

BBotDB

A Key-Bounding-Box-Value Store

BBotDB Streams: Distributed Processing of Real-World Streams of Position Data

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Database Systems for New Applications

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Outline

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 - BBoxDB Streams – Basics
 - BBoxDB – Basics
 - BBoxDB Streams – Architecture

- 2 Demonstration
 - Used Data Streams
 - Live Demonstration

BBoxDB Streams

BBoxDB Streams. . .

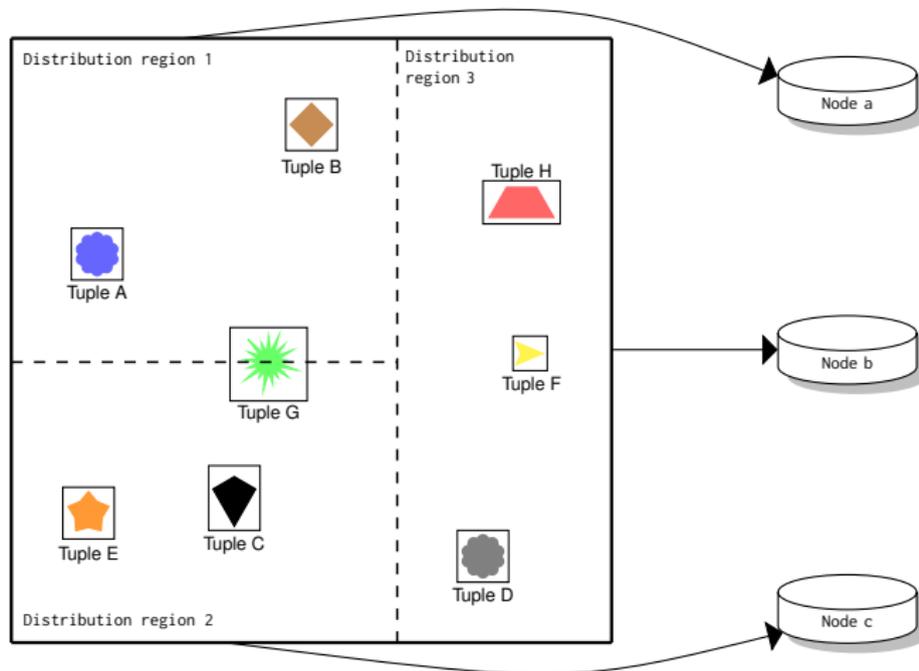
- is a distributed stream processing system that supports n -dimensional *point* and *non-point data*.
- uses the key-bounding-box-value store BBoxDB as data storage.
- supports continuous range queries.
- **allows efficient continuous spatial joins between static n -dimensional big data and stream elements.**

BBoxDB – A distributed key-bounding-box-value store

BBoxDB...

- is a distributed *key-bounding-box-value store*.
- stores each value together with a *bounding box*. The bounding box determines the location of the value in the n -dimensional space.
- partitions the space dynamically and redistributes the data.
- stores data co-partitioned for efficient spatial joins.
- is freely available and licensed under the *Apache 2.0* license.

