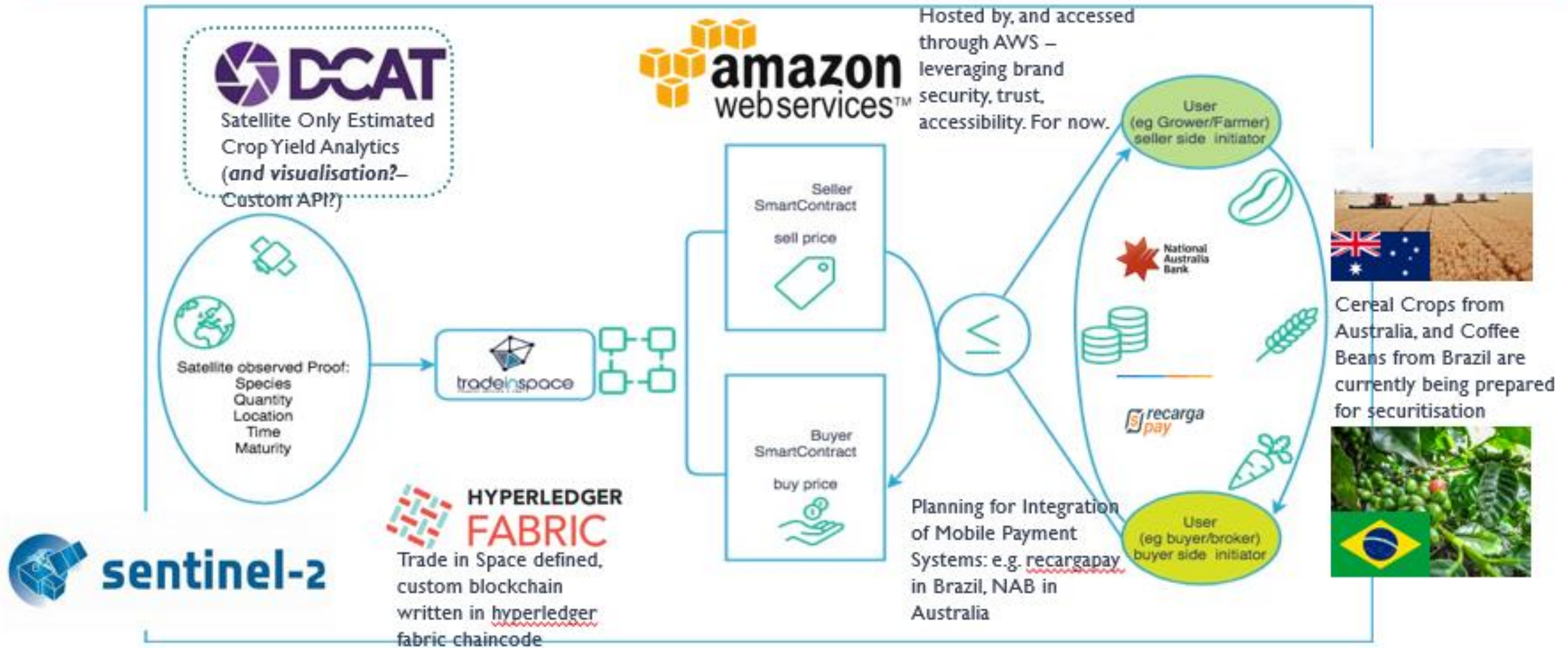
X

DLT

Use Cases: Trading of 'Proof of Observation' Generated Tokens

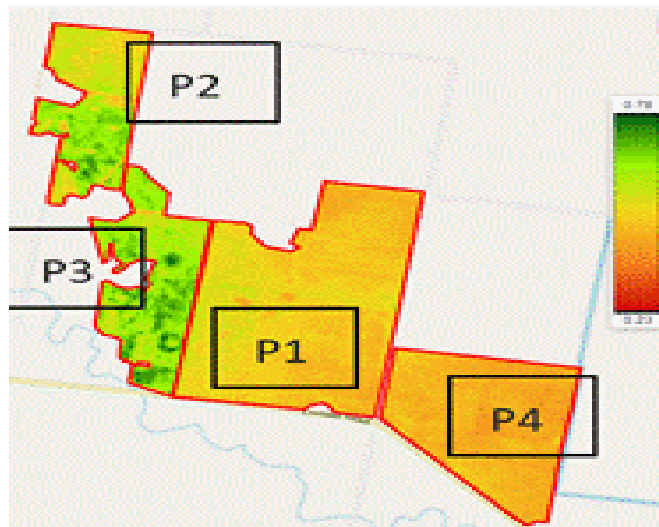


Use Cases: Agricultural Trading with EO Data as a basis of contract



Barley Yield Prediction; Sentinel-2 based yield prediction.

