Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution (for which maturity has been assessed as sufficient to support a decision for industrialization) with a summary of the results stemming from R&D activities contributing to deliver it. It provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization/deployment.

Improvements in Air Traffic Management (ATM)

Some elements of AOP/NOP information are important to consider in AU flight planning in order to better align AU and NM trajectories, improve AU fuel prediction and support target times management.

These elements are:

- The departure taxi time
- The planned departure runways
- The planned SID.

With the implementation of airport CDM procedures, NM receives from most of the major airports up-to-date and reliable information in DPI messages and updates much more dynamically than the FOC this information in its planned trajectory thanks to live information received from airports.

Therefore, this solution defines new information flows for AUs to consider same information as NM related to the departure phase of the flight.

The following table details the potential use of the information in AU flight planning.

AOP/NOP Information from A-CDM airports	Potential use in AU flight planning
Planned Departure Runway	The AU should consider the planned departure runway information coming from A-CDM airports as soon as the first DPI message is sent to NM (EOBT -3H).
Planned SID	The planned SID in the NOP from A-CDM airports is not considering accurately aircraft performance. Therefore, the AU should include his own preferred SID in the flight plan compliant with the planned runway in the NOP.

Planned Departure Taxi Time	AU should consider the planned departure taxi time information in the NOP coming from A-CDM airports when the T-DPI message is sent to NM (EOBT -2H).

Operational Improvement Steps (OIs) & Enablers

AUO-0229: Harmonised and improved integration of AOP/NOP departure information in trajectories calculated by FOCs and NM

Alignment of the AU, NMF and airport views of 4D trajectories in planning phase and increase predictability by exchanging dynamic AOP/NOP departure information – in particular runway configurations in use, departure taxi times, planned runways and SIDs - allow the FOC to plan and share a more accurate and up-to-date 4D trajectory.

Applicable Integrated Roadmap Dataset is DS20.

A prerequisite for this solution is the solution #37 and associated OI (AUO-0203).

The following enablers apply when their scope is for SID and departure RunwayConfigurationPlan information from the CDM airports:

EN code	EN description
AOC-ATM-23	SID/STAR and RunwayConfigurationPlan information integration in the FOC trajectory
NIMS-54	SID, STAR, TT, and Runway Configuration data applied in Initial Flight Plan Processing
SVC-003	Enhance the existing NMFlightData service to publish and subscribe SID/STAR data
SWIM-APS-17	AOC Consume NMFlightData service FlightListByAO interface via P/S

Background and validation process

The validation includes different activities:

- A post-ops analysis of differences between planned SIDs in AU and NM trajectories using EFPL data collected during SESAR 1 to validate solution #37. This objective was to better quantify the problem and the needs.
- A post-analysis of SID/runway/Taxi time updates received from A-CDM airports in DPI messages in order to refine operational scenarios and use-cases.

- Human-in-the loop sessions in shadow-mode involving dispatchers form various airlines. These sessions were supported by a CFSP, Lufthansa System. These sessions fulfilled various objectives:
  - Assess the technical feasibility for an AU flight planning system to retrieve A-CDM information from the NOP and use it to improve flight planning
  - Assess and operational feasibility and acceptance and refine operational use-cases.
  - Validate qualitatively some elements of the benefits mechanisms.

Results and performance achievements

The following table summarises conclusions.

OI AUO-0229 Harmonised and improved integration of AOP/NOP departure information in trajectories calculated by FOCs and NM	**V3 achieved for the OI** **TRL 6 achieved** for the following enablers provided that their scope is limited to departure information from CDM airports: • AOC-ATM-23 • NIMS-54 • SVC-003 • SWIM-APS-17	Technical feasibility to integrate dynamic SID/runway information in AU flight planning demonstrated. Use cases and information flows related to the use of departure SID and taxitime for CDM airports clarified (Including timeliness of information). Benefit mechanisms related to SID/ Runway / Taxitime info use in FPL agreed by end users (dispatchers).

