EUROCONTROL Guidelines for Initial Trajectory Information Sharing

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Abstract

Initial trajectory information sharing consists of making on-board 4D trajectory data available to the ground ANSP and the Network Manager systems to increase awareness, detect discrepancies with ground flight plan data, and enhance ground trajectory predictions.

These guidelines support the implementation of initial trajectory information sharing on the basis of datalink common services that exchange and distribute DLIC and ADS-C data. They document knowledge, recommendations, and best practices.

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Common Service	SWIM	ADS-C/EPP	
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EXECUTIVE SUMMARY

Initial trajectory information sharing consists of making on-board 4D trajectory data available to the ground ANSP and the Network Manager systems to increase awareness, detect discrepancies with ground flight plan data, and enhance ground trajectory predictions.

In practice, it entails the downlinking of ADS-C data according to ATS Baseline 2 standards as defined by ICAO Doc 9880 and EUROCAE/RTCA ATS B2 standards. The on-board 4D trajectory data is conveyed in the ADS-C extended projected profile (EPP).

The EUROCONTROL Specification for Datalink Common Services for the Aeronautical Telecommunication Network (ATN) [Ref 1] and EUROCONTROL Specification for SWIM ADS-C Ground Distribution Service [Ref 2], have specified common services optimising the use of air-ground resources and the ground-ground distribution of air-ground data through system-wide information management (SWIM) services.

This Guidelines document complements the Specifications by documenting knowledge, recommendations and best practices provided by:

- technical and operational experts involved in research, validation, demonstrations, standardisation, industrial developments and deployment;
- ANSPs that operate ATS B2 services; and
- Airspace users that operate ATS B2 services.

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1. Introduction

1.1. Purpose of the document

The purpose of this EUROCONTROL[1] Guidelines document is to support the EUROCONTROL Specification for Datalink Common Services for the Aeronautical Telecommunication Network (ATN) [Ref 1] and EUROCONTROL Specification for SWIM ADS-C Ground Distribution Service [Ref 2], enabling the deployment of initial trajectory information sharing.

It provides guidance in deploying common services for the context management (CM) and automatic dependent surveillance contract (ADS-C) ATN applications also enabling Commission Regulation Common Project One [Ref 11] ATM functionality 6 (AF6) on initial trajectory information sharing. It also provides guidance on the deployment of other non-mandated features of controller-pilot datalink communications (CPDLC) and ADS-C applications.

These guidelines document knowledge, recommendations and best practices provided by:

- technical and operational experts involved in research, validation, demonstrations, standardisation, industrial developments and deployment;
- ANSPs that operate ATS B2 services; and
- Airspace users that operate ATS B2 services.

Screenshot images are provided courtesy of Airbus, DFS Deutsche Flugsicherung, Direction des services de la Navigation aérienne, EUROCONTROL Maastricht UAC, Indra Sistemas and Lufthansa to illustrate the guidance.

Future editions of these guidelines are foreseen to include:

- enhanced recommendations following feedback from deployment initiatives and operational experience; and
- new recommendations covering additional ATS B2 functionality developed under the OEP workstream topic 12.2 or other European projects and programmes.

1.2. EUROCONTROL Guidelines

EUROCONTROL Guidelines may be used, inter alia, to support implementation and operation of ATM systems and services, and to:

- complement ICAO Recommended Practices and Procedures;
- complement EC legislation;
- indicate harmonisation targets for ATM Procedures;
- encourage the application of best practice;
- provide detailed procedural information.

[1] EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

These EUROCONTROL Guidelines have been developed under the EUROCONTROL Regulatory and Advisory Framework (ERAF) to support the deployment of datalink common services for the ICAO Aeronautical Telecommunications Network (ATN).

1.3. Structure of the document

The document structure is similar to that of the EUROCONTROL Specification for Datalink Common Services for the Aeronautical Telecommunication Network (ATN) [Ref 1], which details requirements applicable to the Logon and ADS-C common services. It describes operational and technical experience in operating ADS-C, highlights numerous recommendations and contains examples of operational deployment.

