Supporting European Aviation

EUROCONTROL

Performance Improvements in TMA and En-Route

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FOUNDING MEMBER SESAR JOINT UNDERTAKING

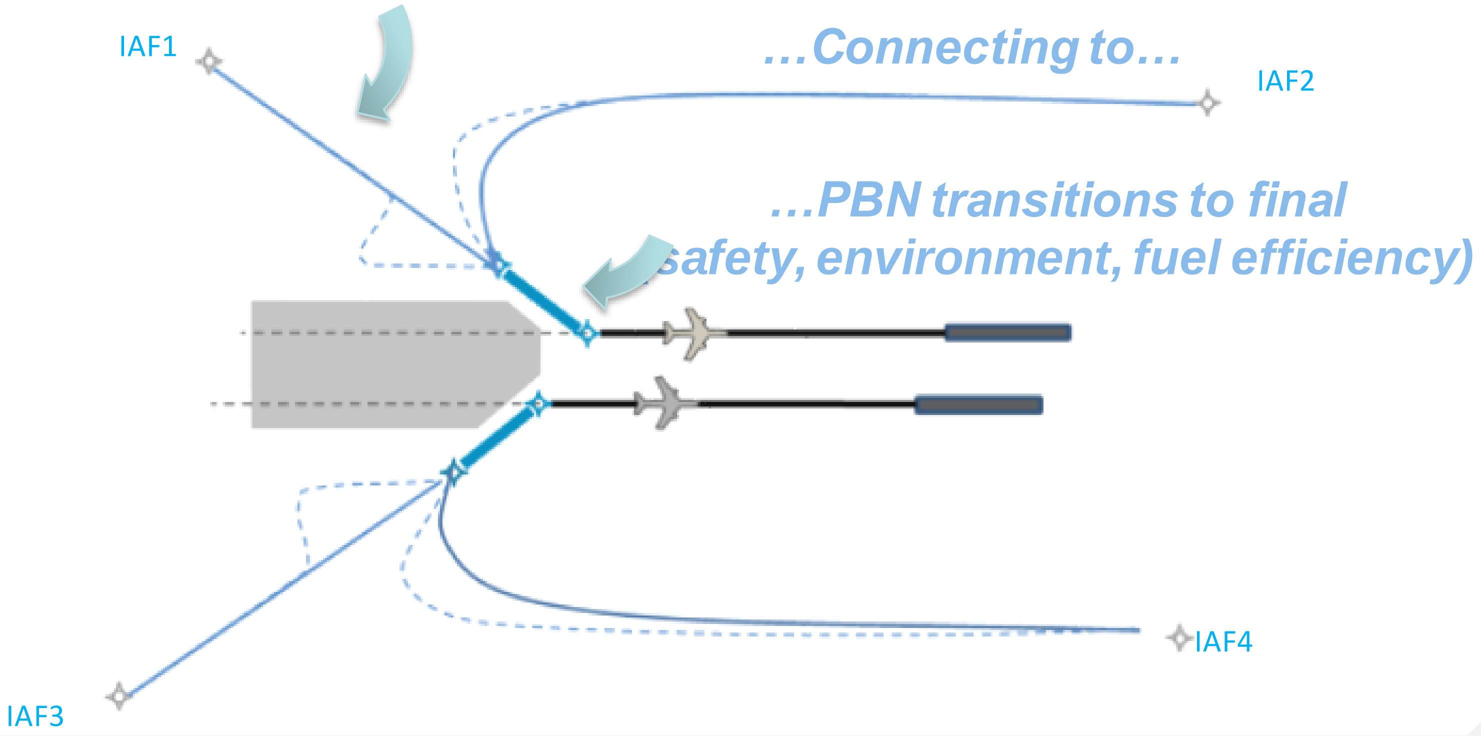
NETWORK MANAGER

Improved Parallel Operations

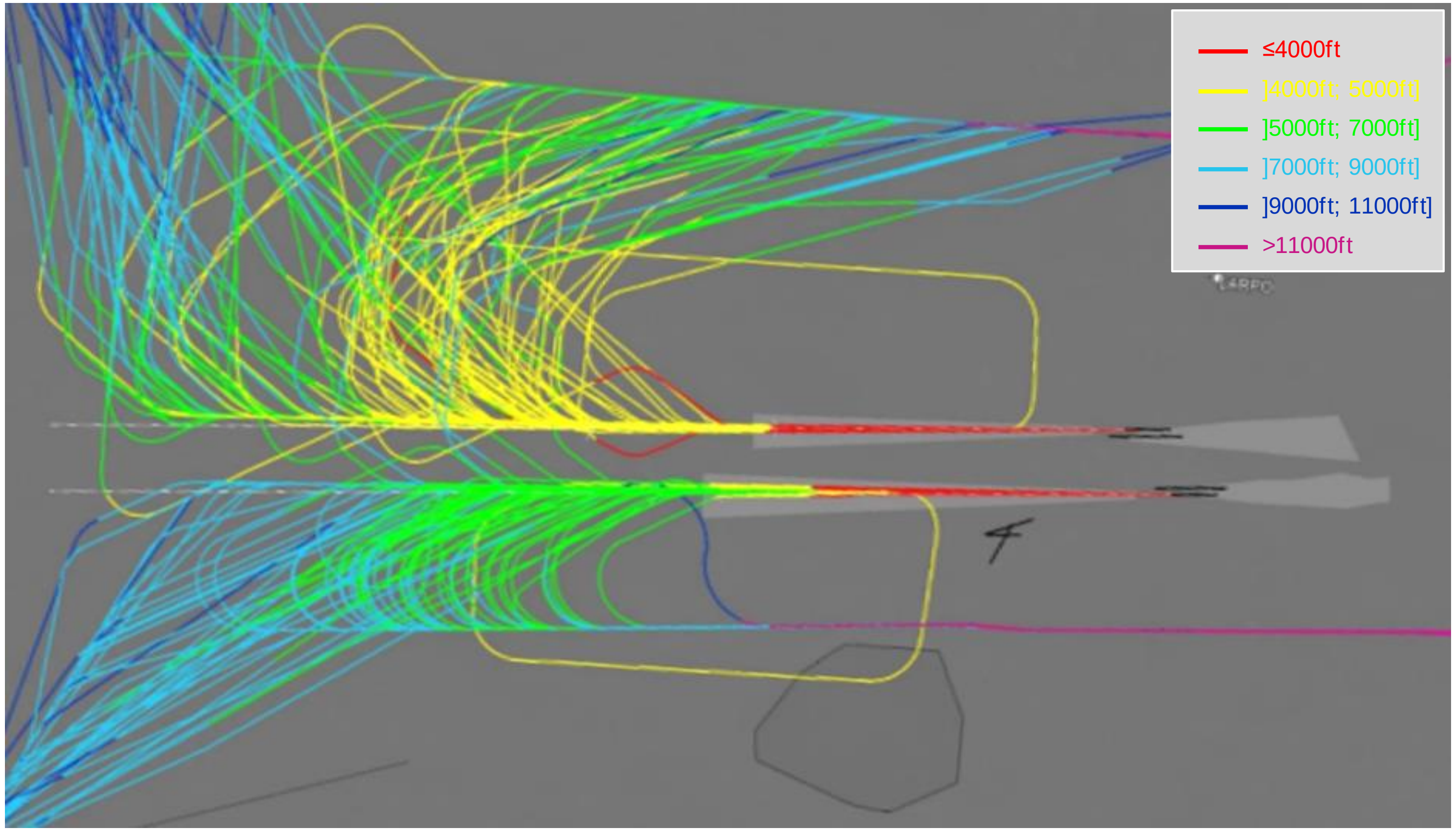
Motivations & Principles

