

Data Visualization

INF552 - 2022 - Session 09 - exercices
Visualization of live data streams with D3 and Vega-lite



PC s09

- Visualization of live air traffic





Version 2 API Fields

This file contains readsb list of recently seen aircraft.

Status information:

- msg: Shows if there is an error, default is "No error".
- now: The time this file was generated, in seconds since Jan 1 1970 00:00:00 GMT (the Unix epoch)
- total: Total aircraft returned.
- ctime: The time this file was cached, in seconds since Jan 1 1970 00:00:00 GMT (the Unix epoch).
- ptime: The server processing time this request required in milliseconds.

For each aircraft object, the following are shown if available.

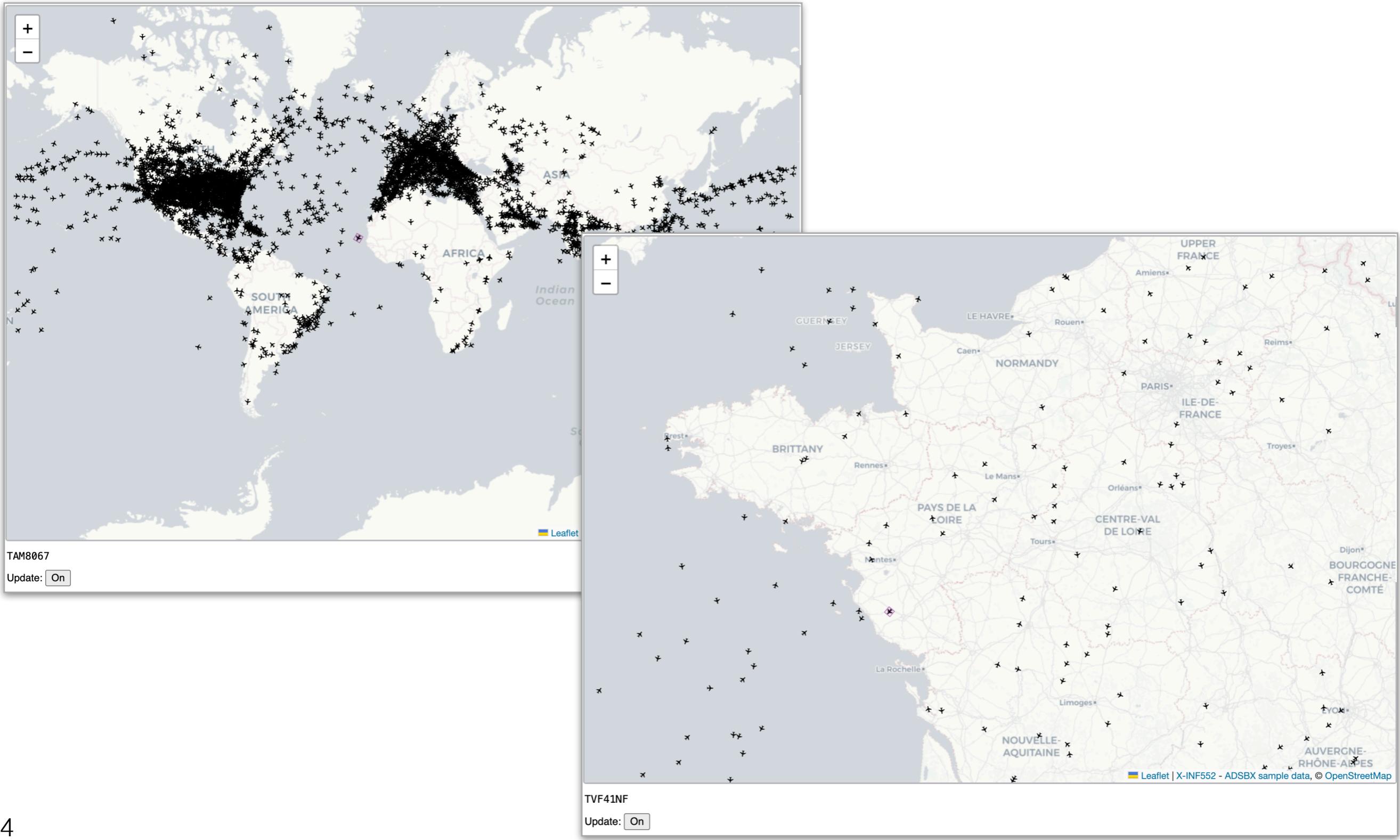
- now: the time this file was generated, in seconds since Jan 1 1970 00:00:00 GMT (the Unix epoch).
- messages: the total number of Mode S messages processed (arbitrary)
- aircraft: an array of JSON objects, one per known aircraft. Each aircraft has the following keys. Keys will be omitted if data is not available.
 - hex: the 24-bit ICAO identifier of the aircraft, as 6 hex digits. The identifier may start with '~', this means that the address is a non-ICAO address (e.g. from TIS-B).
- r: aircraft registration pulled from database
- t: aircraft type pulled from database
- dbFlags: bitfield for certain database flags, below & must be a bitwise and ... check the documentation for your programming language:

```
military = dbFlags & 1;
interesting = dbFlags & 2;
PIA = dbFlags & 4;
LADD = dbFlags & 8;
```