Field	Crop	Seeding Date (dd/mm/yyyy)	Harvesting Date (dd/mm/yyyy)	Moisture (%)	Wet Weight (t/ha)	Area (ha)
P-1	Barley	09/05/2018	03/11/2018	11.17	0.64	222.07
P-2	Barley	14/05/2018	12/11/2018	10.2	1.44	77.79
P-3	Barley	14/052018	05/11/2018	11.07	1.84	87.83
P-4	Barley	10/05/2018	03/11/2018	11.23	0.65	125.63



Sentinel-2 observed 4 different barley paddocks

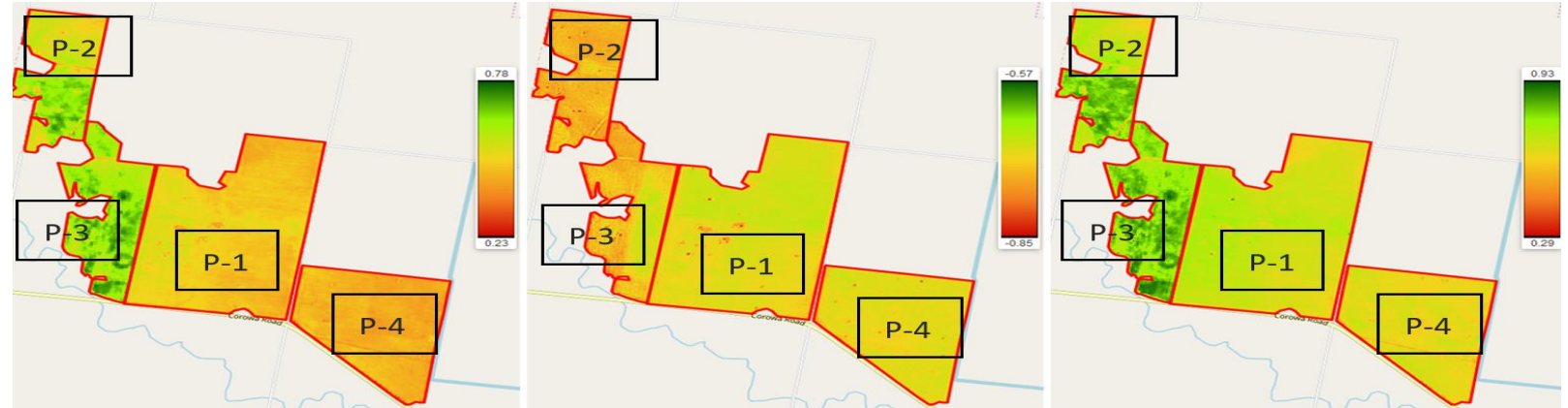
5th September 2018: 16 Images

Ground Truth collected from farms



Barley Yield Prediction; Sentinel-2 based yield prediction.

ML yield forecast accurate to **8.5%**
2 months before harvest.



All Features	P-1	P-2	P-3	P-4
Average (t/ha)	0.66	1.53	1.94	0.66
Standard Deviation ² (t/ha)	0.23	0.54	0.56	0.22
Predicted (t/ha)	0.69	1.6	1.67	0.73
Relative Error (%)	4.55	4.58	13.91	10.61

More on this agri-trading system in this
afternoons presentation...



