



Which Plane Woke **Snowy** the Cat?





Hello!

I am **Simon Aubury**

Data Engineer Architect

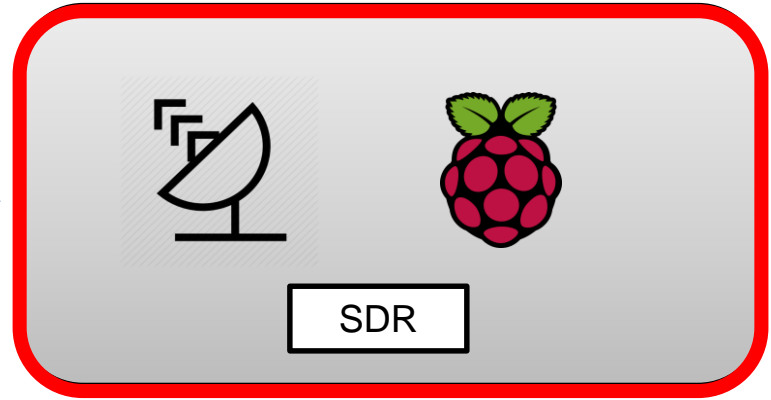
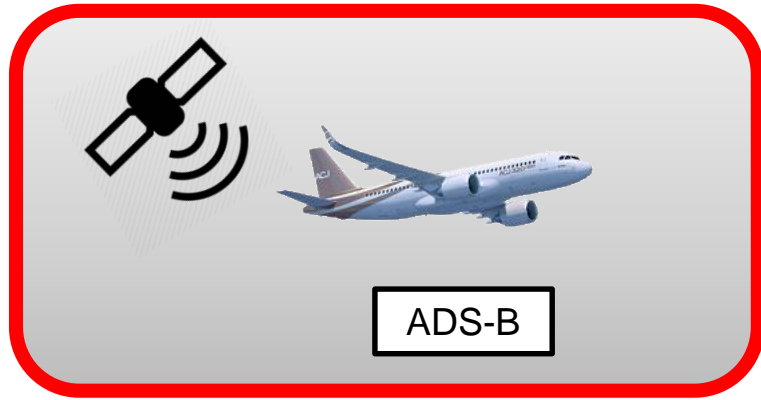
@SimonAubury

github.com/saubury/plane-kafka



Problem Statement

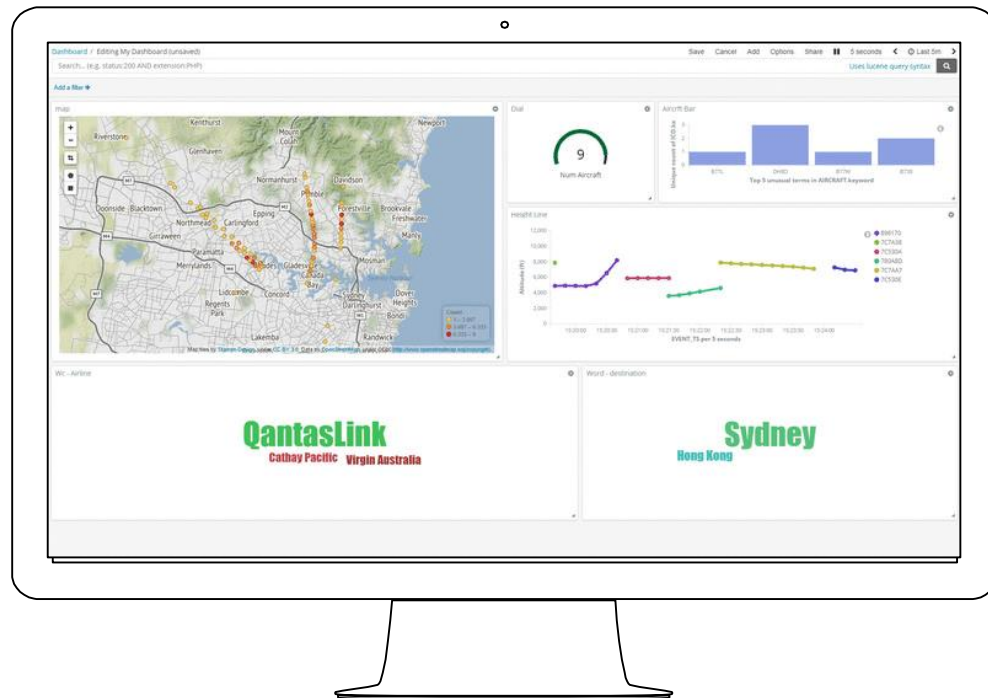
- Planes fly overhead early in morning
- Cat shows dissatisfaction
- Which plane is waking snowy ... and me?

