

Setting the scene: what is TBO?

Olivia Nunez

Pushing the SESAR TBO envelope in flight execution!, EUROCONTROL, 21 March 2023

What is TBO?

BEFORE TBO

- In-flight changes were only coordinated **between flight crew and ATC via voice**
- Only **the portion of the trajectory visible to ATC (immediately ahead)** can be effectively revised
- The ground has **no visibility of the FMS trajectory**
- Clearances are delivered via voice -> **only simple clearances are possible**

→ **Fragmentation of the trajectory**

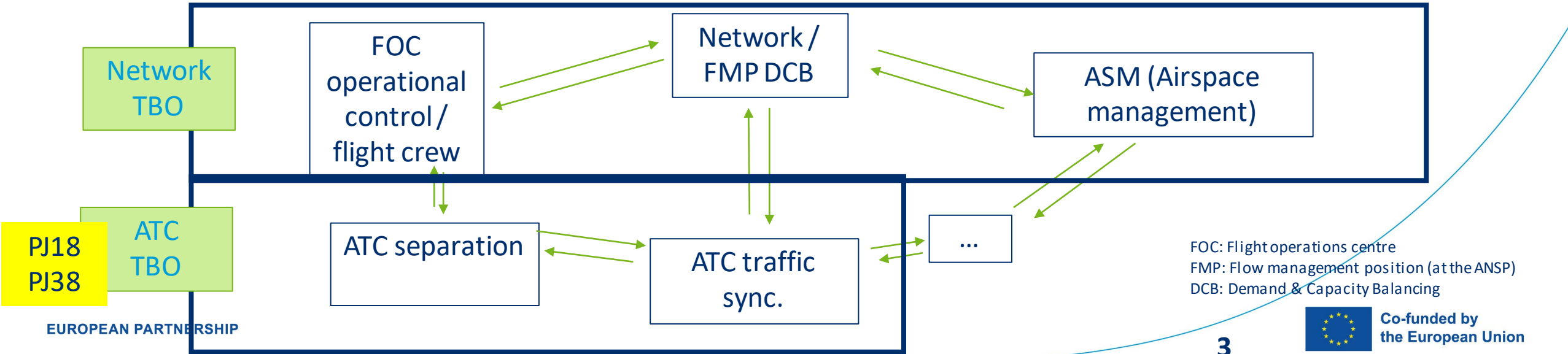
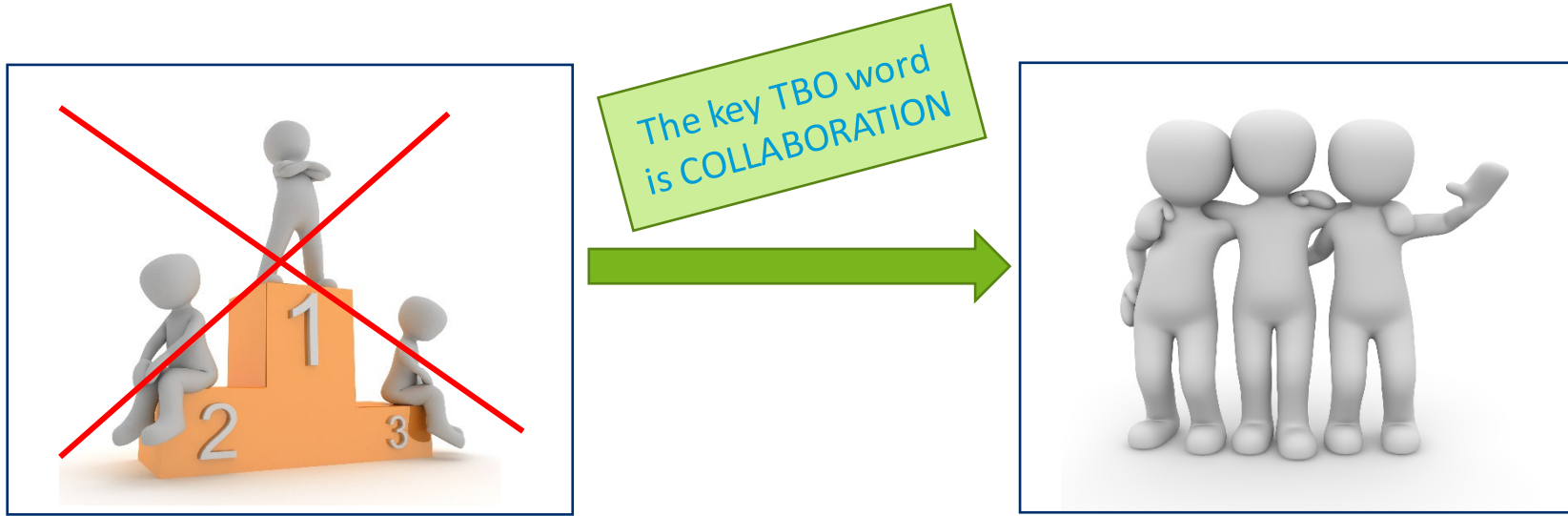