The qualitative results recorded from questionnaires and extensive feedback are positive or very positive regarding the use of departure information as provided by AOP/NOP to elaborate the final flight plan easier and more accurately than in current operations and to increase awareness. No quantitative performance assessment was performed but the stakeholders- mainly AUs – validated qualitatively the benefits mechanisms.

The following elements were clarified during human-in-loop exercise:

- Updates of FPL should occur only at specific milestones rather than event based when receiving AOP/NOP information. The final milestone should be somewhere close to 1H before off-block defined by each AU based on their characteristics of their operations;
- AUs should not necessary plan in the FPL the same SID as the planned SID information received from airports but they should at least plan a SID consistent with the planned departure runway or the runway configuration in use in AOP/NOP;

- Depending on AU and the FOC organisation and system, FPL updates could be either fully automated in case of runway/SID changes, either partially automated with only a dispatch monitoring activity of changes;
- In most of the cases, the taxi time info will not trigger an update of the flight plan. However, it would be useful to have it available in the AU system in case of FPL update for other purpose.

The integration of the dynamic SID/runway/taxitime information on the eFPL with their consequent updates to NM demonstrated an improvement of the NM predictability from predicted to the last planned/before airborne (updated by an A-CDM message), reducing in particular the difference in overall profile EET calculated respectively by the AU and NM.

Note: regarding AOP/NOP information, the OI - and supporting enablers – was initially covering both departure and arrival flight phases information. Since planned STAR information reliability and positive contribution to predictability was not demonstrated, arrival AOP/NOP information has been removed from the scope of this contextual note (and from the scope of related OI and enablers).

Recommendations and Additional activities

The provision of AOP/A-CDM SID, runway and taxitime information to AU and its use to update the AU trajectories is potentially ready for next phase industrialisation. Taxi time may require a filter to only allow changes bigger than an agreed threshold.

Some additional activities/developments have been identified:

- Study the impact of this solution on current rules used in ETFMS related to the prioritisation of information to be used in trajectory prediction. For example, currently ETFMS considers the planned SID and taxi time information from A-CDM airports as more reliable than the SID/taxi time in the eFPL from the AU. This rule should be reviewed for AUs deploying this solution and considering AOP information in their flight planning.
- The sharing with AU of arrival information - STAR and arrival runway - is also important but the wave 1 validation was not conclusive. This topic needs further validation to achieved V3 maturity status.

Actors impacted by the SESAR Solution

Network Manager, Airports, Civil Airspace Users Operations (Flight Dispatcher)

Impact on Aircraft System

N/A

Impact on Ground Systems

The following capability configurations are required for the SESAR Solution:

CC	Capability	Node	Stakeholder
Civil AU Operations Centre	Air Traffic Demand Provision (Airspace); Collaborative Trajectory Planning; SWIM-based Information Dissemination;	Airspace User Ops Support; Flight Deck;	Civil Flight Operations Centre;
Regional ATFCM	Collaborative Trajectory Planning; SWIM-based Information Dissemination;	Air Traffic Flow and Capacity Management; Network Operations;	Network Manager;

The impacted capability configuration with its impacted system, per enabler, is as follows:

Enabler Identifier	Enabler Definition	Impacted Capability Configuration	Impacted System
SVC-003	Enhance the existing NMFlightData service to publish and subscribe SID/STAR data	Regional ATFCM	ATFCM
SWIM-APS-17	AOC Consume NMFlightData service FlightListByAO interface via P/S	Regional ATFCM	ATFCM
AOC-ATM-23	SID/STAR and RunwayConfigurationPlan information integration in the FOC trajectory	Civil AU Operations Centre	FOC
NIMS-54	SID, STAR, TT, and Runway Configuration data applied in Initial Flight Plan Processing	Regional ATFCM	ATFCM