- Section 1: Introduction
- Section 2: Description of initial trajectory information sharing
- Section 3: Guidance for the Logon Service (LS)
- Section 4: Guidance for the ADS-C Common Service (ACS)
- Annex A: Abbreviations
- Annex B: Example of 2D conformance monitoring
- Annex C: Document update procedures

1.4. Applicability

This document applies to air navigation service providers that intend to operate DLIC and ADS-C ATN applications as common services and all other users that need or may need to access such application data such as the Network Manager, airspace users, and military organisations.

Note: The implementation of ADS-C common services is a recognised option to fulfil Commission Regulation CP1 AF6 [Ref 5] as recognised in the SESAR Deployment Programme 2022 [Ref 6]. The SESAR Deployment Manager is expected to document these guidelines in the future updates of the SESAR Deployment Programme for AF6.

This document also applies to airspace users that will be operating DLIC and ADS-C ATN applications interacting with the common services.

1.5. Conventions

Guidance material developed for the purpose of this document is identifiable by the prefix **GM-ITS-<x>**, where <x> is a numerical value. The following drafting conventions are applied:

a) The operative verb "**should**" – indicates something that is a recommendation and not specifically required to meet or satisfy the identified objective(s).

b) The operative verb "**may**" – indicates an optional element.

Referenced documents are listed in section 1.9 and are crossed-referenced by a label [Ref x], where x is a numerical value.

Standardised ASN.1 elements are represented using `Courier` font.

This document cross-references requirements of the EUROCONTROL specifications [Ref 1] and [Ref 2] through their reference number as listed in the below table (where <x> is a numerical value).

Logon Service Requirements [Ref 1]	ADS-C Common Service Requirements [Ref 1]	SWIM Ground Distribution Services Requirements [Ref 2]
LS-GEN-<x>	ACS-GEN-<x>	LS-GDS-<x>
LS-KPI-<x>	ACS-KPI-<x>	ACS-GDS-<x>
LS-FCT-<x>	ACS-FCT-<x>	
LS-DAT-<x>	ACS-DAT-<x>	
LS-MGT-<x>	ACS-MGT-<x>	

This document cross-references requirements of the EUROCAE documents [Ref 5] to [Ref 8] through their requirement number (e.g. SD-GD-ADSC-2A).

This document makes use of the term 'CP1 AF6' in reference to ATM functionality 6 (AF6) of Commission Regulation Common Project One [Ref 11] on initial trajectory information sharing. An extract is provided in section 2.3.

1.6. Maintenance of the Guidelines

These EUROCONTROL Guidelines have been developed under the EUROCONTROL Regulatory and Advisory Framework (ERAF) and are maintained by EUROCONTROL in accordance with this Framework as outlined in ANNEX C.

1.7. Definitions

The following definitions are applied for the purpose of these Guidelines.

Term	**Definition**
ADS-C Report	An automatic report transmitted from the aircraft to a ground user in response to a demand, event or periodic contract request, containing an ADS message.
Closed clearance	A closed clearance is a clearance resulting in a revision of one portion of the agreed trajectory, from a point of the trajectory to another point of the trajectory. Closed clearance can also be from current position of the aircraft with a condition to resume planned navigation which can include a vector until interception of the planned route. A closed clearance can be on any dimension of the trajectory: lateral, vertical, speed, etc. What differentiates this kind of clearance from the open clearance, is that it contains the instruction on how to resume to the initially agreed trajectory. It allows to update and re-calculate a new agreed trajectory up to destination. (Source: SESAR Trajectory Management Document[2]) *Note: Usually, closed-loop clearances can be followed by the aircraft while maintaining managed guidance modes.*