Partitioning the space



Architecture

Processing data with BBoxDB Streams

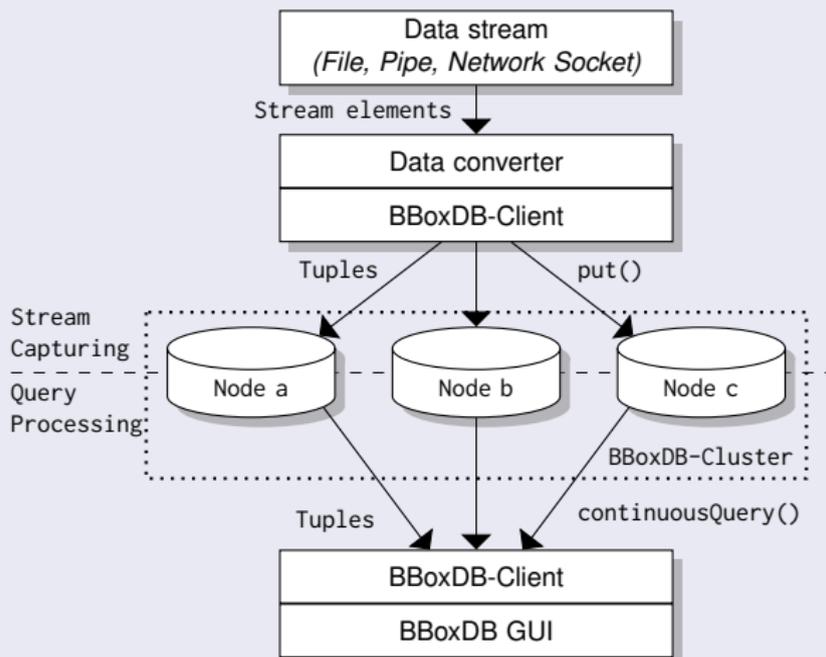




Figure: A USB-receiver which is capable of processing ADS-B (*Automatic Dependent Surveillance-Broadcast*) radio transmissions.

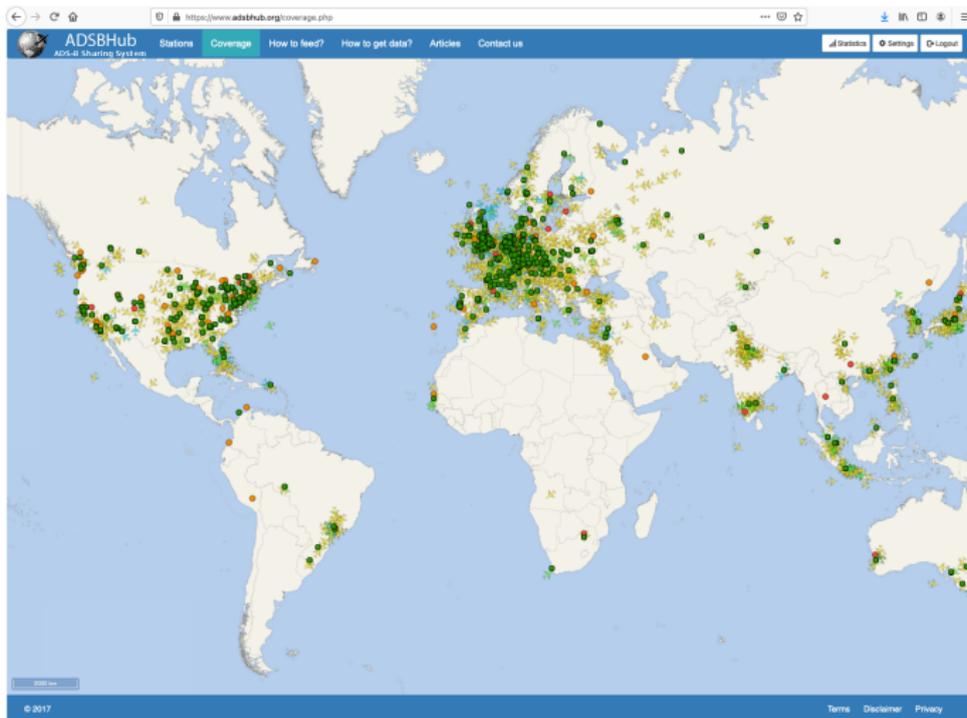


Figure: Aircraft position data fetched from the website <https://adsbhub.org/>

Historical car park data for selected Park&Ride and Metro station car parks is now available. Get it [here](#).

open data

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BROWSE DATA DEVELOPERS INNOVATION FORUM BLOG

Open data available

Today we supply real-time data to apps with over 7 million unique customer downloads in total. The Open Data program will make these datasets, along with other transport data, more broadly available. This data will be capable of supporting apps and a whole lot more.

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Learn more about the open data hub and developer portal
MORE

Developers
Find everything you need to get started and access our data
MORE

Useful Links
A list of useful links that will assist you in developing great apps
MORE

Figure: Public transport data in *GTFS real-time* format are fetched from the website <https://opendata.transport.nsw.gov.au/>

Live Demonstration

Summary

BBoxDB Streams...

- is a stream processing extension of BBoxDB.
- can handle n -dimensional data streams (e.g., *position data*).
- is able to perform continuous queries such as range queries and spatial joins.
- **the spatial joins are performed between the dynamic stream elements and static n -dimensional big data.**
- is written in *Java* and licensed under the *Apache 2.0 license*.

Questions?