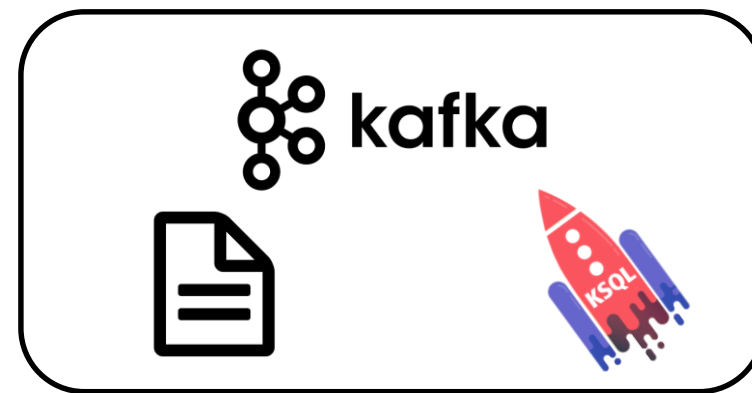
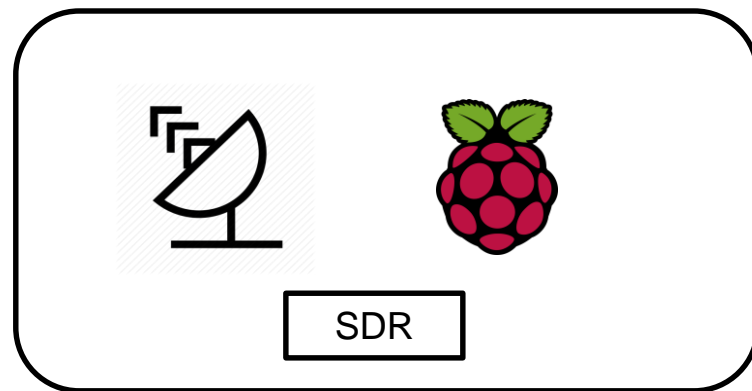
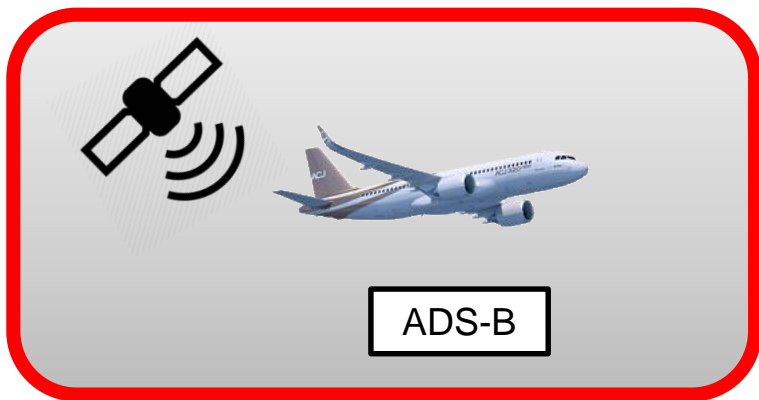




