

Using KSQL, Apache Kafka, a
Raspberry Pi plus a software
defined radio to find the plane
that wakes my cat





Hello!

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github.com/saubury/plane-kafka



Tonight ...

- Overview of the architecture
- Software Defined Radio's (SDR) & community
 - Raspberry Pi & RTL2832U .. And ADS-B transmissions
- Kafka, KSQL & Kafka Connect
 - What is Kafka
- Elastic/Kibana Visualizations
 - What was the plane that woke my cat?
- Demo!

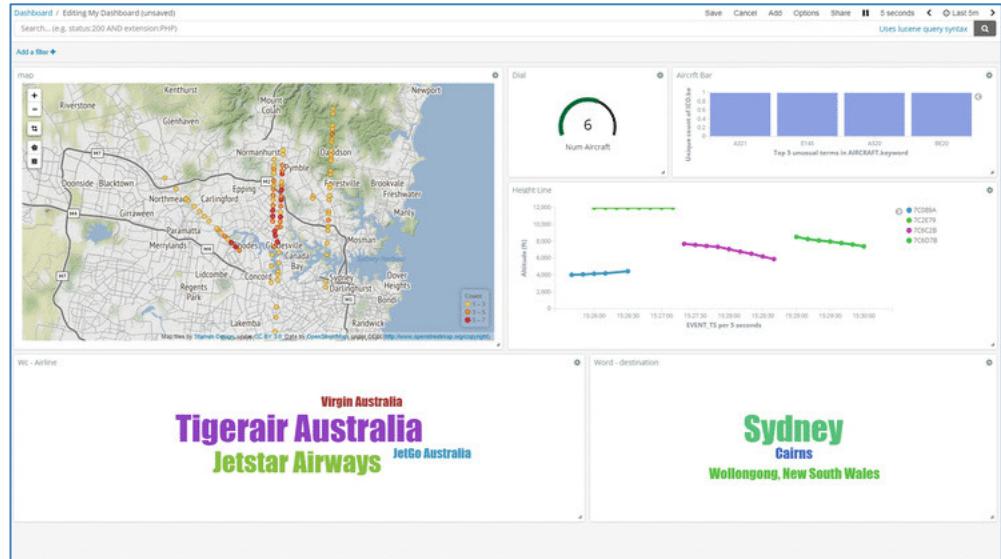


This is End Result

- Stand-alone
- Map radius 20km

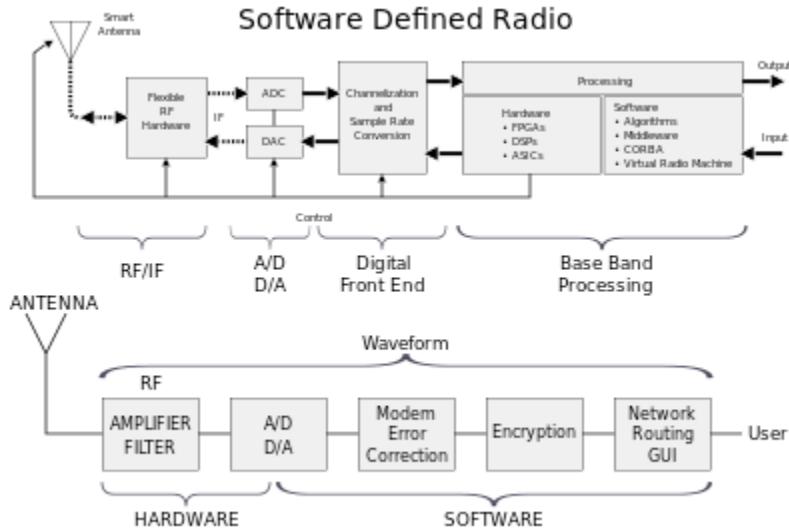


{ REST }





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





And quickly .. 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



Raspberry Pi plus RTL2832U

- On the Pi installed dump1090
- Accesses ADS-B data via the RTL2832U and a small antennae.
- Dumps a raw stream of messages to stdout