- Reinforce safety at/around intercept
- Increase the arrival capacity to cope with higher peaks
- Reduce environmental impact, improve fuel efficiency
- Ensure adherence to PBN procedure even during traffic peaks

PBN routes with embedded
path stretching/shortening (TMA Capacity)…



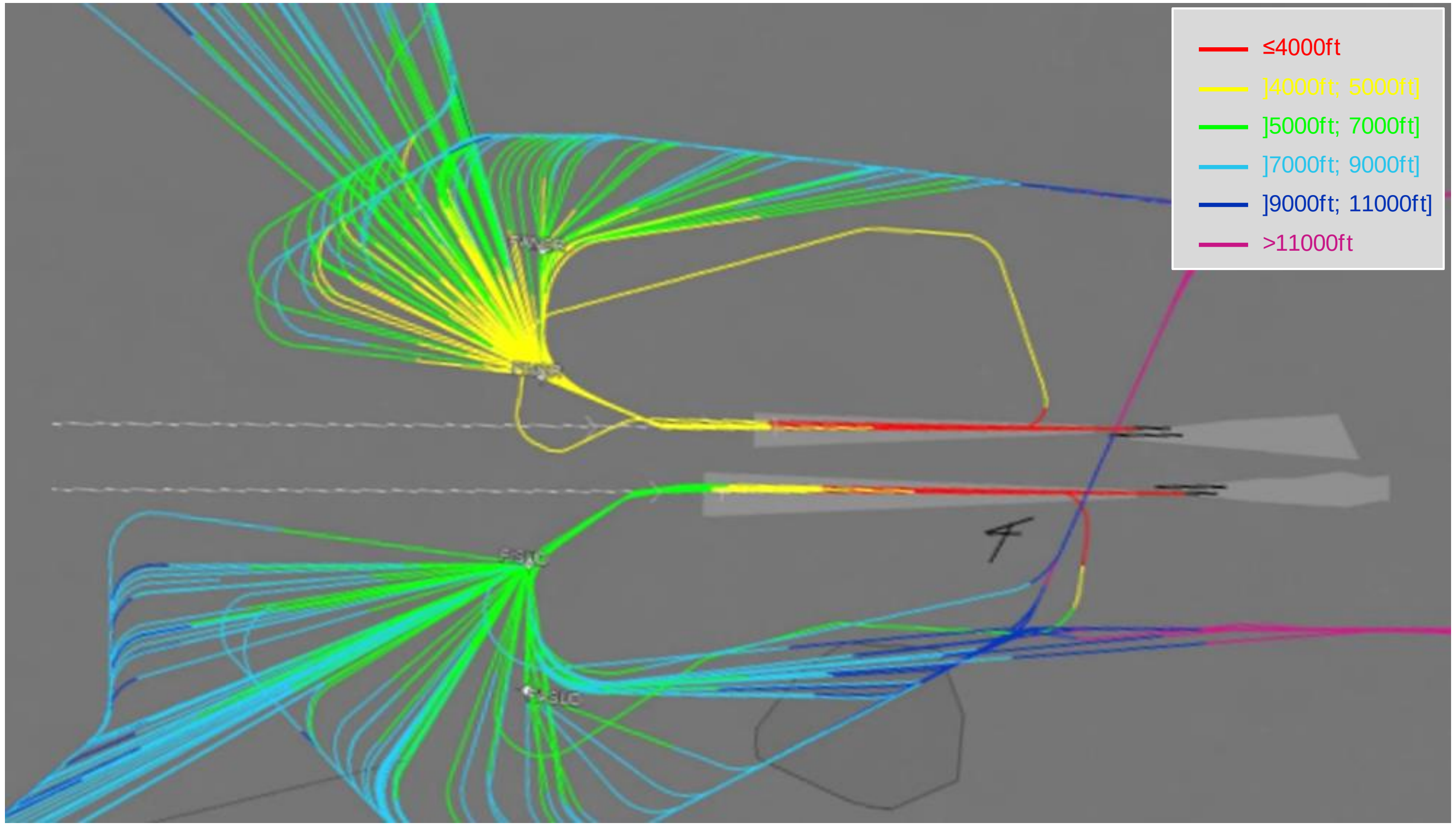
Tracks: Baseline (peak)