This is **End Result**

- Stand-alone
- Map radius 20km



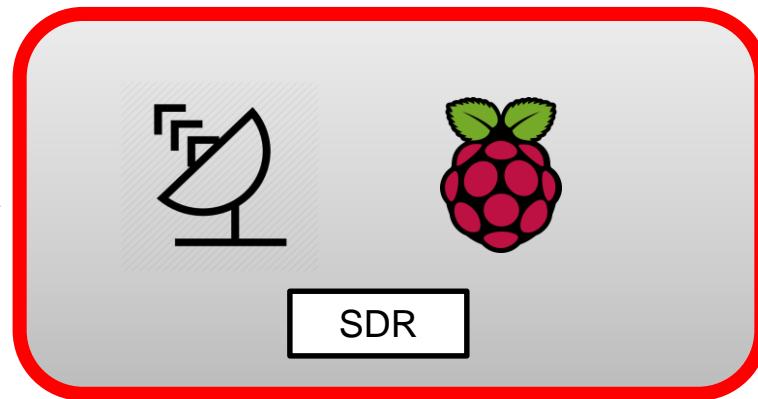
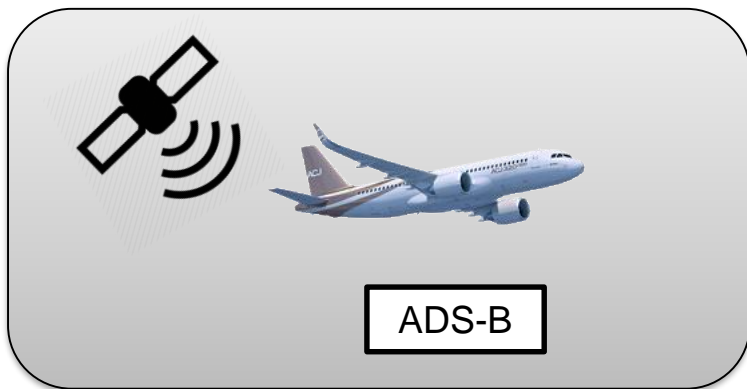




ADS-B transmissions

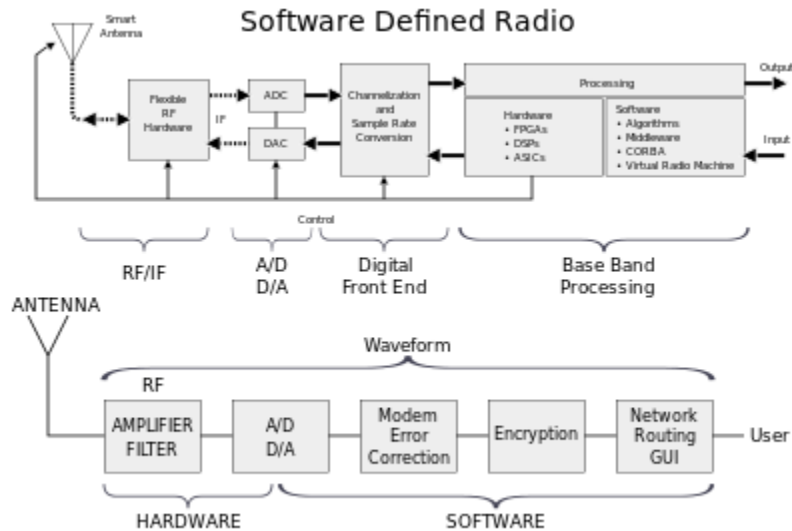


- Aircraft gets its location from a GPS navigation source (satellite)
- The ADS-B transponder on aircraft transmits signal containing the location, speed etc.,
- Transmissions are unencrypted, one-way ... and uncoordinated





What is a Software Defined Radio?





What is a **RTL-SDR**?

- RTL-SDR - USB dongle that can be used as a computer based radio scanner for receiving live radio signals





RTL-SDR Community

- The RTL-SDR can be used as a wide band radio scanner

<https://www.rtl-sdr.com/about-rtl-sdr/>

What are some RTL-SDR Radio Scanner Applications?

The RTL-SDR can be used as a wide band radio scanner. Applications include:

- Use as a police radio scanner.
- Listening to EMS/Ambulance/Fire communications.
- Listening to aircraft traffic control conversations.
- Tracking aircraft positions like a radar with [ADSB decoding](#).
- Decoding aircraft [ACARS short messages](#).
- Scanning [trunking radio](#) conversations.
- Decoding unencrypted [digital voice](#) transmissions such as P25/DMR/D-STAR.
- Tracking maritime boat positions like a radar with [AIS decoding](#).
- Decoding [POCSAG/FLEX pager traffic](#).
- Scanning for cordless phones and baby monitors.
- Tracking and receiving [meteorological agency launched weather balloon data](#).
- Tracking your own self launched high altitude balloon for payload recovery.
- Receiving wireless temperature sensors and wireless power meter sensors.
- Listening to VHF amateur radio.
- Decoding ham radio [APRS packets](#).
- Watching [analogue broadcast TV](#).
- [Sniffing GSM signals](#).
- [Using rtl-sdr on your Android device](#) as a portable radio scanner.
- Receiving GPS signals and decoding them.
- Using rtl-sdr as a [spectrum analyzer](#).
- [Receiving NOAA weather satellite images](#).
- Listening to satellites and [the ISS](#).
- [Radio astronomy](#).
- Monitoring [meteor scatter](#).
- Listening to FM radio, and [decoding RDS information](#).
- Listening to [DAB broadcast radio](#).
- Listening to and [decoding HD-Radio](#) (NRSC5).
- Use [rtl-sdr as a panadapter](#) for your traditional hardware radio.
- [Decoding taxi mobile data terminal](#) signals.
- Use rtl-sdr as a [high quality entropy source for random number generation](#).
- Use rtl-sdr as a [noise figure indicator](#).
- Reverse engineering [unknown protocols](#).
- Triangulating the [source of a signal](#).
- [Searching for RF noise sources](#).
- [Characterizing RF filters and measuring antenna SWR](#).
- [Decoding Inmarsat STD-C EGC geosynchronous satellites](#).
- [Listening to the ISS \(International Space Station\)](#).