- type: type of underlying messages / best source of current data for this position / aircraft: (order of which data is preferentially used)
 - adsb_icao: messages from a Mode S or ADS-B transponder, using a 24-bit ICAO address
 - adsb_icao_nt: messages from an ADS-B equipped "non-transponder" emitter e.g. a ground vehicle, using a 24-bit ICAO address

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- Visualization of live air traffic using D3 on a zoomable leaflet map:



d3.selectAll(...).data(...).enter(): selects items that are not yet bound:

```
d3.selectAll("circle")
  .data(someArray)
  .enter()
  .append("circle")
  .attr("cx", 200)
  .attr("cy", (d,j) => (j*42))
  .attr("r", 10)
  .attr("fill", (d) => (someScale(d)));
```

d3.selectAll(...).data(...).exit(): selects items that are no longer bound:

```
d3.selectAll("circle")
  .data(smallerArray)
  .exit()
  .remove();
```

← actually removes the element from the DOM

Be careful: enter/update/exit subsets will vary if you call d3.selectAll(...).data(...) independently for each of them in sequence. You will likely want to work on those different subsets with the same initial selection. You should thus first store the selection itself:

```
var myCircles = d3.selectAll("circle")
  .data(newArray);
```

... and then work with the different subsets from that selection:

```
myCircles.attr(...)
  .style(...);

myCircles.enter(...)
  .append(...)
  .attr(...);

myCircles.exit()
  .remove();
```