Regulatory Framework Considerations

N/A

Standardization Framework Considerations

N/A

Considerations of Regulatory Oversight and Certification Activities

N/A

Solution Data pack

The solution data pack includes documents from two PJs.
Documents from P18.02c are:

- SESAR Solution 18.02c – SESAR 2020 D3.4.080 Final TS IRS - 18-02c, Edition 00.01.01. This document provides the technical architecture, service definitions, functional and non-functional requirements for the solution.
- SESAR Solution 18.02c – SESAR Technological Solution 18.02c: Technical Validation Report (TVALR), Edition 00.01.06. This document provides the validation exercise definitions, executions and results in terms of validation objectives.
- The SESAR solution 18.02c INTEROP as annex of the TS document,

Documents from P09.03 are:

- SESAR Project 09 – CBA V2 – v00.00.02, September 2019
- SESAR Project 09 – OSED V2 – Part I – OSED – v00.02.01, June 2019
- SESAR Project 09 – OSED V2 – Part II – SAR – v00.01.00, September 2019
- SESAR Project 09 – OSED V2 – Part IV – HPAR – v00.01.02, July 2019
- SESAR Project 09 – OSED V2 – Part V – PAR – v00.01.00, August 2019
- SESAR Project 09 – TS IRS – v00.02.00, September 2019
- SESAR Project 09 – VALR V2 – Part I – v00.01.02, September 2019

Note that the documents listed above from PJ18.02c and PJ09 solutions have a much larger scope than this contextual note.

Intellectual Property Rights (foreground)

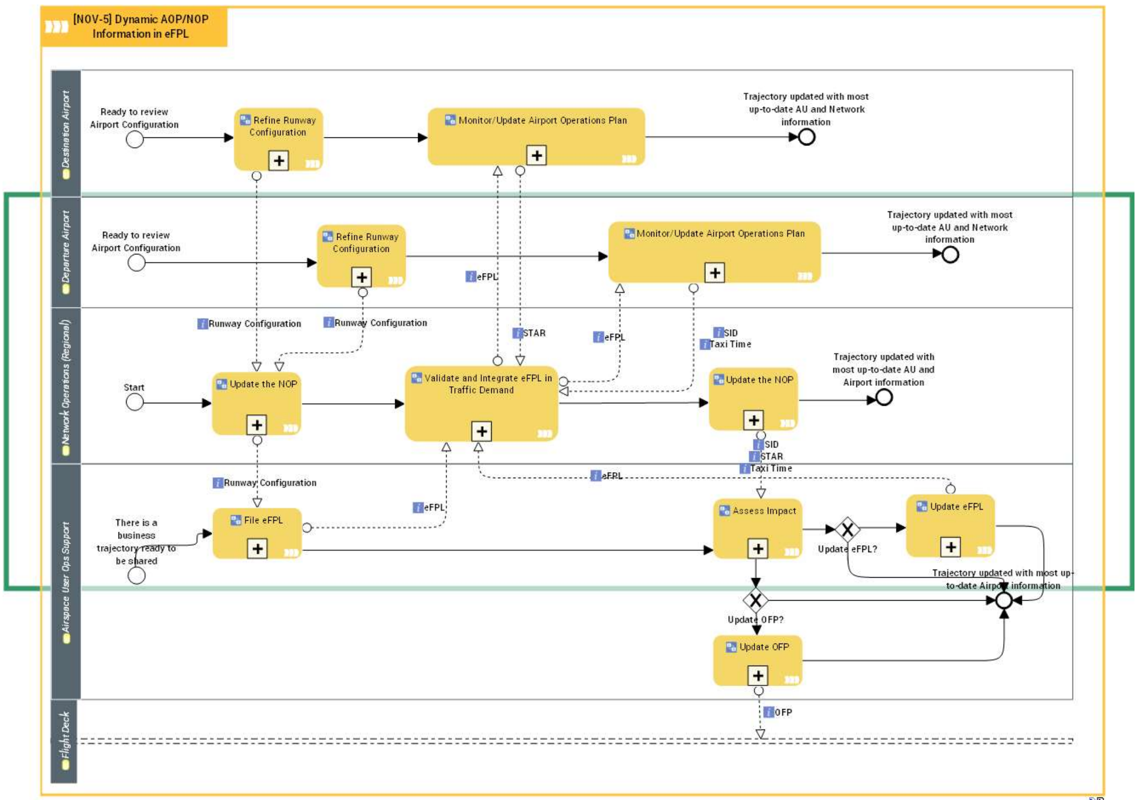
The foreground is owned by the SJU.