[2] https://cordis.europa.eu/project/id/872320/results

Discrepancy	The difference between the ground flight planned trajectory (calculated by the flight data processing system) and the downlinked ADS-C/EPP trajectory (derived from the flight management system).
LatLong	Refers to a waypoint that is identified by latitude and longitude coordinates instead of a name.
Managed mode	The automatic flight system guides the aircraft along lateral and vertical flight paths and speed profiles computed by the flight management system. *Notes:* *1) Aircraft can be operated with mixed selected and managed modes, i.e. lateral guidance 'selected' and speed 'managed' or lateral guidance 'managed' with vertical guidance 'selected'.* *2) For many aircraft types, vertical guidance managed mode is only available if lateral guidance is managed.* 3) *Eurocae ED-228 [Ref 5] refers to this as "coupled".*
Open clearance	An ATC clearance that does not include a specified or implied point where the restriction on the trajectory ends. *Notes:* *1) Most tactical clearances take this form; they include heading (including track offset), level, and speed restrictions and exceptionally could also cover rates of climb or descent. Open clearances are cancelled (closed) by a further instruction from the controller that defines how the flight should revert to the agreed trajectory. (Source: SESAR Trajectory Management Document).* *2) Also called "open loop clearance" in SESAR reference document. The word "loop" being removed to align with the ICAO TBO document and to avoid confusion with the process of monitoring using closed-loop feedback. Generally, open-loop clearances are followed by the aircraft by selecting the appropriate selected guidance mode.*
Route	The horizontal part of a trajectory in 2 dimensions.

Selected mode	The automatic flight system guides the aircraft to the target values selected by pilots. *Notes:* *1) The selected guidance modes are usually used for short term guidance, e.g. to comply with ATC instruction (heading, level, speed) or for weather avoidance.* *2) Eurocae ED-228 [Ref 5] refers to this as "not coupled".* *3) This mode can also be referred as "non FMS mode".*
Trajectory	The intended or planned flight route, levels and estimated times at waypoints.
Waypoint	A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either: Fly-by waypoint. A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or Flyover waypoint. A waypoint at which a turn is initiated in order to join the next segment of a route or procedure. (Source: ICAO Doc 4444)

The following definitions come from [Ref 1] and are reproduced for convenience.

Term	**Definition**
ACS provider	The entity providing the ADS-C Common Service.
ACS operator	A person assigned by the ACS provider to configure the service parameters and procedures.
ACS user	A pre-registered entity authorised to subscribe to ACS data through a SWIM interface (e.g. ANSP, Network Manager, Airspace Users).
ACS governance	The defined governance arrangements of the ACS to whom the ACS provider reports to.
ADS-C application version	The 'ADS-C application version' corresponds to the value of the `apVersion` parameter of the ASN.1 description defined in ICAO Doc 9880 [Ref 9] and is bound to a message set with the same version number as defined in ED-229A [Ref 6] or ED-229B [Ref 7].

ADS message	The 'ADS message' is the PER encoded `ADSMessage` defined in ICAO Doc 9880 which corresponds to the PER encoding of the ASN.1 defined types `ADSRequestContract`, `ADSDataReport`, `ADSPositiveAcknowledgement`, `ADSReject`, `ADSNonCompliance` in ED-229A. This ADS message can contain a report or a service protocol data unit (PDU).
Application address	Corresponds to the content of the `apAddress` in CM logon requests and responses which can be an ATN/OSI TSAP address or ATN/IPS IPv6 address (including a port number).
CM long TSAP address	Corresponds to the content of the `cMLongTSAP` as defined in ICAO Doc 9880 [Ref 9] which can be an ATN/OSI long TSAP address or an ATN/IPS IPv6 address (including a port number).
Logon information	The data content of CM-logon indications from the aircraft, CM-forward exchanges with ANSPs or the CM Logon data set.
Long TSAP address	As defined by ICAO Doc 9880, the long TSAP address corresponds to the NSAP address and transport selector excluding the initial IDP field: (i.e. VER+ADM+RDF+ARS+LOC+SYS+SEL+TSEL).
LS provider	The entity providing the Logon Service.
LS operator	A person assigned by the LS provider to configure the service parameters and procedures.
LS user	A pre-registered entity authorised to subscribe to Logon Service data through its SWIM interface (i.e. ANSP, ACS and Network Manager) or with permissions to exchange data via the CM-forward service.
LS governance	The defined governance arrangements of the Logon Service to whom the LS provider reports to.
Short TSAP address	As defined by ICAO Doc 9880 [Ref 9], the short TSAP address corresponds to the long TSAP excluding the initial RDP field: (i.e. ARS+LOC+SYS+SEL+TSEL) *Note: RDP = VER + ADM + RDF fields.*
24-bit address	Means the globally unique ICAO 24-bit aircraft address.