'Proof Of
Location'

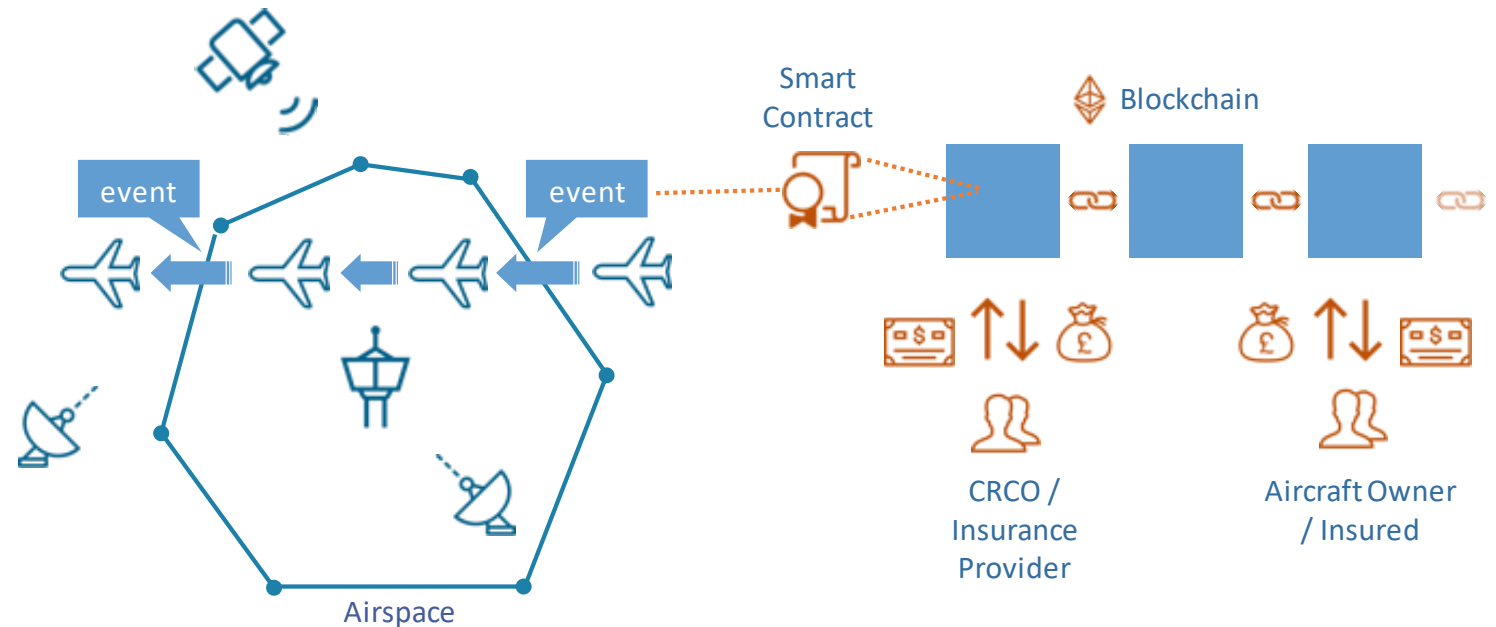
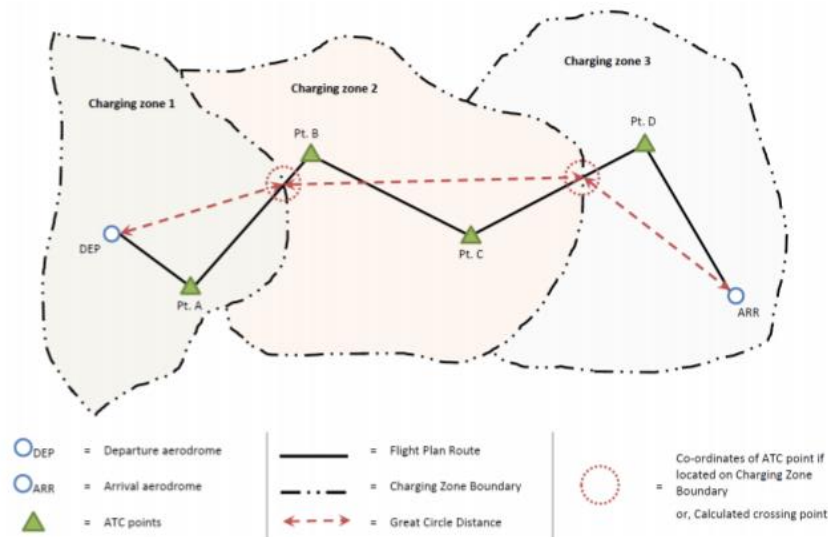
SAT IOT &
GNSS