A.1 The Solution XX Description

The following are applicable for this solution from the '18.02c INTEROP' and 'SESAR 2020 D3.4.080 Final TS IRS - 18-02c, Edition 00.01.01' documents.

Use Case

The operational scope of this solution is highlighted in the green box in the diagram below.



Information Exchange Requirements

The IER applicable for this use case in the PJ.18-02c OSED (please refer to the OSED in the data pack) are:

IER-18-02c-OSED-eFPL.0004
Runway Configuration information to the AU

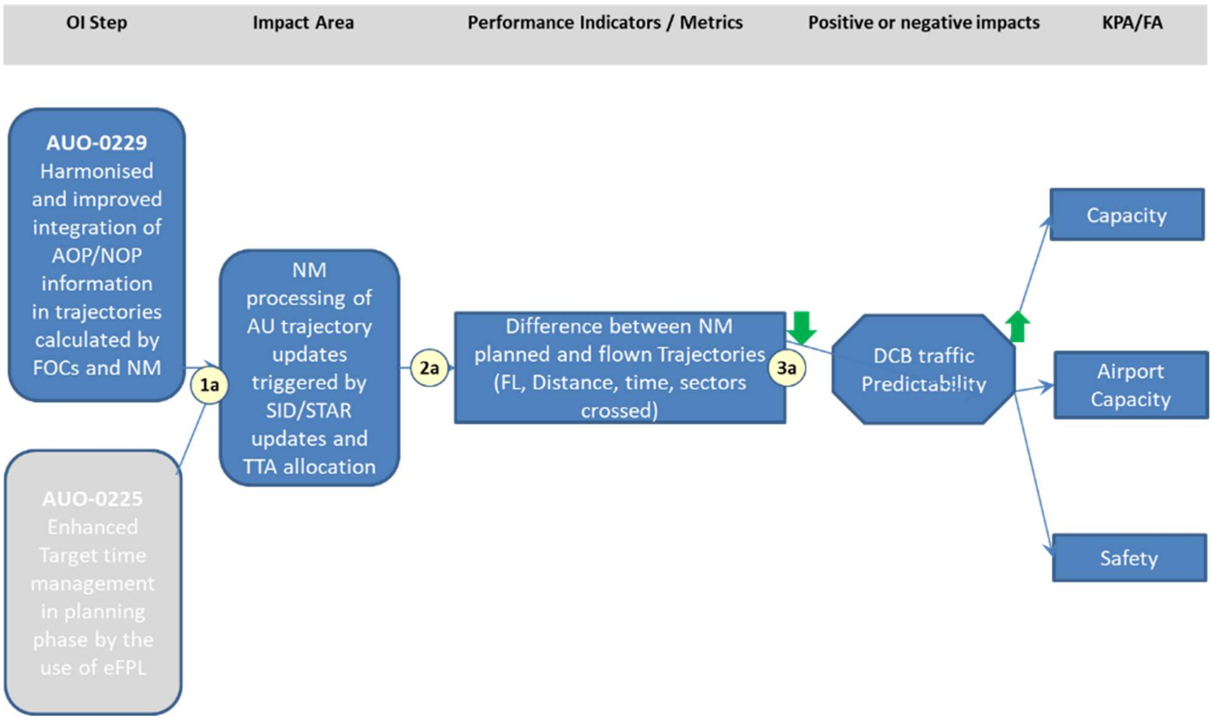
The following requirement shall be read as 'Departure information' rather than only 'SID'.