1.8. Abbreviations

A full list of abbreviations is provided in ANNEX A.

1.9. Reference material

1. EUROCONTROL Specification for Data Link Common Services for the Aeronautical Telecommunication Network (ATN), Edition 1.0, dated 11/12/2023.
2. EUROCONTROL Specification for Data Link Ground Distribution SWIM Services, Edition 1.0, dated 11/12/2023.
3. EUROCONTROL Specification for the for SWIM Technical Infrastructure (TI) Yellow Profile, Edition 1.1, dated 5th July 2020.
4. Operation Excellence Programme Workstream 12.2 Concept of Operations (Deliverable DEL2.1-1), Edition 1.0, dated 4th April 2023.
5. EUROCAE ED-228A – Safety and Performance Requirements Standard for Baseline 2 ATS Data Communications (Baseline 2 SPR Standard), dated March 2016. This document is technically identical to RTCA DO-350A.
6. EUROCAE ED-229A – Interoperability Requirements Standard for Baseline 2 ATS Data Communications (Baseline 2 Interop Standard), dated March 2016. This document is technically identical to RTCA DO-351A.
7. EUROCAE ED-228B – Safety and Performance Requirements Standard for Baseline 2 ATS Data Communication, dated September 2023 (including corrigendum 1). This document is technically identical to RTCA DO-350B.
8. EUROCAE ED-229B – Interoperability Requirements Standard for Baseline 2 ATS Data Communications, dated September 2023 (including corrigendum 1). This document is technically identical to RTCA DO-351B.
9. ICAO Doc 9880 – Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols, 2nd Edition, dated 2016.
10. ICAO EUR Doc 028 - EUR NSAP Address Registry, Version 12.0, 18th November 2022.
11. Commission Implementing Regulation (EU) 2021/116 of 1 February 2021 on the establishment of the Common Project One supporting the implementation of the European Air Traffic Management Master Plan.
12. SESAR Deployment Programme Edition 2022.

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2. Initial trajectory information sharing

2.1. Background

Initial trajectory information sharing has been validated by SESAR PJ31[3] (2016-2020), and was described as:

"Initial Trajectory Information Sharing – Initial 4D (i4D) consists of the improved use of target times and trajectory information, including where available the use of on-board 4D trajectory data by the ground ATC systems and Network Manager systems, implying fewer tactical interventions and improved de-conflicting."

In practice, it entails the downlinking of ADS-C data according to ATS Baseline 2 standards as defined by ICAO Doc 9880 [Ref 9] and EUROCAE/RTCA ATS B2 standards [Ref 5][Ref 6]. The operational intent described by SESAR PJ31 is:

"The predicted trajectory can be synchronised between the ground system and the aircraft by the downlink of trajectory data between equipped aircraft and service providers that are able to incorporate this information into their Flight Data Processing System (FDPS)."

SESAR PJ18[4] (2019-2023) continued trajectory-based operations research under the single European sky with a view of preparing solutions for: improvements to the ground trajectory prediction and separation, complex CPDLC clearances to enhance the synchronisation of the airborne trajectory with the ground trajectory, more automated A/G and G/G trajectory exchanges, and trajectory common service as an alternative architecture for trajectory exchanges between ground ATM actors.

SESAR PJ38[5] (2020-2023) demonstrated the benefits of deploying a common approach for the ground receipt and distribution of ADS-C data. This greatly reduces data exchanges on the limited air-ground data link and makes use of SWIM for ADS-C data distribution to multiple ground users.