DbVis



Raspberry Pi plus RTL2832U

- ◎ Raspberry Pi is a tiny computer
- ◎ Accesses ADS-B data via the RTL2832U and a small antennae.
- ◎ Extract a raw stream of ADS-B messages as they're received

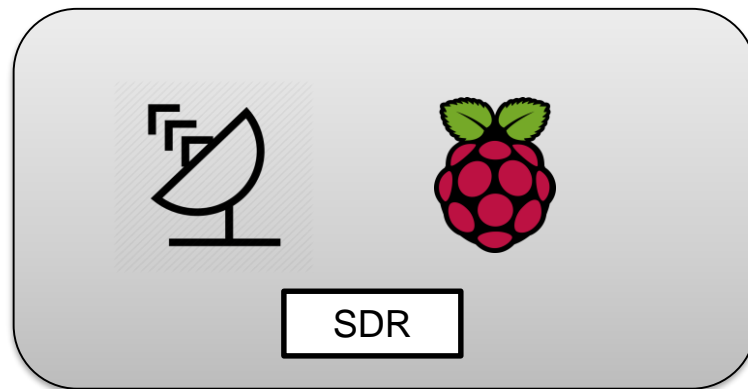
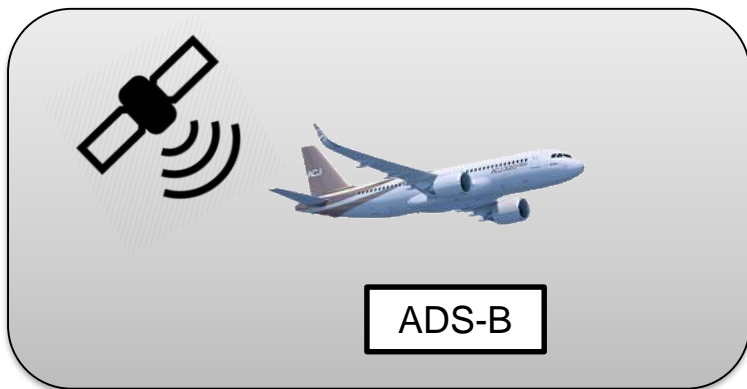




dump1090 – location squark

```
CRC: 000000 (ok)
DF 17: ADS-B message.
  Capability      : 5 (Level 2+3+4 (DF0,4,5,11,20,21,24,code7 - is airborne))
  ICAO Address    : 7c6db8
  Extended Squitter Type: 11
  Extended Squitter Sub : 0
  Extended Squitter Name: Airborne Position (Baro Altitude)
  F flag         : even
  T flag         : non-UTC
  Altitude       : 6250 feet
  Latitude       : -33.807724
  Longitude      : 151.091495
```

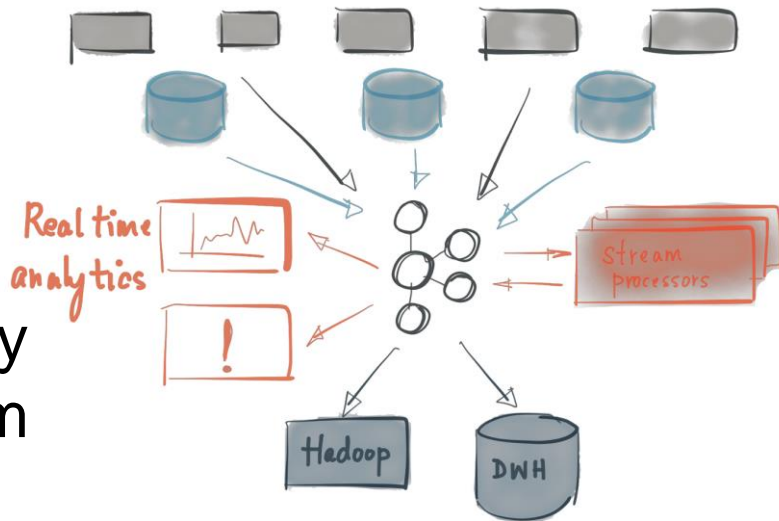
Airframe 7c6db8 is flying at 6,250 feet at location -33.807, 151.091