X

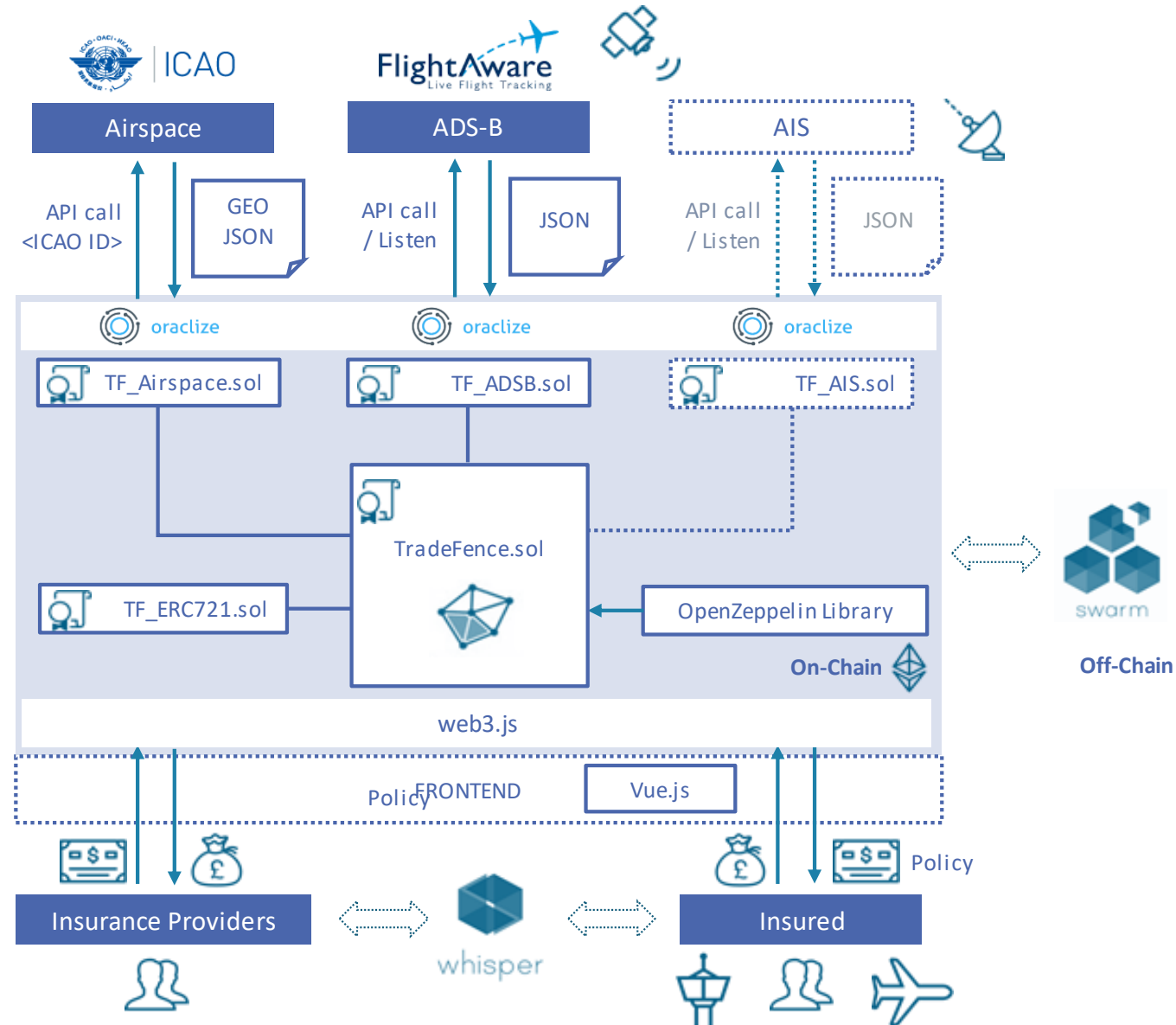
BLOCKCHAIN

Use Cases: ADS-B Based Flight Route Charging

1. Route charges are currently being charged and collected by EUROCONTROL's Central Route Charges Office (CRCO) on behalf of the member states.
2. Financial Services Deployment: Import/Export Tariff Check; Route Charging (Air Traffic Management, Port Authority Services); Insurance Applications (Ad-Hoc Drone Flights)