- Trajectory dispersion & low altitudes

Tracks: Future (peak)

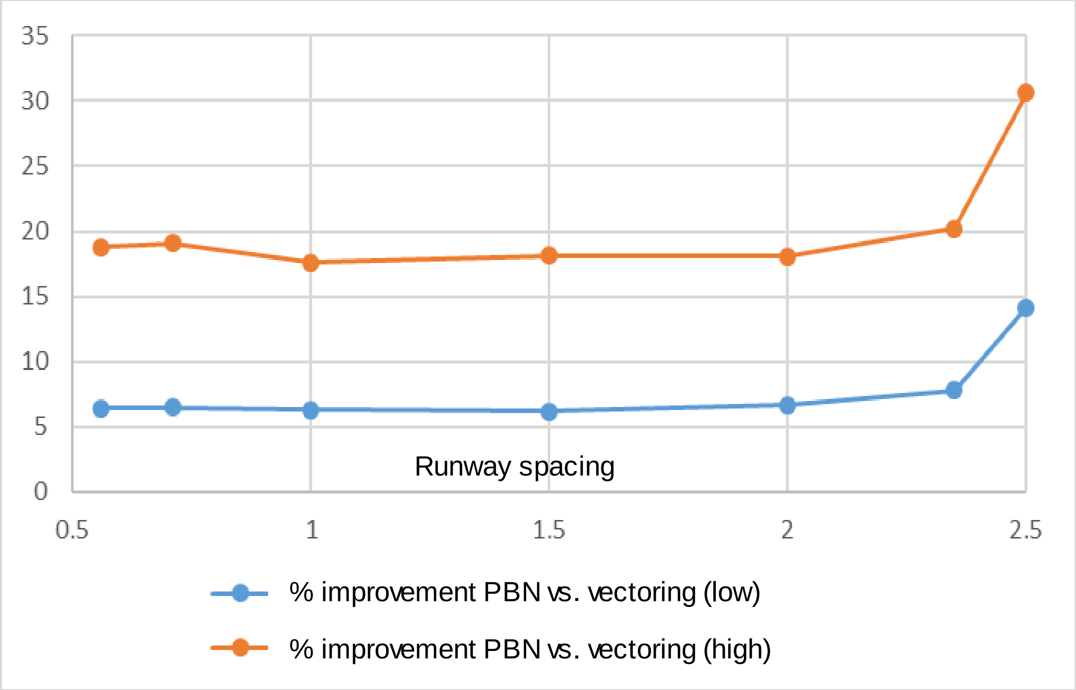
- Iterative series of ground RTS (50+ runs), pilot workshops



- Full adherence to PBN procedure, remain on lateral navigation
- Trajectory containment & higher profiles/altitudes

Safety benefits: sensitivity analysis

- Mathematical modelling (presented at ATM seminar 2019)
- Monte Carlo approach with millions of runs to capture rare events
- Confirmed potential for significant safety benefits: risk of loss of separation down 20% (peak) and 8% (off-peak) compared to vectoring
- High sensitivity to design/geometry of final part



Study outcome

- **Operability**: feasible and usable in a typical dense and complex environment
- **Systematisation**: limited radar vectoring and systematic use of direct-to instructions

leading to :

- **Safety**: effective segregation of arrival flows with regular traffic patterns
- **Environment**: slightly higher vertical profiles and limited dispersion at low altitude