Following the SESAR projects, the following regulatory and standardisation activities are associated to initial trajectory information sharing:

- EU Regulation CP1 AF6 [Ref 5] coordinated by the SESAR Deployment Manager (SDM);
- certification and detailed specifications prepared by EASA;
- EUROCAE/RTCA ATS B2 standards [Ref 5], [Ref 6], [Ref 7] and [Ref 8] prepared by WG-78/SC-214; and
- EUROCONTROL standards specifying common services supporting CM and ADS-C datalink applications and data distribution through SWIM and CM-forward interfaces [Ref 1] and [Ref 2] prepared under the Operational Excellence Programme workstream 12.2 "ATS B2 early deployment".

In terms of current operations, a number of Airbus A320/A321 FANS-C equipped aircraft are directly connecting to the EUROCONTROL Maastricht Upper Airspace Centre, making use of CPDLCv2 and ADS-Cv1 (EUROCAE/RTCA ATS B2 standards Revision A).

[3] https://cordis.europa.eu/project/id/731818
[4] https://cordis.europa.eu/programme/id/H2020_SESAR-IR-VLD-WAVE2-09-2019
[5] https://cordis.europa.eu/project/id/101017626

2.2. ATS B2 overview and operational benefits

ATS B2 standards are an evolution of the ATN B1 standards, the latter being mandated through the European regulatory framework for the single European sky.

Both ATS B2 and ATN B1 are industry standards that further detail and extend provisions of the ICAO ATN standards. Revision A of the ATS B2 standards [Ref 5] [Ref 6] detail safety, performance and interoperability requirements for the CM, ADS-C and CPDLC applications to deliver specific services as listed in Table 1. Revision B of the ATS B2 standards specify new versions of the CPDLC (e.g. v4) and ADS-C (e.g. v3) applications.

Application	Services based on EUROCAE ED228A/RTCA DO-350A	ATN B1	ATS B2 Rev A	ATS B2 Rev B (incl IM and DNRP)
CM	Data Link Initiation Capability (DLIC)	CM	CM	CM
CPDLC	ATC Communications Management (ACM)	CPDLCv1	CPDLCv2	CPDLCv4
CPDLC	ATC Clearances (ACL)	CPDLCv1	n/a	n/a
CPDLC	ATC Microphone Check (AMC)	CPDLCv1	CPDLCv2	CPDLCv4
CPDLC	Clearance Request and Delivery (CRD)		CPDLCv2	CPDLCv4
CPDLC	Departure Clearance (DCL)		CPDLCv2	CPDLCv4
CPDLC	Data Link Taxi (D-TAXI)		CPDLCv2	CPDLCv4
CPDLC/ADS-C	Information Exchange and Reporting (IER)		CPDLCv2/ ADSCv1	CPDLCv4/ ADSCv3
ADS-C	Position Reporting (PR) – this includes Projected Profile (Next 2 waypoints)		ADSCv1	ADSCv3
CPDLC/ADS-C	4-Dimensional Trajectory Data Link (4DTRAD) – this includes Extended Projected Profile (EPP) (Up to 128 waypoints)		CPDLCv2/ ADSCv1	CPDLCv4/ ADSCv3
CPDLC	In-Trail Procedure (ITP)		CPDLCv2	CPDLCv4
CPDLC/ADS-C	Interval Management (IM)		n/a	CPDLCv4/ ADSCv3
CPDLC	Oceanic Clearance Delivery (OCL)		CPDLCv2	CPDLCv4
CPDLC/ADS-C	Dynamic Required Navigation Performance (DRNP)		n/a	CPDLCv4/ ADSCv3

Table 1 - Datalink Services and Applications

Implementing ATS B2 means identifying which services and application versions are to be deployed, in which portion of the airspace, and in which phase of flight. In Table 1, the current ATN B1 datalink services (above FL285) are coloured in grey to be compared with the services that have so far been researched or validated by SESAR coloured in green. Regulation CP1 AF6 [Ref 5] mandates the downlinking and use of 4DTRAD extended projected profile (EPP) above flight level 285 using ADS-C as detailed in the following section 2.3.