Architecture and Scope



Airspace Location Integration – GeoJSON Format



iSTARS API DATA SERVICE

<https://www.icao.int/safety/istars/pages/api-data-service.aspx>

Flight Information Regions – Geographical dataset

API call URL:

GeoJSON file

INPUT: ICAOCODE "XXXX"

OUTPUT: Coordinates

(Polygon)



```
1  [
2  {
3    "type": "Feature",
4    "properties": {
5      "REGION": "EUR",
6      "centlong": -3.46911466,
7      "FIRname": "FIR SCOTTISH",
8      "ICAOCODE": "EGPX",
9      "centlat": 57.66336837,
10     "StateCode": "GBR",
11     "StateName": "United Kingdom of Great Britain and Northern Ireland"
12   },
13   "geometry": {
14     "type": "Polygon",
15     "coordinates": [
16       [
17         [
18           5.000001907000069,
19           55.00000190700007
20         ],
21         [
22           5.000001907000069,
23           57.00000190700007
24         ],
25         [
26           3.6718784730000493,
27           57.85409882300007
28         ],
29         [
30           3.3310420750000276,
31           58.07328576700007
32         ],
33         [
34           3.1795127390000744,
```

ADS-B Integration into Blockchain



InFlightInfo

InFlightInfo looks up a specific tail number (e.g., **N12345**) or ICAO airline and flight number (e.g., **SWA2558**) and returns current position/direction/speed information. It is only useful for currently airborne flights within approximately the last 24 hours. Codeshares and alternate idents are automatically searched.