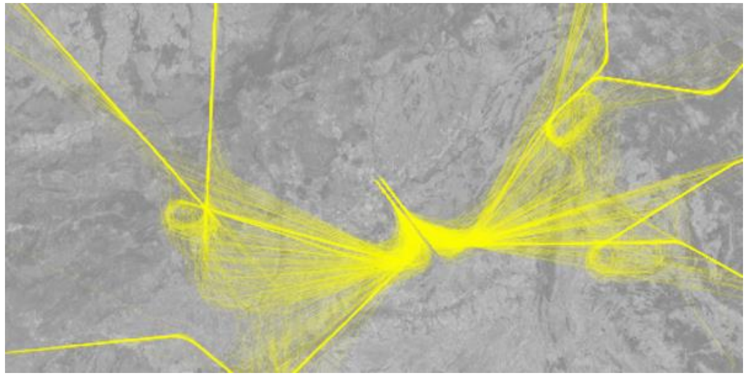
TMA Performance Metrics

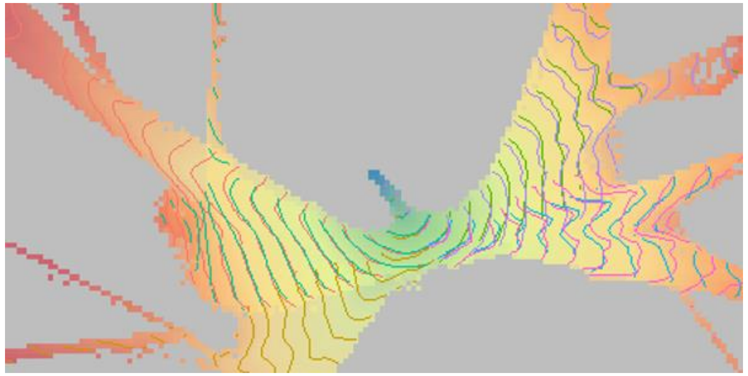
Arrival operations: new method to assess potential for short term improvements

- Objectives
  - Characterise arrival operations, focus on the terminal area
  - Identify best practices and possible inefficiencies
  - Assess the potential for short term improvements

- New method
  - Reference trajectories relying on best practices of each airport
  - New metrics at different time horizons informing on the dynamic of the operations

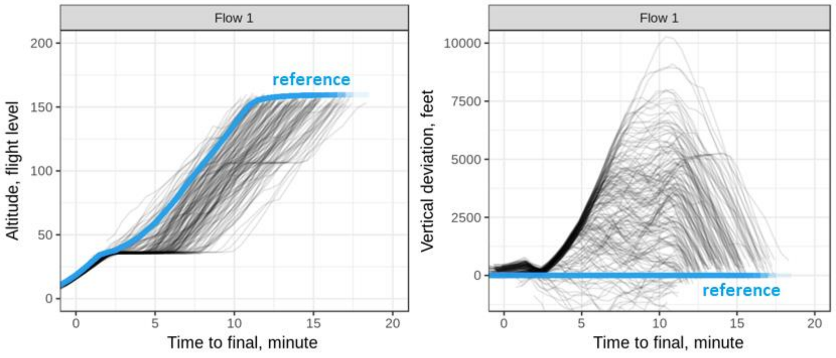
- Perspectives
  - Trajectory deviation (longitudinal, lateral, vertical)
  - Metering and sequencing (sequence pressure and spacing deviation)
  - Separation (proximity and dynamicity)





Example: vertical efficiency in descent

- Assessment of vertical efficiency in descent using best profiles of each airport (flow, runway, ..) as reference

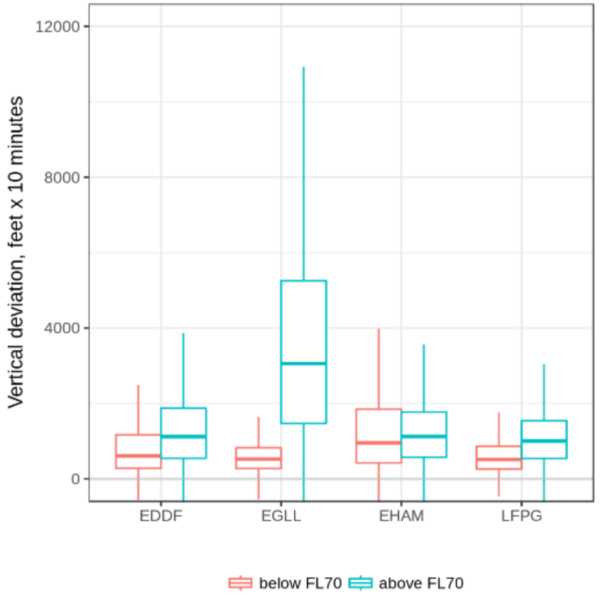


- Case study: top 4, 50NM around airport, 6 months from 2018, +200k flights

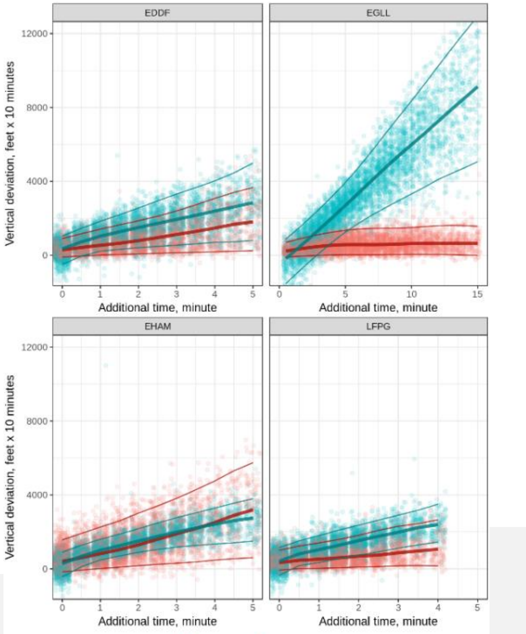
- Next: identify causes of deviations and possible ways to reinforce adherence to best profiles