dump1090 - location squark

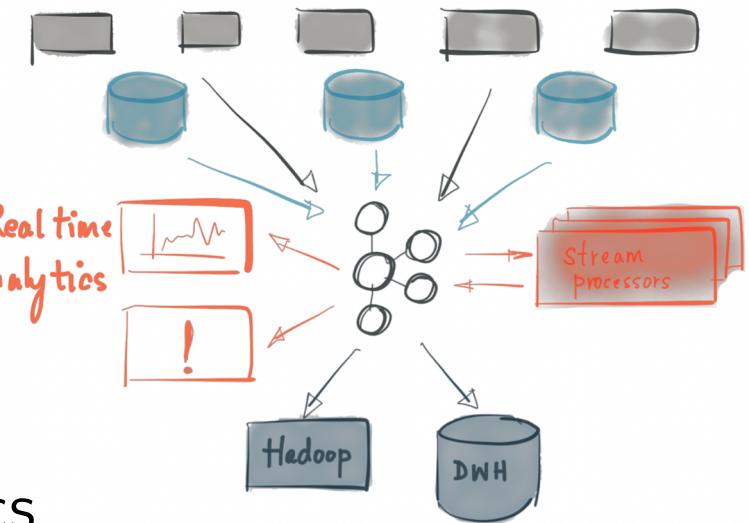
```
CRC: 000000 (ok)
DF 17: ADS-B message.
  Capability : 5 (Level 2+3+4 (DF0,4,5,11,20,21,24,code7 - is airborne))
  ICAO Address : 7c6db8
  Extended Squitter Type: 11
  Extended Squitter Sub : 0
  Extended Squitter Name: Airborne Position (Baro Altitude)
    F flag : even
    T flag : non-UTC
    Altitude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

*Airframe 7c6db8 is flying at 6,250 feet at location
-33.8,151.0*



What is Kafka?

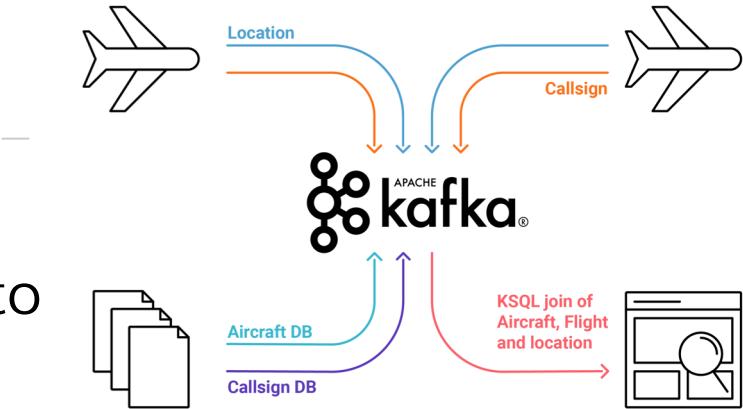
- Apache Kafka is a community distributed streaming platform
- Messages are persisted in topics.
- Kafka is based on an abstraction of a distributed commit log





All together

- Raspberry Pi ADS-B messages; into the location-topic and ident-topic Kafka topics.
- One-off load of the icao-to-aircraft (types of planes) and callsign-details (flight routes) topics
- Kafka KSQL used to left join streams to reference data





What is KSQL?

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



```
CREATE STREAM possible_fraud AS  
SELECT card_number, count(*)  
FROM authorization_attempts  
WINDOW TUMBLING (SIZE 5 SECONDS)  
GROUP BY card_number  
HAVING count(*) > 3;
```



Read a topic

```
kafka-console-consumer --bootstrap-server localhost:9092 --  
property --topic location-topic  
  