`d3.join()` is a (better) alternative to the general update pattern:

```
d3.selectAll("circle")
  .data(someArray)
  .join(
    enter => (
      enter.append("circle")
        .attr(...)

    ),
    update => (
      update.attr(...)

    ),
    exit => (
      exit.remove()

    )
  );

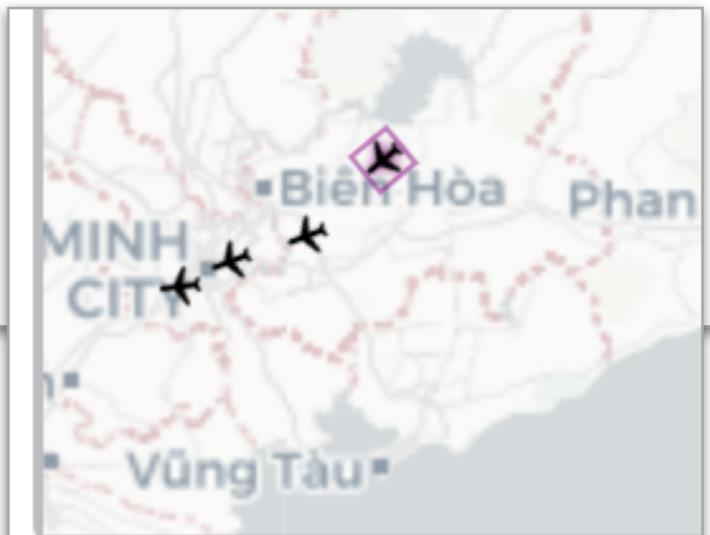
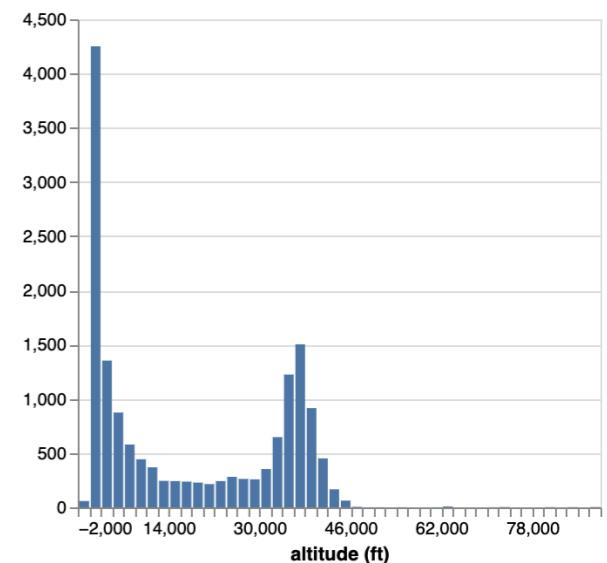
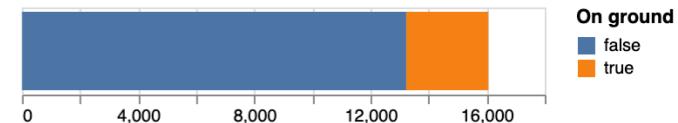
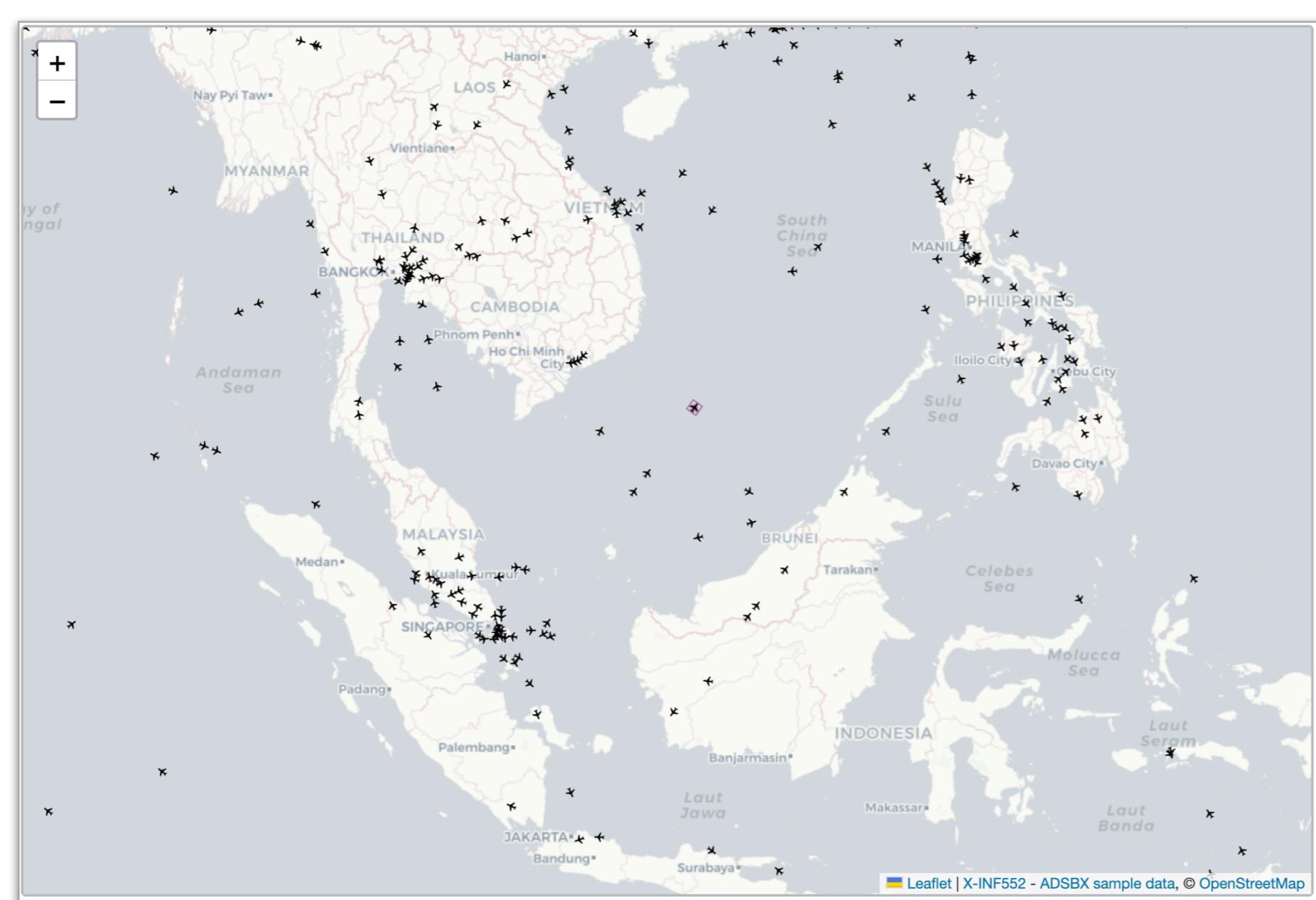
```