- *Profiles generally **2300ft below** best profiles (median vertical deviation)*
- *Some profiles **4300ft below** best profiles for a same additional time (95th percentile)*
- *Differences among airports (low dispersion for EGLL below FL70, high for EHAM)*

Vertical deviation above/below FL70



Vertical deviation and additional time



Leveraging Datalink in EnRoute

ATS Unit – SESAR studies

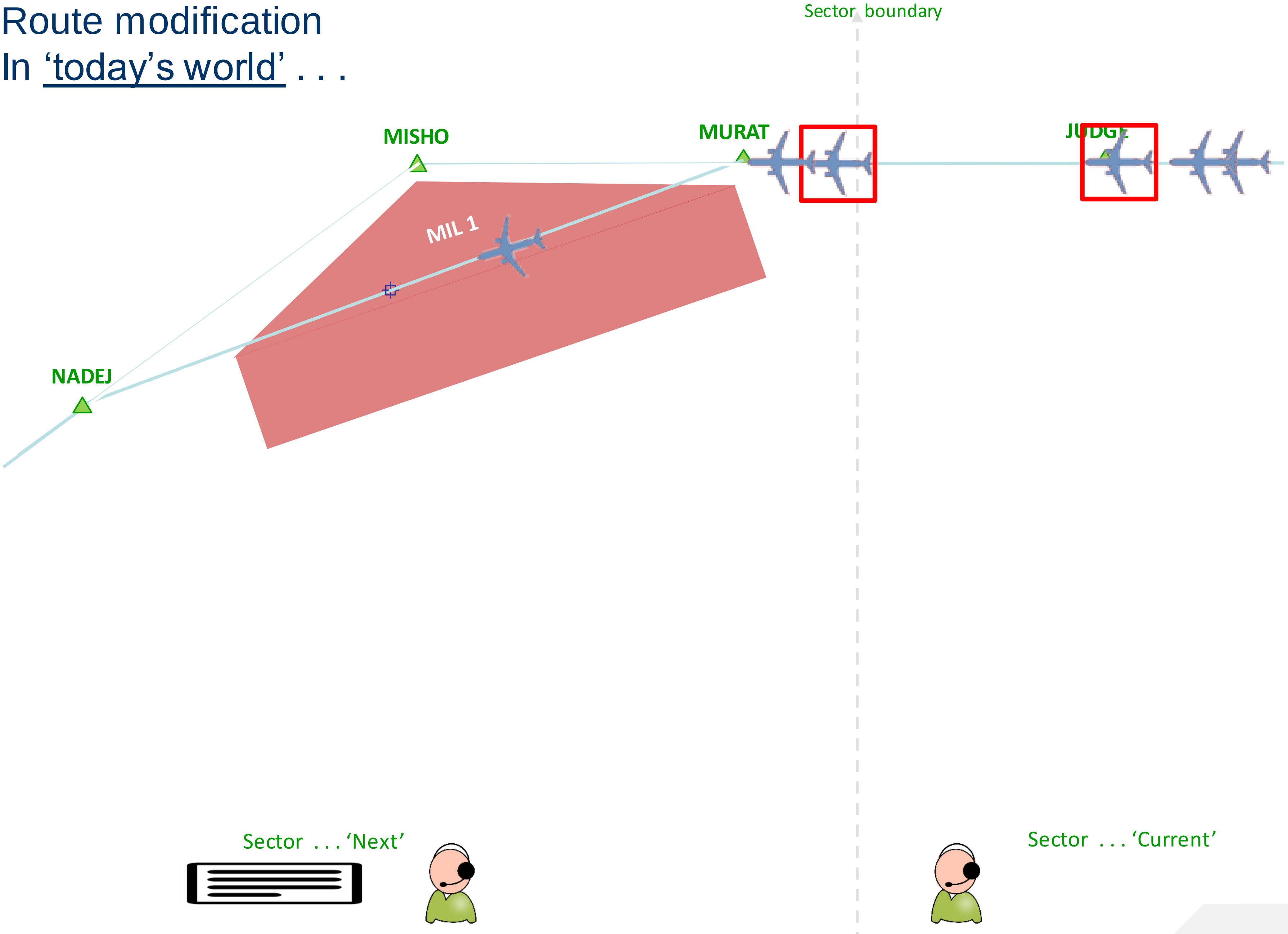
- Researching Trajectory Management using Datalink: triggered by some specific outcomes
  - EU mandates on datalink: significant increase of connections
  - Significant validation gaps on the usage of CPDLC

- Key concept
  - Provide planning information well in advance to the aircraft (flying in other upstream sector/ centre), with clearance to execute