{"ico": "7C6DB8", "height": "6250", "location": "-33.807724,151.091495"}
```



Let's do it with it KSQL

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

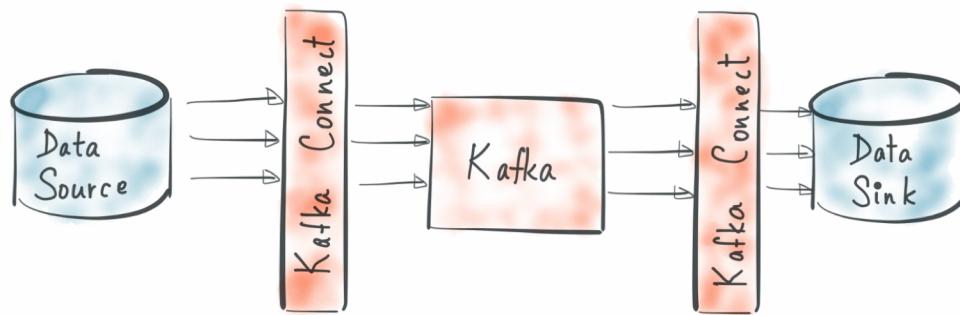
```
ksql> SELECT TIMESTAMPTOSTRING(rowtime, 'yy-MM-dd HH:mm:ss') \
, manufacturer \
, aircraft \
, registration \
, height \
, location \
FROM location_and_details_stream;
```

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

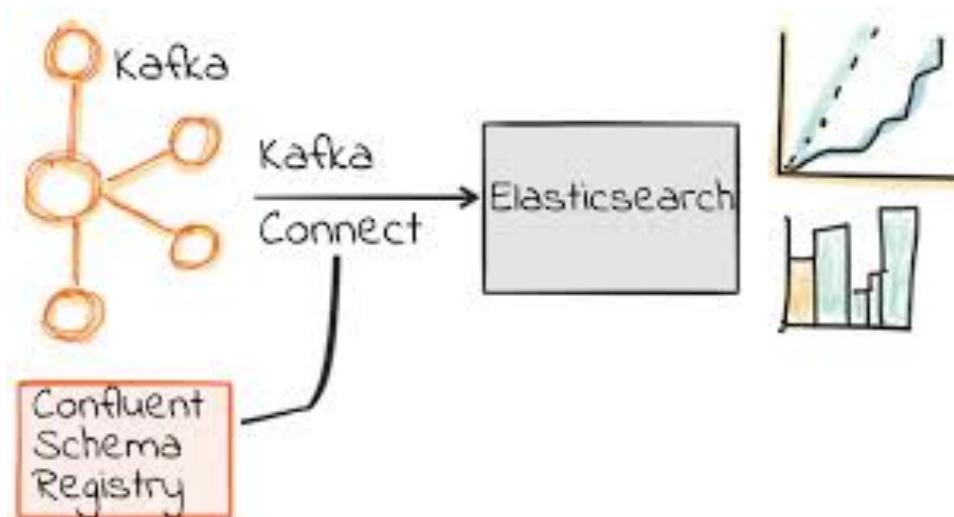
- Kafka Connect is a framework for streaming data between Apache Kafka and other data systems
 - Kafka connect **sources** – from something into Kafka
 - Kafka connect **sinks** – from Kafka into something





Using **Elastic & Kibana** for visualizations

- Kafka topic to elastic using connect **elastic sink**





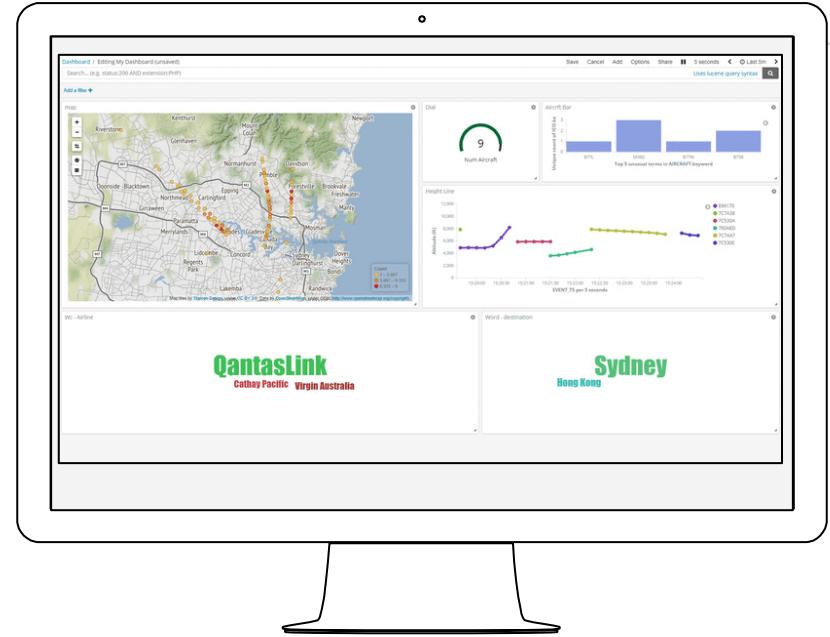
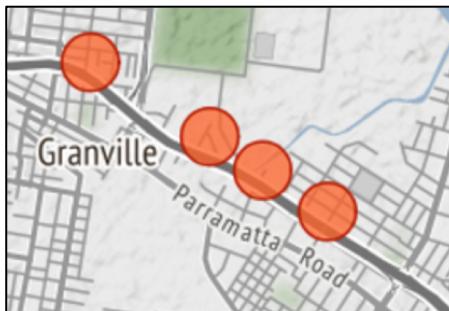
Using Kibana for visualizations

- Kafka topic to elastic using connect **elastic sink**
 - Sink “topic.index.map” to map uppercase topic LOCATIONTABLE to lowercase elastic index locationtable
 - Elastic dynamic templates for geo_point and timestamp



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



Demo!



Thanks!

Any *questions* ?

You can find me at

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