IER-18-02c-OSED-eFPL.0010
SID Information to the AU

Benefit Mechanisms

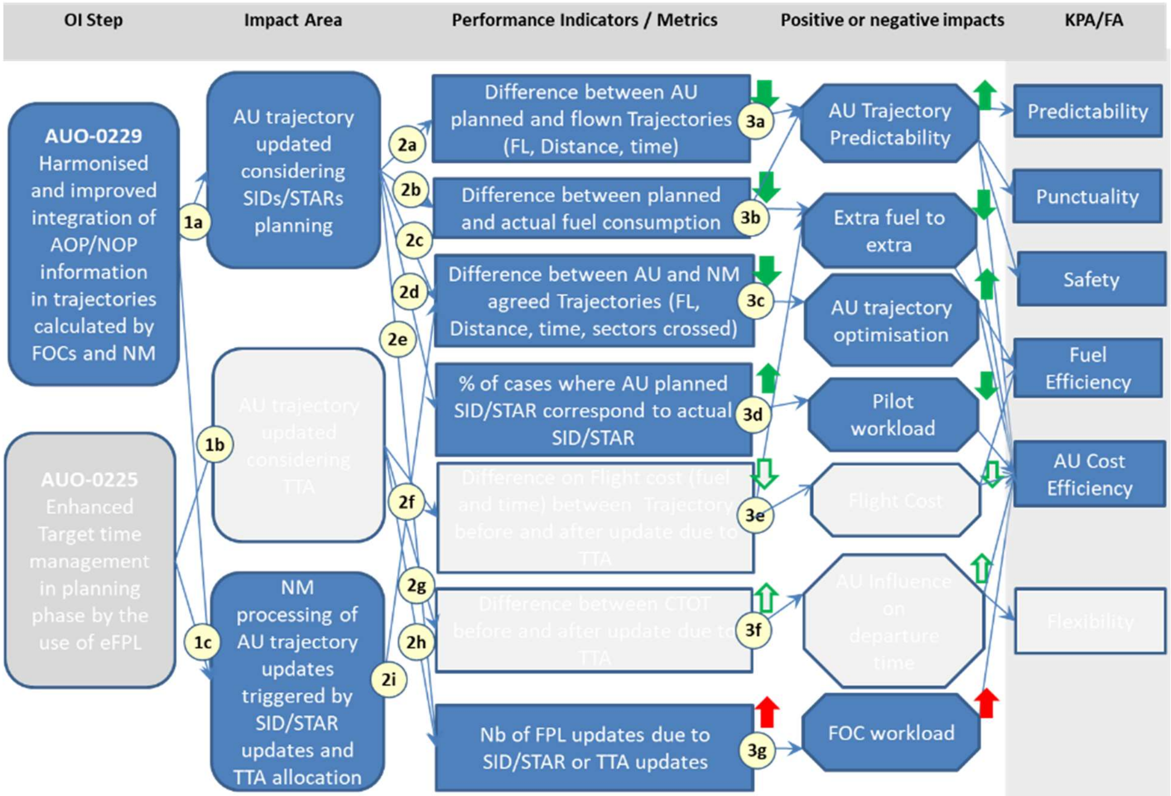
The following benefit mechanisms – included in the 07.01- OSED document- apply in the context of AUO-0229 OI **limited to** AOP/NOP **departure** information (elements related to STAR and Target times have be moved out of the scope of the solution based on validation results).