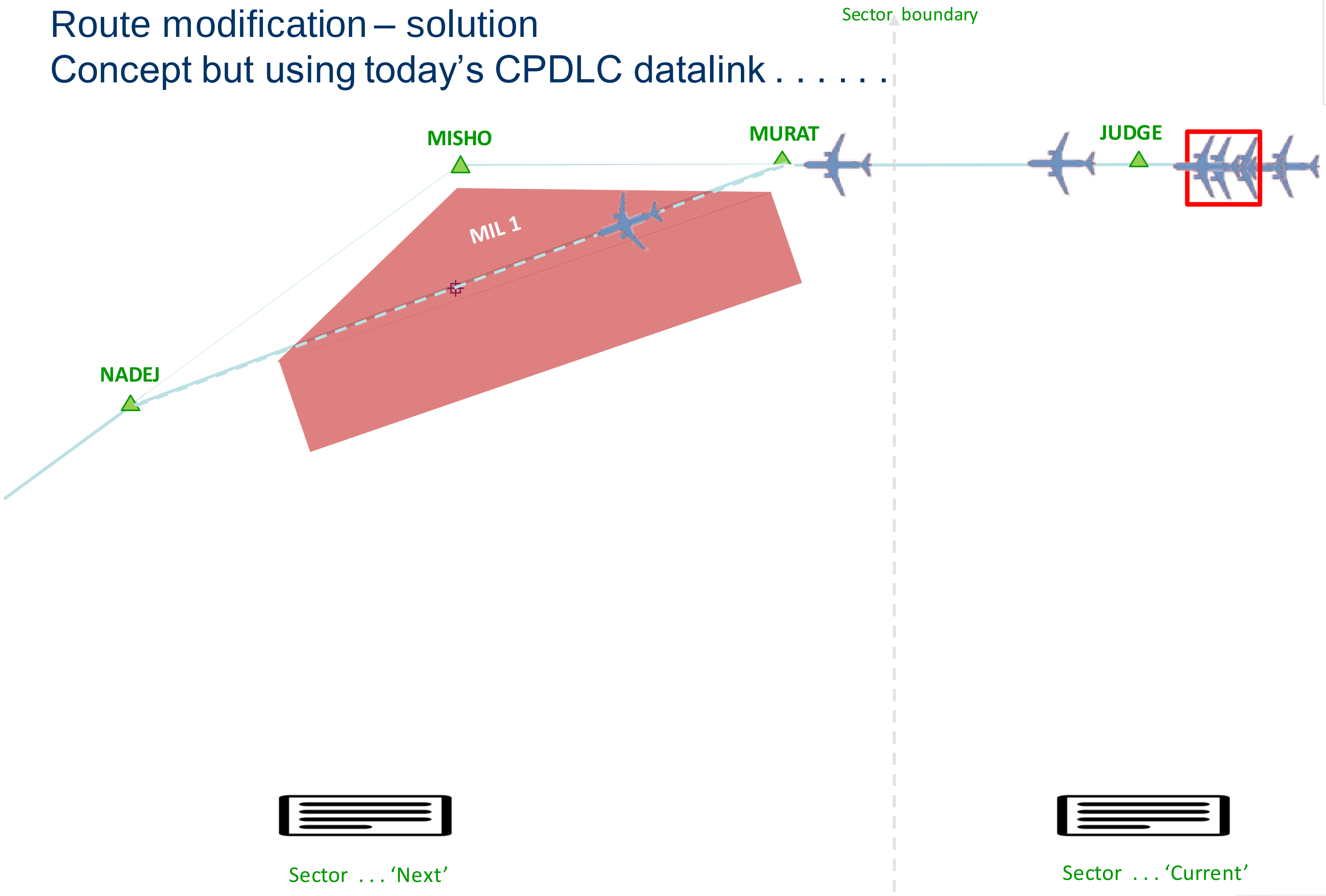
  - By anticipating changes, the new procedures will allow to move from tactical to planning horizon:
    - Act earlier – more efficient approach with a better adherence between air / ground predictions
    - Increased predictability - more certainty in flight deck situational awareness
      - changes in 2D route remaining in a close loop situation via CPDLC instructions
      - more useful trajectory data from the aircraft
    - Shared & synchronised air / ground views
      - Detect & correct discrepancies

- Is not a today datalink evaluation
  - Not a re-run or re-assessment of CPDLC Benefits / Use Case . . .
  - Not a replacement of a voice based procedure with a CPDLC one

Route modification
In ‘today’s world’ . . .



Route modification – solution
Concept but using today's CPDLC datalink . . . . . .