The operational benefits of ATS B2 are increased when making use of both ADS-C and CPDLC applications, leading to greener flights, reduced workload and increased safety as identified in Table 2 based on nearly one year of operations and quantified fuel/emission savings[6]:

Airlines	Pilots	Air Traffic Controllers
Optimized climb and descent profiles	Link of the ATSU to FMS for easier handling of messages (CPDLCv2)	FMS trajectory can be checked anytime, discrepancy warnings reduce the need for monitoring → **workload reduction**

[6] Airspace World 2023, https://airspaceworld.com/agenda/operational-introduction-of-ats-b2-ads-c-in-muac-operations/

Optimized routes, less miles flown	Less radio usage for routine information requested by controllers	Reduced need for monitoring the vertical profile (ToC/ToDdisplay) → **workload reduction**
Fuel saving + Reduced CO2 emissions → **greener flights**	Reduced Flight crew workload	EPP can clearly show offset procedures during weather-deviation, reducing the need of keeping aircraft on radar headings → **workload reduction**
Future (possibly): less regulations through a more optimized network (use of EPP ETA, runway occupancy parameter, etc.)		Better ATCO awareness of the lateral trajectory enables coordination for better routings beyond the limits of the ground trajectory → **improved service**
		Push-to load capability for entering lateral clearances onboard. MUAC recorded 8 instances in 2022 where pilots entered the received route-clearance wrongly (UM79 CLEAREDTO [FIX2] VIA [FIX1]) → **safety enhancement**
		Lat-Long coordinate uplinks: track shortening → **less time in the airspace → workload reduction**
		Lat-Long coordinate uplinks: closed trajectories –aircraft will cater for the wind effect itself, resulting in as much more predictable profile and conflict detection → **workload reduction +automation enabler**
		Higher expected logon rates due higher pilot acceptance – less "ABC123, logon CPDLC [XXXX]" → **workload reduction**

Table 2 – Experienced ATS B2 Operational Benefits

2.3. Deployment target and planned operations

The deployment of initial trajectory information sharing within the single European sky has been mandated by Regulation CP1 AF6 [Ref 5] as follows:

> *"a) Aircraft [Ed. operating as GAT above FL285] must be equipped with the capability to automatically down-link trajectory information using ADS-C EPP as part of the ATS B2 services. The trajectory data automatically down-linked from the airborne system must update the ATM system in accordance with the terms of the contract.*
>
> *b) Data link communications ground systems must support ADS-C (downlink of aircraft trajectory using EPP) as part of the ATS B2 services while keeping compatibility with controller – pilot data link communications ('CPDLC') services as required by Commission Regulation (EC) No 29/2009[(3)], including provision of service to flights equipped only with the Aeronautical Telecommunication Network Baseline 1 ('ATN-B1').*
>
> *c) All ATS providers referred to in point 6.3 [Ed. ANSP, NM] and the related ATC systems must be able to receive and process trajectory information from equipped aircraft.*
>
> *d) The ATC systems must enable controllers to display the route of the downlinked trajectory.*
>
> *e) The ATC systems must provide a warning to controllers in case of a discrepancy between the downlinked aircraft trajectory and the ground system trajectory elaborated using the filed flight plan route."*

Operational experience[6] has shown that, by its own, EPP data already provides quantifiable benefits to airlines, pilots and air traffic controllers:

- ToC information provides controllers with an aircraft's specific climb performance, avoiding stepped climbs and leaving the aircraft to manage its climb, saving fuel consumption and emissions;

- ToC information allows controllers to provide direct routings earlier instead of having to wait until the aircraft is at level;
- ToD information provides controllers with the possibility to maintain the cruising level for longer, even up to 20-30 nm, saving fuel consumption and emissions.