Stakeholder Group: ATC/Airport



SIDs/STARs & TTAs	Stakeholder group: ATC/Airports
AUO-0229: Harmonised and improved integration of AOP/NOP information in trajectories calculated by FOCs and NM **AUO-0225:** Enhanced Target time management by the use of eFPL	
(1a)	Taking into account the new eFPL information coming from AUs which integrates SIDs/STARs & TTA information, NM will recalculate the Trajectory accordingly.
(2a)	The processing by NM of AU updated trajectories triggered by SID/STAR will result in better TTA allocation. More accurate SID/STAR and TTA will permit the NM and the AU to reduce the difference between their trajectories.
(3a)	The reduction of difference between the NM planned and flown trajectories will result in an increased predictability implying a positive impact on safety and allowing a better use of the available airport capacity.

Stakeholder Group: AU



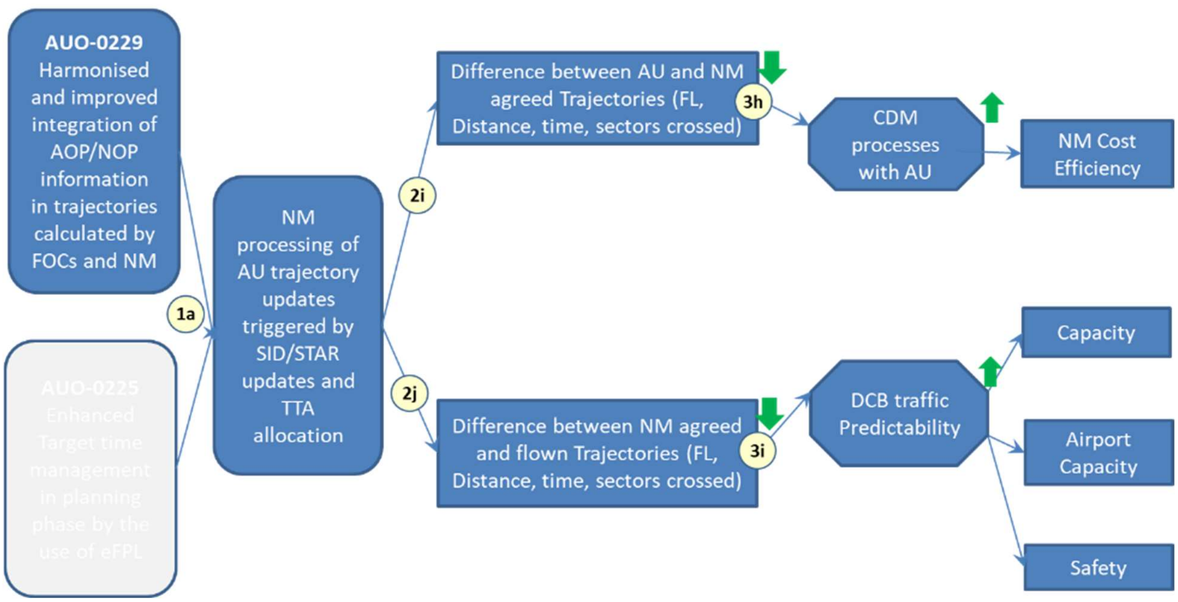
SIDs/STARs & TTAs	Stakeholder group: AUs
AUO-0229: Harmonised and improved integration of AOP/NOP information in trajectories calculated by FOCs and NM **AUO-0225:** Enhanced Target time management by the use of eFPL	
(1a)	Receiving SIDs/STARs planning information from Airports, AUs will update their trajectory taking into account more accurate information.
(1b)	By receiving Target Times, the AU will have the possibility to refile an eFPL by changing some parameters (e.g. adapting the speed …).
(1c)	Taking into account the new eFPL information coming from AUs which integrates SIDs/STARs & TTA information, NM will recalculate the Trajectory accordingly.
(2a)	The consideration of updated SID/STAR in the AU trajectory will permit to reduce the difference between the planned and the flown trajectory since the planned trajectory profile will be in line with the departure and arrival procedures clearances.
(2b)	By considering updated SID/STARs into the profile, the planned trajectory will be closer to the flown trajectory and consequently the actual fuel consumption will be closer to the planned fuel consumption.
(2c)	Consideration of SID/STARS planning by the AU will permit to improve the alignment of the agreed trajectories with NM since NM will also receive updated SID/STAR planning.