but that makes animations a bit more difficult to specify:

```
update => (
  update.call(update => update.transition()
    .duration()
    .attr(...)

  ),

```



BAV281

Update: On



SQ7410

Update: On

<https://www.adsbexchange.com/data-samples/>

<https://www.adsbexchange.com/version-2-api-wip/>

Sample trace

<https://www.adsbexchange.com/version-2-api-wip/>

```
{  
    icao: "0123ac", // hex id of the aircraft  
    timestamp: 1609275898.495, // unix timestamp in seconds since epoch (1970)  
    trace: [  
        [ seconds after timestamp,  
            lat,  
            lon,  
            altitude in ft or "ground" or null,  
            ground speed in knots or null,  
            track in degrees or null, (if altitude == "ground", this will be true heading instead of track)  
            flags as a bitfield: (use bitwise and to extract data)  
                (flags & 1 > 0): position is stale (no position received for 20 seconds before this one)  
                (flags & 2 > 0): start of a new leg (tries to detect a separation point between landing and takeoff that separates flights)  
                (flags & 4 > 0): vertical rate is geometric and not barometric  
                (flags & 8 > 0): altitude is geometric and not barometric  
  
            ,  
            vertical rate in fpm or null,  
            aircraft object with extra details or null (see aircraft.json documentation, note that not all fields are present as lat and lon for example arlready in the values  
above),  
            // the following fields only in files generated 2022 and later:  
            type / source of this position or null,  
            geometric altitude or null,  
            geometric vertical rate or null,  
            indicated airspeed or null,  
            roll angle or null  
        ],  
        [next entry like the one before],  
        [next entry like the one before],  
    ]  
}
```

```
{"icao":"484416",  
"r":"PH-BQM",  
"t":"B772",  
"dbFlags":0,  
"desc":"BOEING 777-200",  
"timestamp": 1698796800.000,  
"trace": [  
[7.13,53.091663,-99.354935,35000,504.8,77.1,0,0,null,"other",34000,null,null,null],  
[26.57,53.104791,-99.259697,35000,504.8,77.1,0,0,{"type":"adsb_icao","flight":"KLM678",  
"alt_geom":34000,"track":77.06,"baro_rate":0,"squawk":"1317","emergency":"none","category":"A5","nav_qnh":1012.8,"nav_altitude_mcp":350  
08,"nav_heading":57.66,"nic":8,"rc":186,"version":2,"nic_baro":1,"nac_p":10,"nac_v":2,"sil":3,"sil_type":"perhour","gva":2,"sda":2,"alert":0,"spi":0},  
"adsb_icao",34000,null,null,null],  
[46.43,53.115172,-99.184570,35000,504.8,77.1,0,0,null,"adsb_icao",34000,null,null,null],  
[66.16,53.125414,-99.110574,35000,505.6,77.2,0,0,null,"adsb_icao",33975,null,null,null],  
[83.61,53.134415,-99.044652,35000,505.6,77.2,0,0,null,"adsb_icao",33975,null,null,null],  
[95.21,53.140457,-99.000157,35000,505.3,77.3,0,0,{"type":"adsb_icao","flight":"KLM678",  
"alt_geom":33975,"track":77.31,"baro_rate":0,"squawk":"1317","emergency":"none","category":"A5","nav_qnh":1012.8,"nav_altitude_mcp":350  
08,"nav_heading":66.80,"nic":8,"rc":186,"version":2,"nic_baro":1,"nac_p":10,"nac_v":2,"sil":3,"sil_type":"perhour","gva":2,"sda":2,"alert":0,"spi":0},  
"adsb_icao",33975,null,null,null]
```