Inputs

field	type	description	example
ident	string	requested tail number	SWA1035

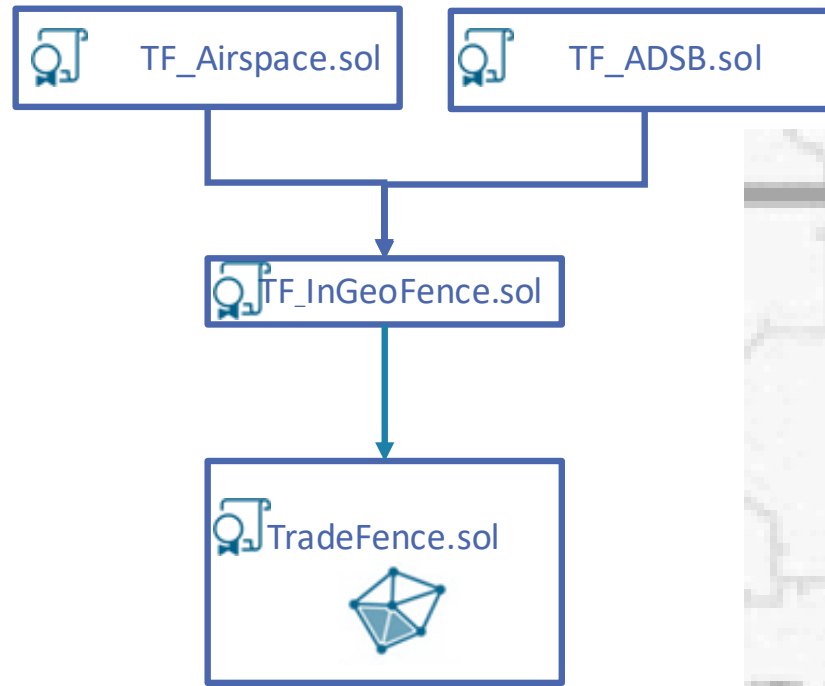
Returns

InFlightAircraftStruct - returned results

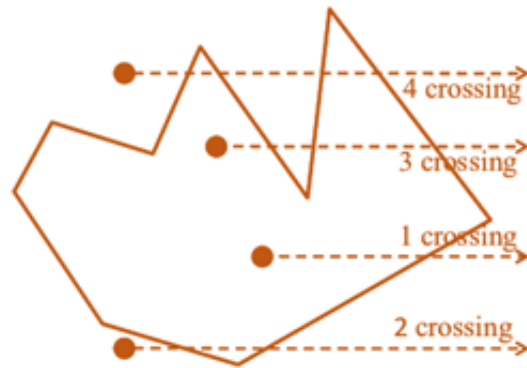
field	type	description	example
latitude	float		33.47390
longitude	float		-111.61919
lowLatitude	float		33.43104
lowLongitude	float		-112.01711
origin	string	the origin ICAO airport ID	KPHX

```
1  /*
2   * This requires: restler
3   * To install, type 'npm install restler'
4   * Tested with node.js v0.6.14
5   */
6
7  var util = require('util');
8  var restclient = require('restler');
9
10 var fxml_url = 'http://flightxml.flightaware.com/json/FlightXML2/';
11 var username = 'YOUR_USERNAME';
12 var apiKey = 'YOUR_APIKEY';
13
14
15 restclient.get(fxml_url + 'MetarEx', {
16   username: username,
17   password: apiKey,
18   query: {airport: 'KAUS', howMany: 1}
19 }).on('success', function(result, response) {
20   // util.puts(util.inspect(result, true, null));
21   var entry = result.MetarExResult.metar[0];
22   util.puts('The temperature at ' + entry.airport + ' is ' + entry.temp_air + 'C');
23 });
24
25 restclient.get(fxml_url + 'Enroute', {
26   username: username,
27   password: apiKey,
28   query: {airport: 'KIAH', howMany: 10, filter: '', offset: 0}
29 }).on('success', function(result, response) {
30   util.puts('Aircraft en route to KIAH:');
31   //util.puts(util.inspect(result, true, null));
32   var flights = result.EnrouteResult.enroute;
33   for (i in flights) {
34     var flight = flights[i];
35     //util.puts(util.inspect(flight));
36     util.puts(flight.ident + ' (' + flight.aircrafttype + ')\t' +
37       flight.originName + ' (' + flight.origin + ')');
38   }
39 });
```

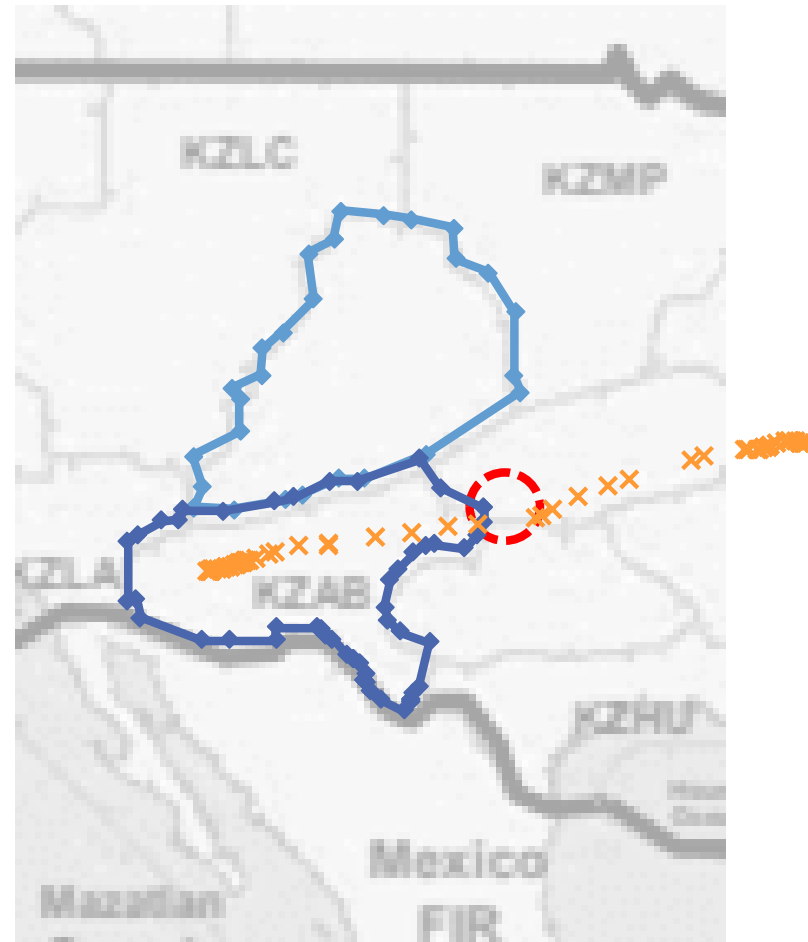
Use Cases: ADS-B Based Flight Route Charging



Ray Casting Algorithm



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Thank You!

Robin@tradeinspace.com

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