What is **Kafka**?

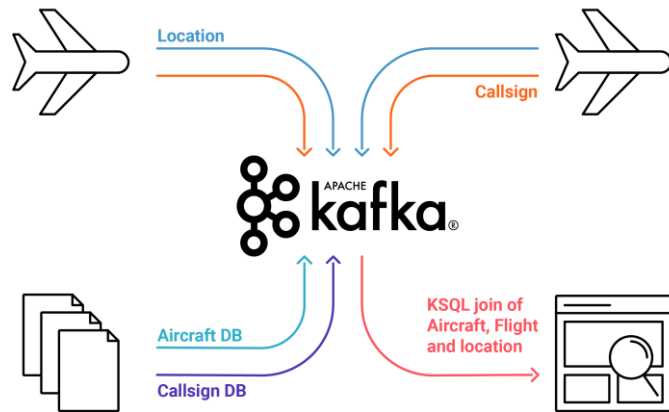
- Apache Kafka is a community distributed streaming platform
- Messages are persisted in topics.
- Kafka is based on an abstraction of a distributed commit log





All together

- Raspberry Pi ADS-B messages streamed into Kafka topics.
- Data sourced from openflights.org
 - 172,000 types of planes
 - 6,400 flight routes topics
- How to join steamed data to reference data?





What is **KSQL**?

- KSQL is an SQL interface for interacting with Kafka
- KSQL - build on top of Kafka Streams API

```
SELECT height, location, aircraft, count(*) as events
FROM location_and_details_stream
  WINDOW TUMBLING (SIZE 10 SECOND)
GROUP by height, location, aircraft;
```

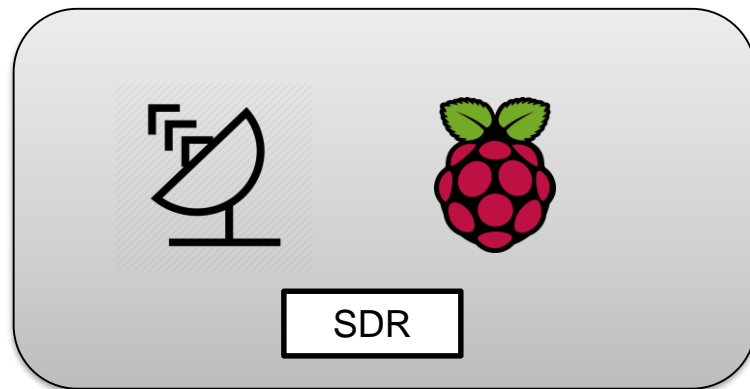
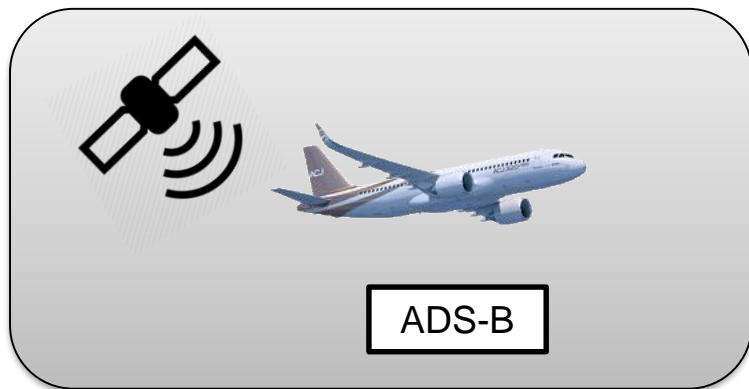


