AURORA: Advanced User-Centric Efficiency Metrics for Air Traffic Performance Analytics

Shen Wang, Aditya Grover, Javier Lopez, Fernando Celorrio Camara, Philip Plantholt, Brian Mac Namee

***Index Terms*—air traffic management, streaming data**

The perspectives of air navigation service providers (ANSP) and airlines on the efficiency of the routes that flights follow can often differ. While airlines are concerned mainly with schedule adherence and fuel consumption, ANSPs focus on more in-depth components like managing sector capacity, minimising air traffic controllers' interventions, and reducing emissions and noise. Designing indicators to capture these different perspectives for effective air traffic management (ATM) is challenging. Designing a data processing pipeline that can calculate and update these indicators in almost real-time makes this an even bigger challenge. The goal of the AURORA project is to address these challenges.

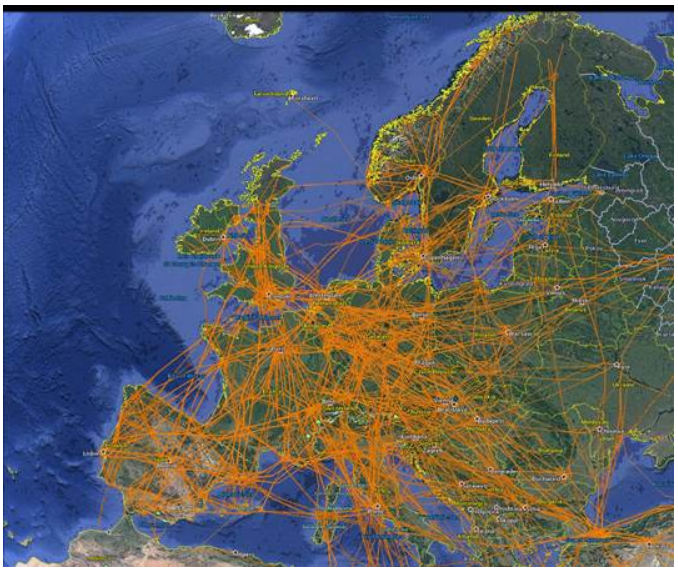

Fig. 1. A visualisation of the flight trajectories of every flight in European airspace in a single day (trajectories are reconstructed from ADS-B data).

Current indicators of route efficiency typically used in ATM rely only on radar track and flight plan data. These data sources, however, are insufficient when trying to take into account issues such as flight fuel consumption and cost; and radar track data itself is limited in coverage and typically only available to the local ANSP that generates it. *Automatic dependent surveillance broadcast* (ADSB) data is an alternative, widely available, reliable source of global surveillance data with increasing coverage. ADS-B surveillance data can provide accurate location of flights updated approximately every 4 seconds (Figure 1 shows an illustration of reconstructed trajectories for European flights in a single day). In AURORA we are using ADS-B data to calculate efficiency indicators that capture the different perspectives of both airlines and ANSPs. The methodology we use is based on comparing the differences between flight trajectories reconstructed from ADS-B surveillance data and ideal trajectories generated based on user preferences (for example trajectories constructed to minimise fuel used or cost).

For the efficiency indicators calculated to be most useful they should be calculated in near real-time and updated every time new surveillance data for a flight becomes available. This involves performing relatively complex processing of large scale, fast changing ADS-B surveillance data and modern data streaming technologies are being used for this. Figure 2 shows a schematic of the AURORA real-time analytics platform that has been developed. Early experimental results indicate that this platform is capable of calculating sophisticated efficiency indicators in near real-time for large volumes of flights. The current platform is based on Apache Kafka, Spark Streaming and Cassandra technologies and novel approaches to distributed real-time indicator calculation.

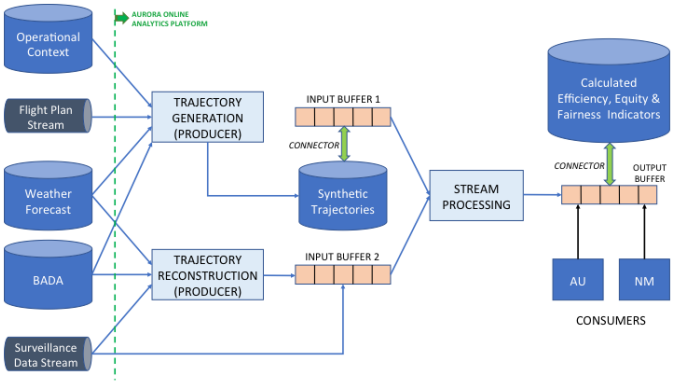

Fig. 2. A schematic of the AURORA real-time analytics platform.

The AURORA project is supported by the SESAR Joint Undertaking (SJU) under grant 699340 under the European Union's Horizon 2020 research and innovation programme. The collaborating partners are Centro de Referencia I+D+i ATM (CRIDA), Boeing Research and Technology Europe (BR&TE), Centre for Applied Data Analytics (CeADAR) and Flight Radar 24 (FR24). More information is available from **www.aurora-er.eu**.

S. Wang, A. Grover, and B. Mac Namee are with the School of Computer Science, University College Dublin.
J. Lopez is with Boeing Research & Technology Europe (BR&TE).
F. Celorrio Camara is with Centro de Referencia I+D+i ATM (CRIDA).
P. Plantholt, is with Flight Radar 24 (FR24).