(2d)	If the AUs take into account the SID/STAR planning in its trajectory calculation, the percentage of SID/STAR applied to the actual flight will automatically increase.
(2e)	By including up to date planning information SID/STAR, the trajectories will be more accurate but the number of FPL changes will increase.
(2f)	Fight cost is not reduced, it could be increased. What is reduced is the disruption cost associated to a potential reduced delay with departure time adaptation or no holding at arrival thanks to TTA consideration.
(2g)	Considering TTA into the trajectory will permit the AU to adapt the departure time depending on its need instead of getting applied an imposed CTOT. There will be depending on the optimized trajectory a certain difference between the imposed CTOT and the influenced CTOT.
(2h)	By including up to date planning information TTA, the trajectories will be better reflecting the constraints but the number of FPL changes will increase.
(2i)	The processing by NM of AU updated trajectories triggered by SID/STAR and TTA allocation will permit the NM and the AU to reduce the difference between their trajectories .
(3a)	By reducing the difference between the AU planned and flown trajectories, the AU trajectory predictability is directly improved with a positive impact on the predictability, AU cost efficiency and safety. The improvement of the AU cost efficiency is positive because more accurate are the predictions, more efficiently AUs can control the operations and anticipate recovery of operational irregularities.
(3b)	When considering updated SID/STAR information the trajectories are less deviated, the planned fuel consumption is closer to the actual fuel consumption and in consequence, flight plans will be closer to the reality. Therefore, flight crews will reduce the extra fuel to carry associated to ATC uncertainties implying a positive impact on the fuel efficiency and on the AU cost efficiency.
(3c)	The improved alignment between AU and NM agreed trajectories will allow the AU to optimise trajectories implying a positive impact on AU cost efficiency.
(3d)	The percentage of SID/STARs that are applied to a flight increase by considering them in the trajectory calculation implying a reduced difference between the planned and the actual trajectory and resulting in a reduction of the pilot workload. This implies directly a positive safety impact.
(3e)	Flight cost not necessarily reduced except if we compare the CTOT+TTA application and the TTA alone application
(3f)	By considering the TTA, the AU will be able to recalculate its trajectory and deduce the most suited departure time to match the TTA with an optimized trajectory. This will permit the AU to influence the departure time by sharing the preferred target time of departure to the ATM stakeholder.

(3g)	Updating the flight plans with TTA input will imply a possible FOC workload increase depending on the level of automation given to the AU and the operational procedure associated to the flight plan update.