Further information

- Web: <https://bboxdb.org>
- GitHub: <https://github.com/jnidzwetzki/bboxdb>
- Twitter: @bboxdb
- Google Groups: <https://groups.google.com/forum/bboxdb>

Backup Slides

ADS-B data

ADS-B data in SBS format

```
MSG,1,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR681,,,,,,,,,  
MSG,3,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,30525,,29.562973,33.627777,,,,,  
MSG,4,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,477.000000,0.000000,,,-448,,,,,
```

```
MSG,1,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR914,,,,,,,,,  
MSG,3,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,25200,,29.792269,32.485603,,,,,  
MSG,4,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,434.000000,99.000000,,1792,,,,,
```

```
MSG,1,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,NMA6389,,,,,,,,,  
MSG,3,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,424,,52.379501,13.527200,,,,,  
MSG,4,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,6.000000,150.000000,,,-510,,,,,
```

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MSG,4,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,6.000000,150.000000,,,-510,,,
```

Aircraft ID

```
MSG,1,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,NMA6389,,,,,,,,,  
MSG,3,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,424,,52.379501,13.527200,,,,,  
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MSG,4,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,477.000000,0.000000,,,-448,,,,,
```

```
MSG,1,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR914,,,,,,,,,  
MSG,3,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,25200,,29.792269,32.485603,,,,,  
MSG,4,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,434.000000,99.000000,,1792,,,,,
```

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MSG,1,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,NMA6389,,,,,,,,,  
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MSG,4,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,6.000000,150.000000,,,-510,,,,,
```

Call-Sign

ADS-B data

ADS-B data in SBS format

```
MSG,1,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR681,,,,,,,,,  
MSG,3,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,30525,,29.562973,33.627777,,,,,  
MSG,4,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,477.000000,0.000000,,,-448,,,,,
```

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MSG,1,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR914,,,,,,,,,  
MSG,3,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,25200,,29.792269,32.485603,,,,,  
MSG,4,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,434.000000,99.000000,,1792,,,,,
```

Height
(Foot)

```
MSG,1,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,NMA6389,,,,,,,,,  
MSG,3,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,424,,52.379501,13.527200,,,,,  
MSG,4,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,6.000000,150.000000,,,-510,,,,,
```

ADS-B data

ADS-B data in SBS format

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MSG,3,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,25200,,29.792269,32.485603,,,,,  
MSG,4,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,434.000000,99.000000,,1792,,,,,
```

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MSG,1,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,NMA6389,,,,,,,,,  
MSG,3,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,424,,52.379501,13.527200,,,,,  
MSG,4,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,6.000000,150.000000,,,-510,,,,,
```

Speed
(Knots)

ADS-B data

ADS-B data in SBS format

```
MSG,1,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR681,,,,,,,,,
MSG,3,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,30525,29.562973,33.627777,,,,,
MSG,4,0,0,100A4,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,477.000000,0.000000,,,-448,,,,,

MSG,1,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,MSR914,,,,,,,,,
MSG,3,0,0,100DD,0,2021/02/01,07:07:39.000,2020/02/01,07:07:39.000,,25200,29.792269,32.485603,,,,,
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MSG,4,0,0,10140,0,2021/02/01,07:07:39.000,2020/02/01,07:07:38.000,,6.000000,150.000000,,,-510,,,,,
```

The diagram features a callout box with the text "Position (WGS84)" inside an oval. Three arrows originate from this box and point to the latitude and longitude coordinates in three different ADS-B messages. The first message (MSG,3,0,0,100A4) has coordinates 29.562973, 33.627777. The second message (MSG,3,0,0,100DD) has coordinates 29.792269, 32.485603. The third message (MSG,3,0,0,10140) has coordinates 52.379501, 13.527200.

GTFS real-time data

GTFS real-time data of a bus in GeoJSON format

```
{
  "geometry" : {
    "coordinates" : [151.17762756347, -33.92598342895],
    "type" : "Point"
  },
  "type" : "Feature",
  "properties" : {
    "Speed" : "19.2",
    "TripStartDate" : "20200121",
    "TripScheduleRelationship" : "SCHEDULED",
    "OccupancyStatus" : "MANY_SEATS_AVAILABLE",
    "TripStartTime" : "02:00:00",
    "RouteID" : "2437_N20",
    "Timestamp" : "1579530867",
    "TripID" : "883447",
    "Bearing" : "77.0",
  }
}
```

Demonstration

Our demonstration. . .

- performs continuous queries on real-world data streams.
- visualizes the results interactively on a map.
- performs spatial joins between *OpenStreetMap* data and a data stream.

Performed continuous queries

- *Which aircraft is currently in the area of Berlin?*
- *Which bus drives currently through a forest?*