Trajectory Based Operations (TBO)

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Enabling Performance - Improving System Capabilities

- Planning
- Medium-and short-term planning
- Pre-departure

- Taxi-out and take-off
- Climb
- Cruise
- Descent
- Landing and taxi-in
- Post-flight

- Automation support
- Flight- and flow-centric operations
- Sharing of information
- Integration of all vehicles
- Integrated systems
- Virtualisation
TBO: a global initiative

ICAO Global Air Traffic Management Operational Concept (GATMOC) – Doc 9854

ICAO TBO concept definition

Initiated March 2014 ATMRPP

SESAR has contributed four WP based on SESAR V&V
  – WP601: Accuracy of the flight trajectory – the need to manage uncertainty
  – WP632 Comments on TBO
  – WP636 Time adherence in TBO
  – WP637 Sharing Trajectory Predictions in TBO

DATACOM needs global standardization:

• ICAO

• Industry standardisation bodies, e.g. EUROCAE, RTCA
TBO in the ASBUS

**Block 0**
- **B0-10**: Improved Operations through Enhanced En-route Trajectories
- **B0-15**: Improved Runway Traffic Flow through Sequencing AMAN/DMAN
- **B0-25**: Increased Interop., Efficiency and Capacity through G/G Integration
- **B0-35**: Impr. Flow Perf. through Planning based on a Network-Wide view
- **B0-80**: Improved Airport Operations through Airport-CDM

**Block 1**
- **B1-10**: Improved Operations through Free Routing
- **B1-15**: Improved Departure, Surface & Arrival Management
- **B1-25**: Efficiency and Capacity through FF-ICE/1 appl. before departure
- **B1-35**: Enhanced Flow Perf. through Network Operational Planning
- **B1-40**: Improved Traffic Synchr. and Initial Trajectory-Based Operation
- **B1-80**: Optimised Airport Operations through Airport CDM

**Block 2**
- **B2-15**: Linked AMAN - DMAN
- **B2-25**: Impr. Coord. through multi-centre G/G integr: FF-ICE/1 and FO SWIM
- **B2-31**: Enabling Airborne Participation in collaborative ATM through SWIM
- **B2-35**: Increased user involvement in the dynamic utilisation of the network

**Block 3**
- **B3-05**: Full 4D Trajectory-based Operations
- **B3-15**: Integrated AMAN/DMAN/SMAN
- **B3-25**: Impr. Operational Perf. through the introduction of Full FF-ICE

**Timeline**
- Block 0: 2013
- Block 1: 2018
- Block 2: 2023
- Block 3: 2028 onwards
A concept enabling globally consistent performance-based 4D trajectory management by sharing and managing trajectory information. TBO will enhance planning and execution of efficient flights, reducing potential conflicts and resolving upcoming network and system demand/capacity imbalances early. It covers ATM processes starting at the point an individual flight is being planned through flight execution to post flight activities (TBO CD)
Moving from Airspace to 4D Trajectory Management

- 3D Position & Time - all phases of flight, all stakeholders
- A set of trajectories delivering preferred routes and timings taking into account all constraints
- Predictable Civil Airline Operations & Military Mission Planning
- All phases of operation
- Depends on a predictable Airport Turnaround process
TBO in flight execution

- Based on airborne-ground trajectory sharing
- Agreed trajectory is used as reference TBO agreed trajectory = Reference Business Trajectory (RBT) in SESAR
- Retain flexibility in the system: RBT update
- ANSP or AU may require changes: RBT revision (CDM)
- RBT = FMS Active Flight Plan
- RBT is not the same as clearance (share the ground plan concept)
- Do not constrain aircraft unless necessary!

In SESAR, the Concept Development is Based on V&V
Once the A/C enters the ATC arrival horizon:

1. A/C downlink of 4D predicted trajectory (ADS-C), including ETA for metering fix

2. ATC requests ETA min/max for metering fix (via ADS-C). A/C downlinks RTA min/max (via ADS-C) ATC uplinks feasible RTA

3. Crew inserts RTA into the FMS, A/C downlinks EPP (via ADS-C).

4. 4D trajectory agreed by crew and ATC ➔ Descent can be flown in full managed
Next Steps: Ground ↔ Air

- Register ATCO intention in ground system... and share it
- Improve TP
- Uplink with or without clearance: FMS flight optimization
- Symmetric concept: crews initiate request to change RBT and/or clearance
- Lateral & Vertical...
- PBN (link to FAA DRNP)
- Wind uplink (ATC Winds)
- ...

Beyond CPDLC/ADS-C:
Develop operational requirements for future DATACOM
Thank you for your attention