Aircraft stream processing with KSQL

```
CREATE STREAM location_and_details_stream AS
SELECT l.ico, l.height, l.location, t.aircraft
FROM location_stream l
LEFT JOIN icao_to_aircraft t ON l.ico = t.icao;
```

```
ksql> SELECT TIMESTAMPTOSTRING(rowtime, 'yy-MM-dd HH:mm:ss')
, manufacturer
, aircraft
, registration
, height
, location
FROM location_and_details_stream;
```

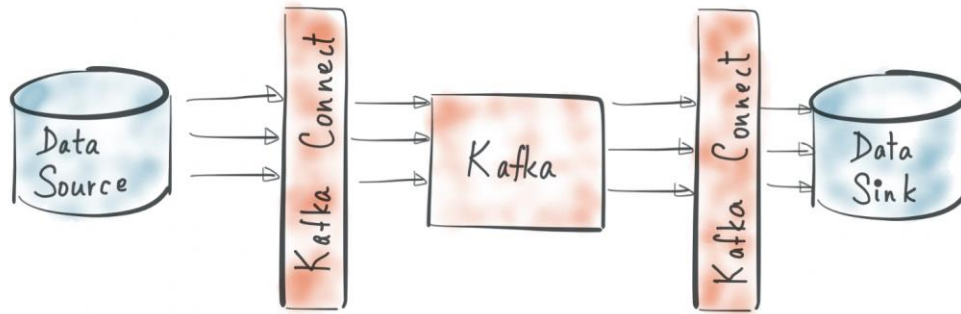
```
19-01-27 09:53:28 | Boeing | B738 | VH-YIA | 7225 | -33.821,151.052
19-01-27 09:53:31 | Boeing | B738 | VH-YIA | 7375 | -33.819,151.049
19-01-27 09:53:32 | Boeing | B738 | VH-YIA | 7425 | -33.818,151.048
```





Kafka connect

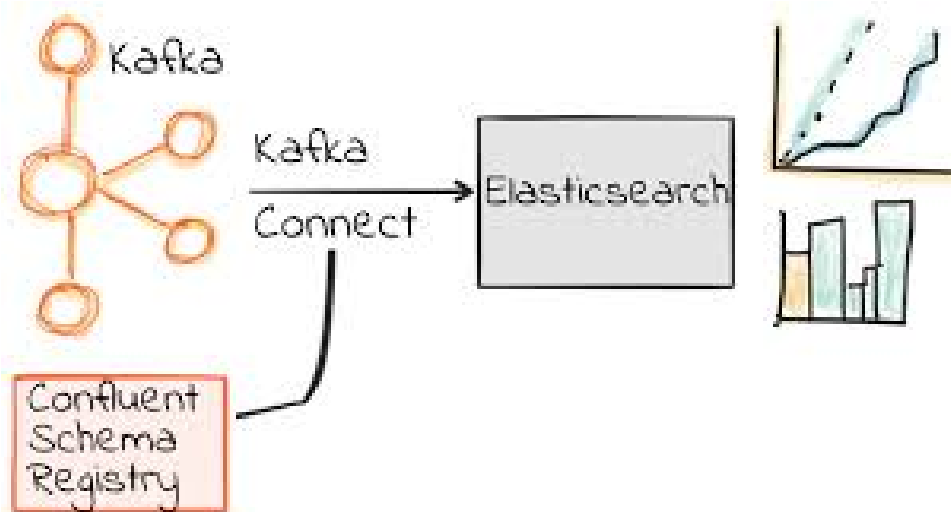
- Kafka Connect is a framework for streaming data between Apache Kafka and other data systems
 - Kafka connect **sources** – from something into Kafka
 - Kafka connect **sinks** – from Kafka into something