“Route modification … ” Concept but using today’s CPDLC datalink

Intention is to give the aircraft trajectory change in advance, and by CPDLC, in order to:

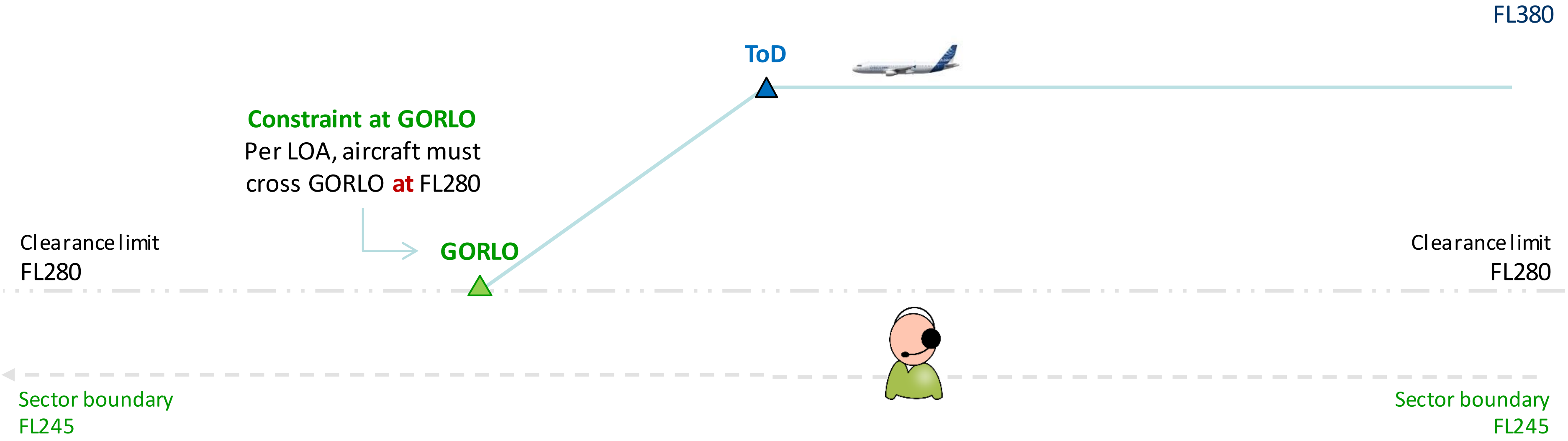
- Enables aircrew to plan – effectively and in good time - their onward profile
    - Using FMS to built accurate trajectory and execute it
    - Fly their ‘expected profile’

- Enables route messages (beyond DCT) to be delivered / suitably assessed by aircrew
    - Possibility to read/re-read

Benefits :

- Getting the ‘right’ information only in advance (STAR, RWY): increased predictability and certainty
- Supports pilots better arrange their flights - with potential fuel/time savings and environmental efficiencies

“When ready, descend . . . .”
In ‘today’s world’ . . .



Current Operating Method

- Limited use
- Normally given by voice (EXE only)
- Normally given not far from anticipated TOD, but TOD is not known
- Normally without reliance on system support conflict detection, limited check

“When ready, descend . . . .”
Concept validation

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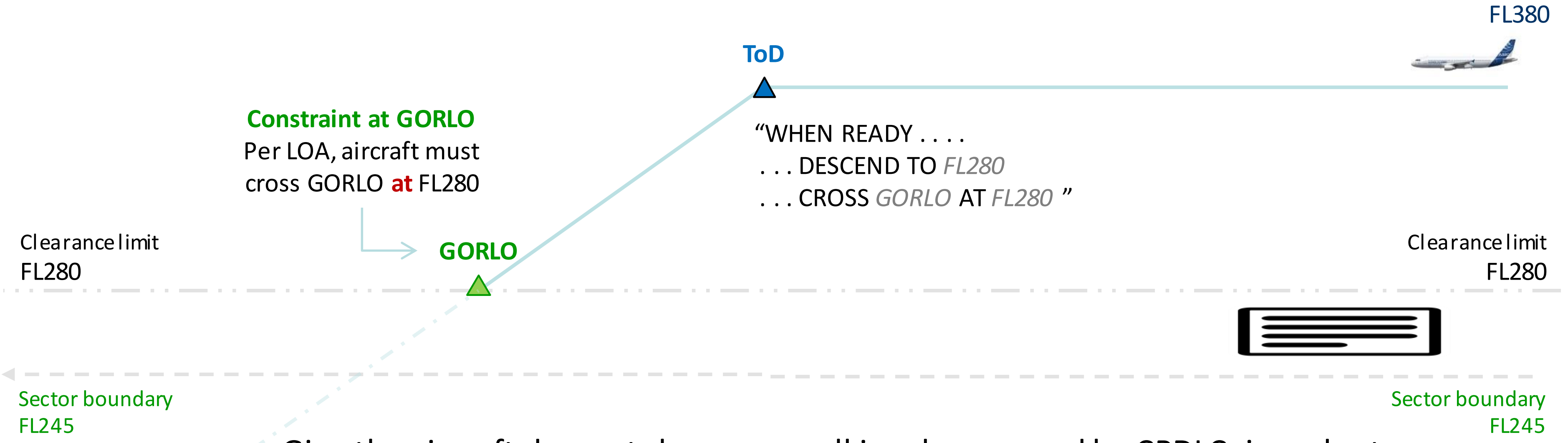