Stakeholder Group: NM

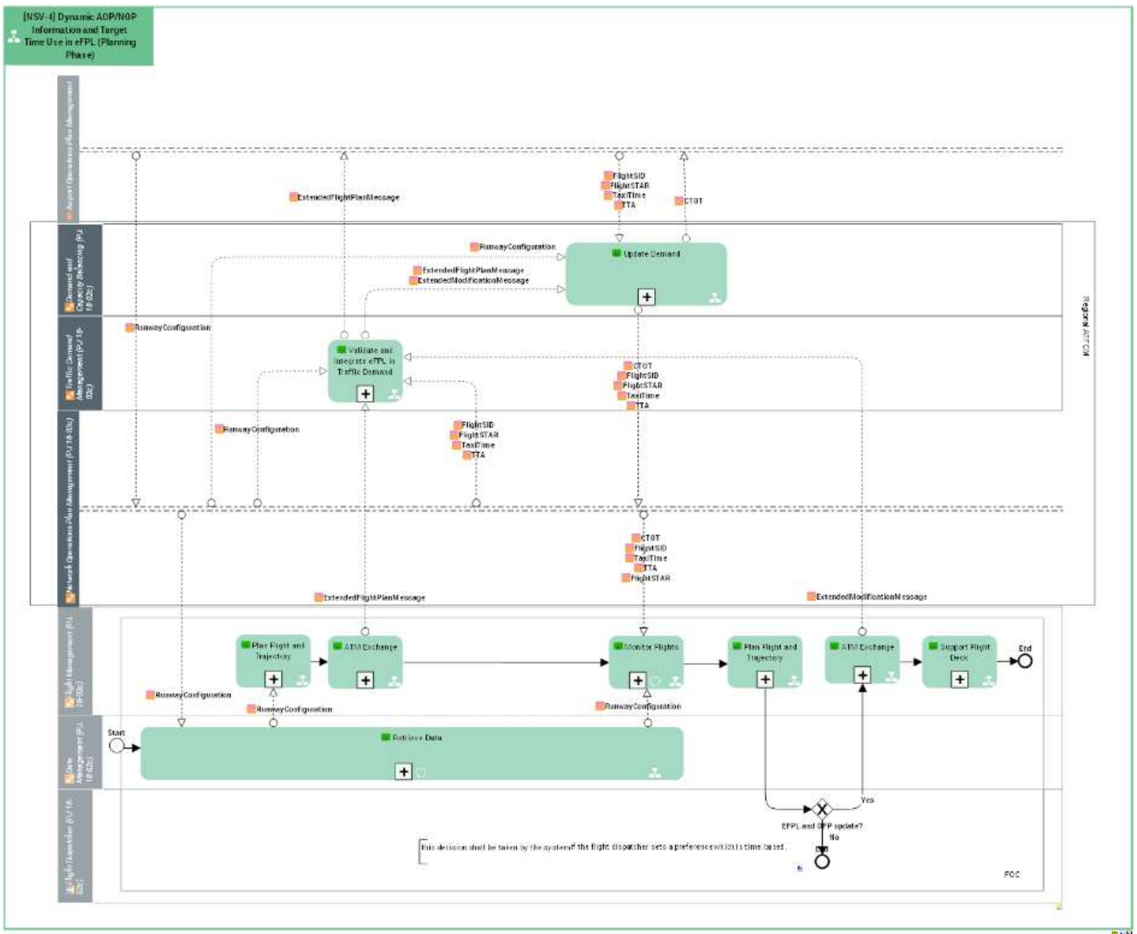
OI Step	Impact Area	Performance Indicators / Metrics	Positive or negative impacts	KPA/FA



SIDs/STARs & TTAs	**Stakeholder group: NM**
AUO-0229: Harmonised and improved integration of AOP/NOP information in trajectories calculated by FOCs and NM **AUO-0225:** Enhanced Target time management by the use of eFPL	
(1a)	NM will determine the plan trajectory taking as input the filed trajectory coming from AUs which integrates up-to-date SIDs/STARs & TTA information
(2i)	Since the AU already integrates up-to-date SID/STAR information in the filed trajectory the difference between the AU trajectory and the NM trajectory will be reduced
(2j)	Taking into account more accurate eFPL information from AUs will allow NM to improve their prediction and reduce the difference between NM planned trajectory and flown trajectory.
(3h)	Since that actors have a more consistent and shared view a the trajectory this will improve CDM processes both in flight plan flow management contexts
(3i)	Obvious

Functional Architecture

The following functional architecture applies with the exception of FlightSTAR data exchange.



Functional Requirements

The following requirements shall be applied with the exception of STAR data exchange.

REQ-18.02c-TS-DCB1.0001
NMFlightData Service for AU

REQ-18.02c-TS-FM01.0001
Apply the runway configuration

REQ-18.02c-TS-FM01.0002
Retrieve flight data (SID/STAR)

REQ-18.02c-TS-FM01.0005
Monitor flights for affecting data

REQ-18.02c-TS-FM01.0006
Decision about sending a flight plan update

REQ-18.02c-TS-FM01.0003
Apply SID/STAR allocation information

REQ-18.02c-TS-DM01.0001
Retrieve runway configuration