WITH TBO

- The trajectory in the flight plan can be **revised at any time** during the flight
- Strategic changes (longer look ahead time) are coordinated **between NM and FOC, ATC is not involved**
- **Tactical changes** (separation management, traffic synchronisation) are still possible (and necessary!), and they are still managed by ATC
- **Clearances** for all trajectory revisions (tactical or strategic) are delivered via **CPDLC** and correct implementation is checked with **EPP**

→ **A/G are always synchronised**

Network TBO & ATC TBO



FOC: Flight operations centre
FMP: Flow management position (at the ANSP)
DCB: Demand & Capacity Balancing

PJ18
PJ38

European R&D Strategy for TBO in the execution phase

Where to start in Europe?

- Many short hauls (< 2-3 hours)
- Very high traffic density
- Need to support ATC decision making
- FOC baseline focus is pre-departure

What's Next?

SESAR R&D NM TBO in execution to address in-flight flight-plan update building on the ongoing eFPL deployment

In parallel, work needs to continue on:

- ATC TBO separation and traffic sync
- Focus on CPDLC
- NM – ATC and ATC - ATC exchanges

PJ18

A/G information exchange

- Direct connection flight-deck to ATM
- **Downlink of FMS predicted trajectory - Extended Projected Profile (EPP)**
 - This is not necessarily what the aircraft is cleared to, but the optimised trajectory with the constraints known to the FMS at the time of the downlink
 - Invaluable information for ATC and NM
 - High level of automation (flight crew not involved, contract-based, etc.)
- **Clearance uplink (via CPDLC) from ATC to flight-deck, and auto-load in the FMS – including complex clearances**



What TBO is NOT...

The “Intervention by exception” misunderstanding:

- TBO is NOT a 4D contract between ANSP and AU
Note that concept for use of multiple time constraints along the route was removed from ATM MP
- Flights DO NOT need to adhere to this contract by going from time constraint to time constraint every few miles
- ATC intervention WILL NOT BE the exception

In fact, TBO will not eliminate the need for routine ATC intervention.

- Separation provision/conflict management
- Traffic synchronisation

SESAR ATC TBO R&D aim is NOT to eliminate/reduce the need for ATC intervention, but to **INCREASE THE EFFICIENCY OF ATC** thanks to ↑ automation support

Why not?

- **To ensure separation and traffic sync. without ATC, large separation buffers would need to be added → huge reduction of capacity**
- Time constraints/time adherence has limitations:
If used for separation ↑↑ fuel burn/CO2 emissions
It can support traffic sync., but needs to be complemented by other sequencing techniques

Take off time uncertainty +/- XX (assuming perfect adherence to the second after take-off)	YY margin to be added	New minima (5NM + 2*YY) (assuming 420-480KT)
[-5 min, + 10 min] current off-block tolerance for regulated flights in Europe	105- 120 NM	215 – 245 NM
+/- 30 seconds	7-8 NM	19 - 21 NM
+/- 10 seconds	2.3 – 2.7 NM ≈ 3 NM	11NM

Illustration of separation buffers required to avoid the need for in-flight separation provision

THANK YOU FOR
YOUR ATTENTION

