IDP /Master Thesis

Design and Implementation of a Deployment Model and Data Pipeline for ADS-B Data Processing

Background:

The Institute for Flight System Dynamics (FSD) operates an ADS-B Antenna, which receives broadcasted data from aircraft (a/c); see Figure 1 and Figure 3. We use an open-source ADS-B decoder to decode the received radio signals.

To make our ADS-B data accessible for batch and real-time analyses regarding Munich Airport (EDDM), we need a deployment model and data pipeline to be designed and implemented on the FSD's cluster computer.

Figure 1: FSD ADS-B Antenna Range

Task Description:

From a previous EU-Project SafeOPS, we have a data pipeline built for ADS-B data, retrieved as batch data from external providers. With our ADS-B antenna installed, we would like to develop the investigated use case further toward online risk assessment. Therefore, the following work packages are identified as next steps:

WP1: Familiarize with ADS-B Data, ADS-B decoder software, and possible deployment models (data warehouse/data lake/lambda/delta architecture…).

WP2: Design a deployment model suitable for the needs of the use case **and** the provided resources of our cluster. Also, deploying additional data (e.g. weather → METAR, DWD API) should be considered.

WP3: Implementation of the data deployment on the cluster

WP4: Implementation of a data pipeline on the cluster

WP5: Documentation

Required Profile of Qualifications & Interests:

- General interest in aviation and data science
- Basic knowledge of Docker
- Basic knowledge of Linux OS
- Proficient Coding Skills in Matlab or Python; JS and C basics would be beneficial.

Figure 2: A/C Tracks from 03.11. recorded by FSDs Antenna at EDDM, showing approach and departure patterns.

{ "now" : 1699439264.449,
  "messages" : 4445456,
  "aircraft" : [
    {"hex":"4008b2","type":"adsb_icao","flight":"BAW63CZ ","alt_baro":38000,"alt_geom":37675,"gs":399.4,"ias":247,"mach":0.780,"track":297.27,"mag_heading":296.54,"true_heading":299.63,"baro_ra
    {"hex":"3c5ee7","type":"adsb_icao","flight":"EWG8EC ","alt_baro":37050,"alt_geom":37050,"gs":443.1,"track":215.45,"baro_rate":64,"squawk":"2575","category":"A3","nav_qnh":1012.8,"nav_altit
    {"hex":"3c6542","type":"adsb_icao","flight":"DLH76E ","alt_baro":37025,"alt_geom":37075,"gs":425.5,"ias":252,"mach":0.776,"track":227.76,"mag_heading":220.78,"true_heading":223.88,"baro_ra
    {"hex":"400fe2","type":"adsb_icao","flight":"EZY80QR ","alt_baro":39000,"alt_geom":38725,"gs":479.4,"ias":230,"tas":432,"mach":0.748,"oat":-56,"tat":-31,"track":105.49,"track_rate":0.03,"ro
    {"hex":"4bb859","type":"adsb_icao","flight":"PGT63AP ","alt_baro":36000,"alt_geom":35850,"gs":400.9,"ias":258,"mach":0.780,"track":305.35,"mag_heading":302.87,"true_heading":306.04,"baro_ra
    {"hex":"3ceee1","type":"adsb_icao","flight":"VJH313 ","alt_baro":39000,"alt_geom":38950,"gs":430.7,"ias":227,"tas":426,"mach":0.740,"oat":-55,"tat":-31,"track":197.85,"track_rate":0.00,"ro
    {"hex":"4404a4","type":"adsb_icao","flight":"EJU71ZM ","alt_baro":38000,"alt_geom":38100,"ias":244,"mach":0.772,"calc_track":290,"mag_heading":289.16,"true_heading":292.35,"baro_rate":0,"ge
    {"hex":"40756b","type":"adsb_icao","alt_baro":37050,"alt_geom":36875,"gs":501.5,"ias":254,"tas":452,"mach":0.784,"track":124.77,"track_rate":0.00,"roll":0.00,"mag_heading":122.34,"true_head
    {"hex":"4d00ee","type":"adsb_icao","alt_baro":29100,"alt_geom":28375,"gs":505.0,"ias":307,"mach":0.780,"track":104.92,"mag_heading":99.67,"true_heading":102.98,"baro_rate":1152,"geom_rate":
    {"hex":"8964e1","type":"adsb_icao","flight":"UAE7CN ","alt_baro":39000,"alt_geom":38725,"gs":550.0,"ias":267,"mach":0.856,"track":107.35,"mag_heading":104.24,"true_heading":107.54,"baro_ra
    {"hex":"a87876","type":"adsb_icao","alt_baro":29000,"alt_geom":28850,"gs":472.8,"ias":280,"mach":0.728,"track":105.33,"mag_heading":102.66,"true_heading":106.01,"baro_rate":-64,"geom_rate"

Figure 3: JSON data, received from our ADS-B Antenna every second.

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Potential Related Lectures (only IDP):

- Operational Flight Safety (3ECTS) provides fundamental knowledge about today's methods in risk management of airlines, important safety organizations and aircraft systems aimed for providing safe flight operation.
- In combination with: Flight Guidance 2 (3 ECTS) which covers topics like e.g. aviation stakeholders, air traffic management, and meteorology.

OR:

- Flight Guidance 1 (5 ECTS): More in depth content about cockpit instruments, navigation, aviation law than Flight Guidance 2