Note: Even though the individual flight savings may appear marginal, MUAC has calculated over a short period (15/11/22-31/01/23) for equipped A320 aircraft in its airspace, a total saving of 6.517 nm by allowing the aircraft to descend at their own rate from the ToD, saving 5,218 kg fuel and avoiding 16,475 kg CO2 emissions.

Although the scope of CP1 AF6 only refers to the downlinking of ADS-C/EPP for aircraft operating as general air traffic above flight level 285, the Common Services Specification [Ref 1] requirements also cover the deployment of additional validated features of the ICAO Doc 9880 [Ref 9] and EUROCAE/RTCA ATS B2 standards [Ref 5][Ref 6]. These additional features were first described in the OEP workstream 12.2 Concept of Operations document (CONOPS) [Ref 4] and address the following technical and operational aspects:

- common logon service for datalink applications (CM, CPDLC and ADS-C) in all SES airspace;
- immediate ADS-C contract establishment once CM logon information becomes available;
- ADS-C periodic contract definitions (e.g. EPP, ground vector, air vector, meteorological information, speed schedule profile);
- ADS-C periodic contract updates (e.g. reporting rate, TOA range);
- ADS-C event contract definitions (e.g. waypoint change, EPP change);
- ADS-C demand contract requests submitted by ACS users;
- ADS-C message set versions;
- CM-contact airborne aircraft for which no logon information has been received;
- ground distribution of data by SWIM and CM-forward; and
- forthcoming deployment of ATN/IPS.

The common service specifications identify the need for governance arrangements which will:

- oversee common procurement and operational delivery;
- plan service evolutions and support of new CPDLC/ADS-C application versions;
- periodically review service parameters and reported service KPIs;
- oversee ACS user access to data.

Note: These guidelines do not aim to support the establishment of the governance arrangements, they aim to support airspace users, air navigations service providers, Logon and ACS service providers, and the Network Manager in accessing and making use of the common services. Such arrangements are expected to be part of common procurement initiatives[7].

[7] https://www.eurocontrol.int/sites/default/files/2023-12/ectl-src-230119.pdf

3. Logon Service (LS) and operational procedures

3.1. Guidance on the Logon Service

The long-term objective of datalink common services is that all aircraft invoke CM-logon requests to the Logon Service so that the ADS-C common service (ACS) can establish ADS-C contracts as early as possible.

A common service approach for datalink ensures that complete logon information is shared and made available to all ANSPs operating CPDLC, and that ADS-C data is made available to all ground users as early as possible using a standard SWIM ground distribution service. Moreover, one important long-term benefit of this service for airspace users is that there will be only one address for crews to perform the initial logon procedure enabling all ATS-related datalink services (i.e. CM, CPDLC and ADS-C).

The concept of operations (CONOPS) [Ref 4], documents the assessment defining a long-term solution for a common pan-European Logon Service. It also details the numerous interfaces to enable a transition from today's environment to the long-term objective of the Logon Service.

The long-term objective of the Logon Service is illustrated in Figure 1, where all aircraft log on to a common Logon Service as early as possible (arrow (1)), so that the ACS can establish ADS-C contracts as early as possible (arrow (2)) and distribute ADS-C data to all ground users (arrow (3)), named ACS users. When an ACC is ready to process logon information for a flight, an internal trigger generates a request for logon information to the Logon Service (arrow (4)) which is returned via CM-forward or a SWIM interface (arrow (5)). ACCs can establish CPDLC (arrow (6)) using logon information from the Logon Service or from a received OLDI LOF message from an upstream ACC. It is to be noted that the ACC request (arrow (5)) will need to indicate the response method and whether the Logon Service is to respond immediately with any available information, or once information becomes available within a set time.