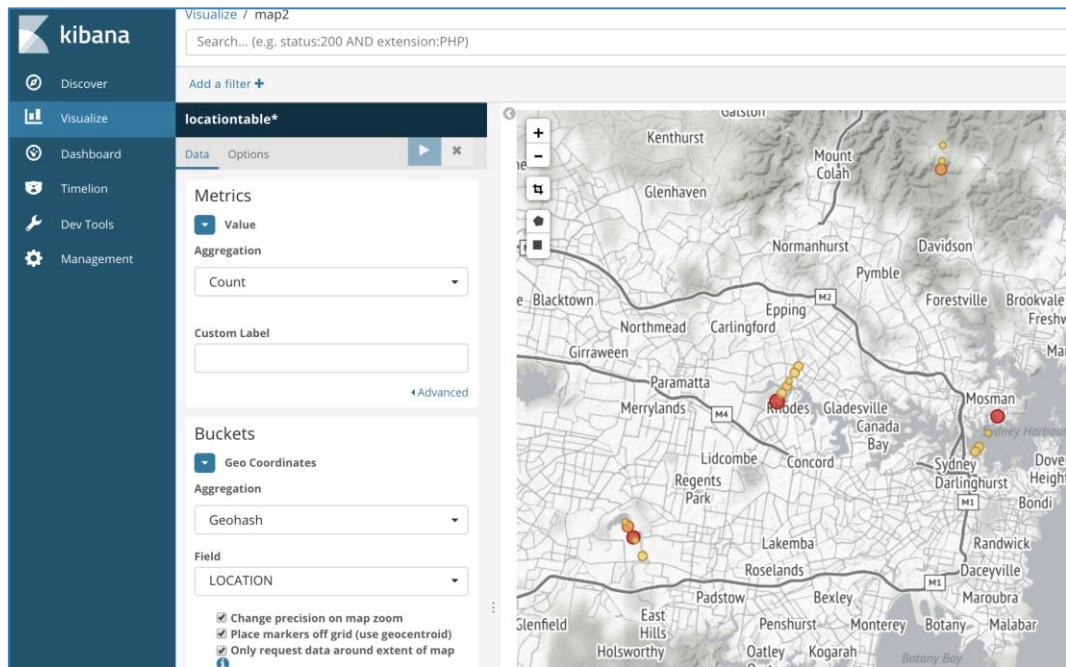
Using Elastic & Kibana for visualizations

- Kafka topic to elastic using connect elastic sink





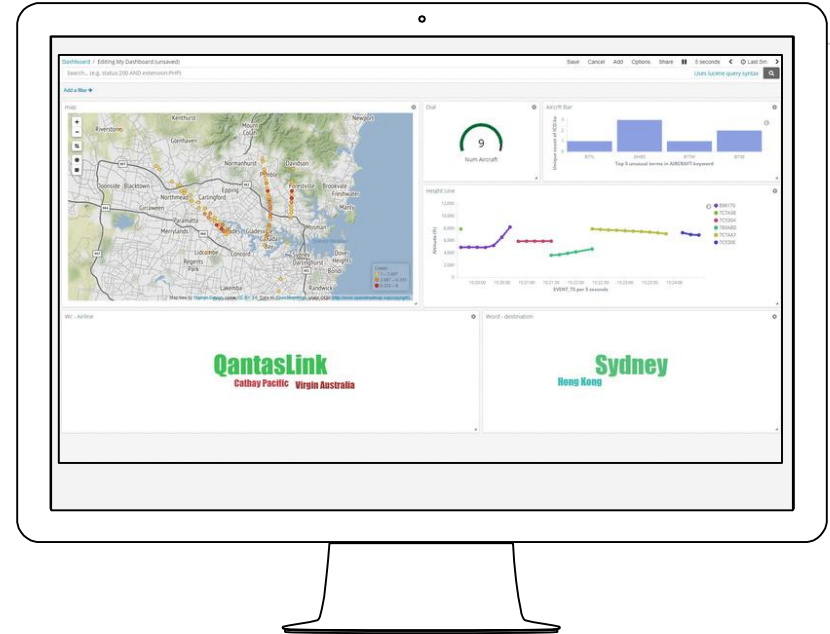
Using Kibana for visualizations





Kibana for visualizations

- Nicer maps when zoomed by using open street map with Kibana





And the annoying flight

```
select timestamptoString(rowtime, 'yyyy-MM-dd HH:mm:ss')
, manufacturer
, aircraft
, registration
, height
from location_and_details_stream
where height < 3500 and rowtime > stringtoTimestamp('19-01-27 06:10',
'yy-MM-dd HH:mm') and rowtime < stringtoTimestamp('19-01-27 06:20', 'yy-
MM-dd HH:mm');
```

```
2019-01-27 06:15:39 | Airbus | A388 | A6-EOD | 2100.0
2019-01-27 06:15:58 | Airbus | A388 | A6-EOD | 3050.0
```



The plane that woke snowy

2019-01-27 06:15:39	Airbus	A388	A6-EOD	2100.0
2019-01-27 06:15:38	Airbus	A388	A6-EOD	3050.0





Thanks!

Any **questions** ?

You can find me at

- @SimonAubury
- github.com/saubury/plane-kafka