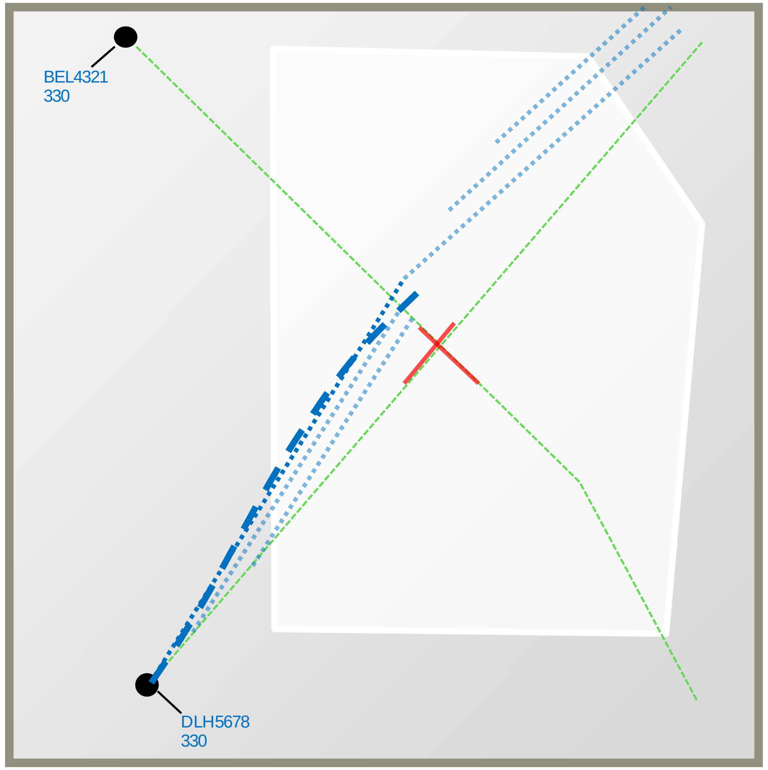
Give the aircraft descent clearance well in advance, and by CPDLC, in order to:-

Potentially Benefit Airspace User

- Enables aircrew to plan – effectively and in good time - their descent profile
  - Using FMS to built trajectory per C.I. (with constraint information, if necessary)
- Enables aircrew to effectively plan/execute their descent briefing, related cockpit ops
  - As per their company / cockpit SOPs
  - Fly their ‘expected profile’ from ToD (at least to the exit of that ATC sector/unit)

- This type of concept could also be an enabler for other concepts, such as CDO
- Ability to descend without the need for the R / T to be unoccupied at the appropriate time

Early conflict resolution: typical (current) scenario

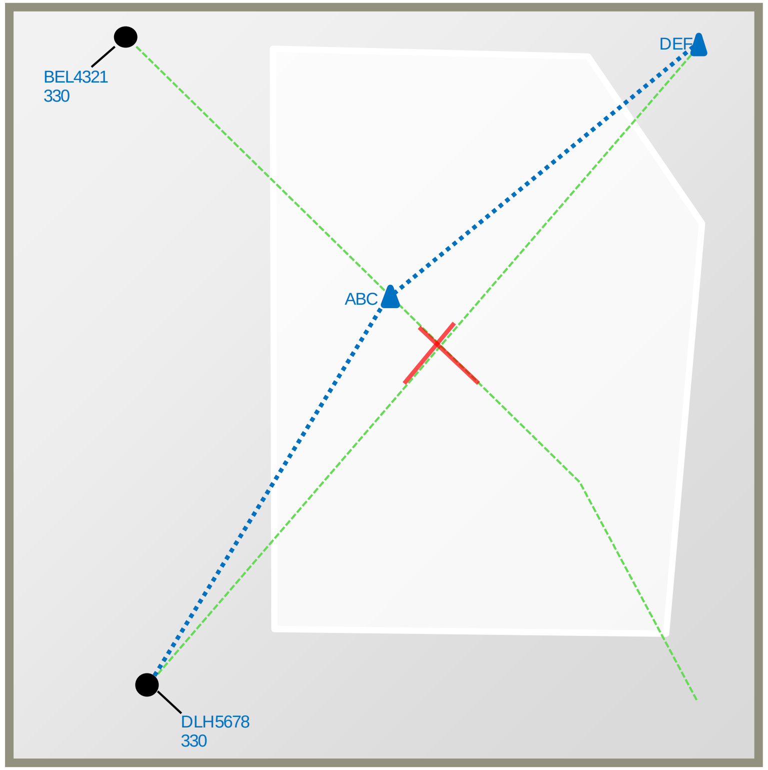


<u>Situation</u>
Conflict detected in sector between two inbounds.

<u>Action</u>
Planner asks previous sector to put one of the aircraft on a heading to solve conflict.

<u>Issues</u>
1. The actual separation achieved is dependent on when the manoeuvre is effected;
2. The actual path of the aircraft is subject to wind drift (if the wind changes) whilst on an assigned heading;
3. A further instruction is needed for the aircraft to resume its planned route;
4. Until this second instruction is given, the further route is unknown to the aircrew and the downstream controllers.

Early conflict resolution:
Conflict Resolution Using Closed Clearance



Action
Planner asks previous sector to clear the aircraft to point “DEF” via point “ABC” via

Impacts
1. The separation achieved is much less dependent on when the manoeuvre is effected;
3. As the clearance constitutes a “closed loop”, no further clearance is required;
4. Both the aircrew and downstream sectors are aware of the complete route.

Benefits
Reduced controller workload
-> Increased ATC Capacity
-> Fewer delays

Questions ?