

## Business Trajectory / '4D' Trajectory

### Summary

The four-dimensional (4D) trajectory or 'business trajectory' is key to the concept of the future Air Traffic Management (ATM) system being developed by the Single European Sky ATM Research (SESAR) programme.

Airspace users will agree with Air Navigation Service Providers (ANSPs) and airport operators, from early planning to the day of operations the airspace user's preferred trajectory for the flight in four dimensions (three spatial dimensions, plus **time**), where the various constraints of airspace and airport capacity have been fully taken into account.

This '4D' trajectory is called the 'Business trajectory' in the case of civil aviation and the 'Mission trajectory' for military flights, and once agreed it becomes the reference which the airspace user agrees to fly and all the service providers agree to facilitate with their respective services. From then on, all stakeholders will share information on this 4D Business/Mission trajectory in real time throughout the flight: from preparation through operations to post-disembarking.

#### Four dimensions

- **Dimensions 1 & 2:** Latitude & longitude - the grid reference giving the aircraft's position on the map.
- **Dimension 3:** Altitude - the height of the aircraft above ground or sea level, depending on the reference for the particular phase or flight.
- **Dimension 4:** Time - the aircraft position and altitude is defined for specific moments in time for the whole flight.

### Description: The four-dimensional (4D) trajectory

#### The background

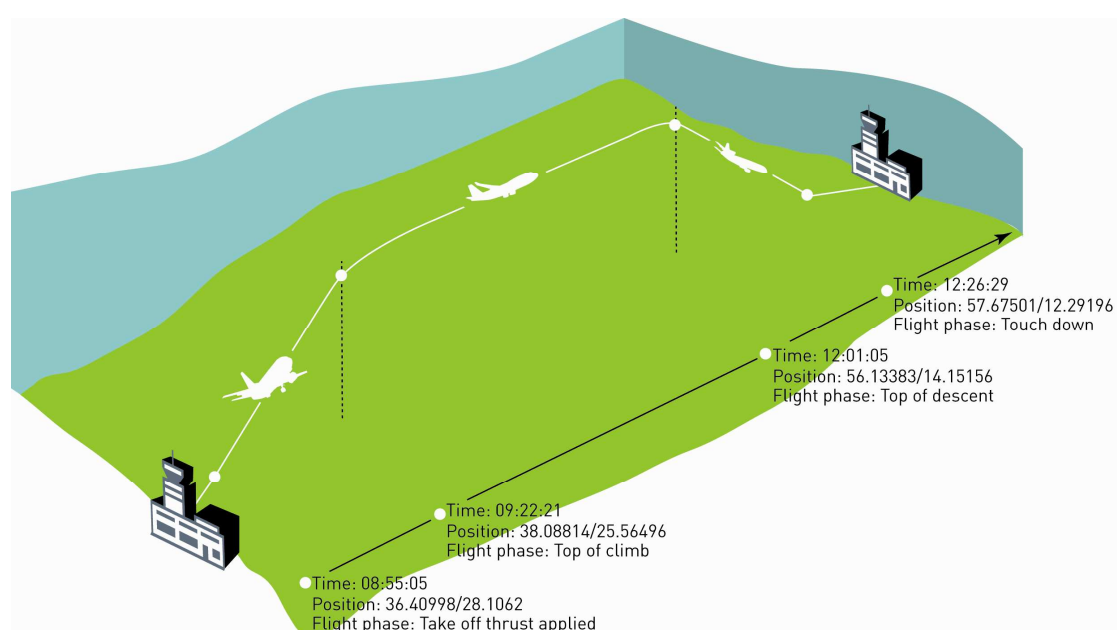
Currently, aircraft operators plan each flight in detail and then submit a less detailed flight plan in overview to the relevant air traffic control providers and central flow management unit. The respective air traffic control units then compute these flight plans down to a detailed level in their respective flight data processing systems. These then form the baseline for the voice communication controllers and pilots throughout the flight.

## Implementing 4D trajectories

The 4D trajectory concept requires that airspace users are able to agree the detailed 4D Business/Mission trajectory directly with the service providers involved in facilitating the flight in the specific airspaces concerned.

Detailed positional information for the aircraft throughout the flight will be exchanged with all service providers on the route, as well as ascent and descent paths, and times will be agreed with departure and arrival airports in advance. ATM operations will be automated to a greater extent than currently, with data exchanged directly between the airborne and ground systems.

Greater certainty about the positions of every airspace user in the sky at any given moment will improve safety as well as flight predictability. The more efficient resource planning which this allows will in turn enable a greater carrying capacity for both airports and the European sky in general.



Eventually, the sharing of all trajectory information in real time will require the network management functionality provided by SWIM, another key SESAR element. System Wide Information Management (SWIM) is explained in factsheet 03/2010.

## Benefits

- **Predictability** - the trajectory of the aircraft is defined in detail in advance, taking into account local conditions and other airspace users. This means that pilots and service providers have far more time to plan their respective operations and assets and make manoeuvres, making flight paths smoother and ensuring that air travel departures and arrivals are more predictable and efficient.
- **Safety** - The position of every aircraft in the sky is known for each moment in time. Greater automation of ATM means that air traffic controllers and pilots will have more capacity for monitoring safety aspects.
- **Cost efficiency** - Knowing the exact trajectory and timing for each flight means that aircraft can optimise routing and fuel usage. Smooth ascent and descent paths consume less fuel than the step-wise adjustments that are currently necessary. Carrying less fuel reduces weight, further reducing fuel consumption.
- **Environmental impact** - In turn, optimal routing and lower fuel usage reduces emissions of CO<sub>2</sub> and therefore the impact on climate change. In addition, trajectories can take into account local needs in terms of noise and other pollution

and avoid unnecessary over-flights. Greater predictability of aircraft operations means a further optimisation of resources at airports, for example, which will reduce the CO2 emissions related to the operation of airport services.

#### **Challenges:**

The technology to implement four-dimensional trajectories exists already - its efficient deployment will be one of the earliest tangible results from SESAR and deliver the first improvements in ATM from the programme.

The main challenge to implementing 4D trajectories lies in agreeing standard definitions, procedures and methodologies, as well as global standards for the exchange of 4D trajectory information. International agreements also need to cover interoperability for technical enablers such as multimodal communications equipment.

#### **The SESAR Programme**

- **Work Packages 4, 5, 6 and 7** - focus on the standards in operation, meaning methodologies and procedures for the efficient handling of 4D Business/Mission trajectories. These form the operational requirements from both a ground and airborne perspective for the necessary technical enablers and automation support levels. It is also in these work packages that the final validation activities will take place when operational procedures, as well as airborne and ground technical enablers, come together. The validation will prove the increase performance of trajectory management so as to reduce aircraft separation and improve traffic flow, resulting in increased capacity, flight regularity and safety.
- **Work package 9** - focuses on aircraft system elements. This work package will develop, verify and validate the airborne equipment necessary to support the 4D Business/Mission trajectory concept.
- **Work package 10** - covers the research and development to define, design, specify, verify and validate en-route and Air Traffic Control (ATC) technical enablers for 4D Business/Mission trajectories.

Further information:

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