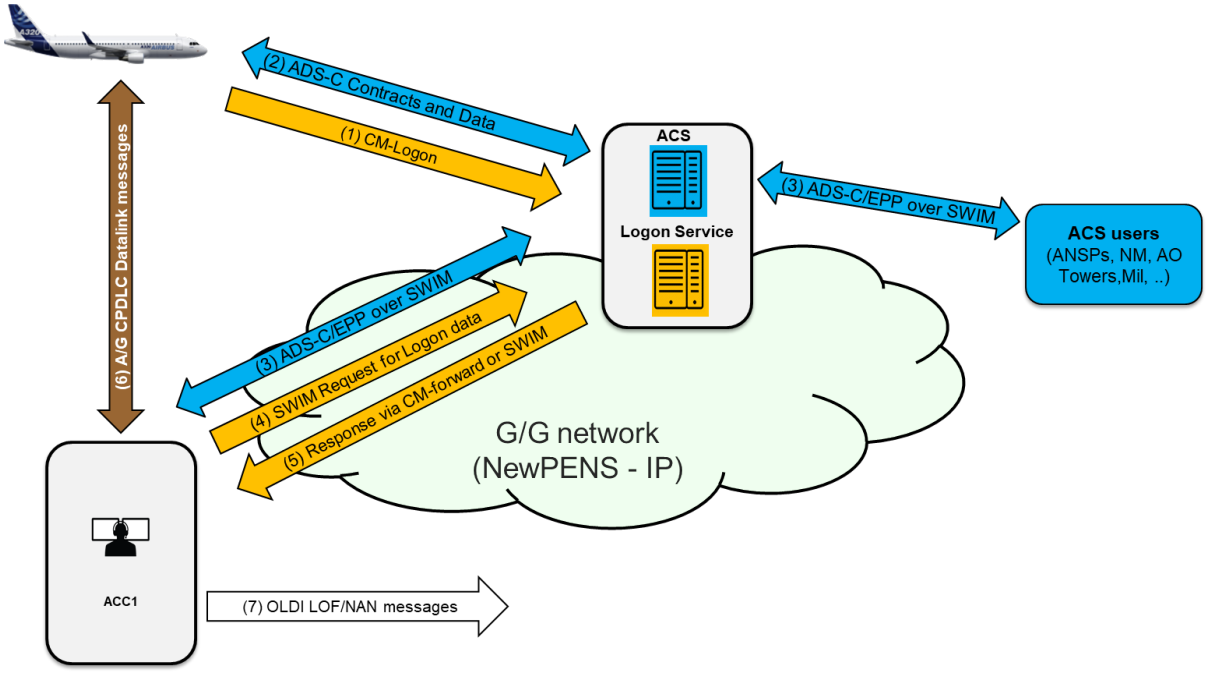

Figure 1 – Logon Service (long-term objective)

An airborne and ground transition period will be necessary to achieve the long-term objective of the Logon Service, however, this does not need to be fully synchronised as the Logon Service accommodates multiple interfaces for a progressive approach as shown in Figure 2.

As airspace users will need time to transition to the Logon Service, ACCs will need to continue processing direct CM-logon indications and forward logon information to the Logon Service (arrows (9a)). Logon procedures will be documented in national AIPs, taking into account aircraft capabilities.

Upstream ACCs may not be party to the Logon Service, therefore the first ACC associated to the Logon Service will need to forward received logon information from OLDI LOF messages (arrows (9b)) to the Logon Service. Always having ACCs forward received logon information from OLDI LOF messages (arrow (10)), simplifies ACC processing and increases the resilience of information sharing between participating ACCs and the Logon Service (e.g. recovery from failures as described in section 5.5.2 of the CONOPS).

For transitions purposes, ACC SWIM requests to the Logon Service (arrow (5)) can also indicate that a ground-air CM-contact request has to be initiated (arrows (6c)).

The multiple interfaces between the ANSP and the Logon Service can be used as a “toolkit” by ANSPs to build their transition plans, offering different solutions for different ATM ground system architectures. With this “toolkit”, ANSPs should be able to build a transition roadmap fit for their purpose and optimised to the specific situation and needs of each ACC.

For example, an ANSP that is geographically situated on the edge of the coverage area might not build the same transition plan as an ANSP surrounded by other ANSPs within the coverage area. Similarly, an ANSP that has already implemented ADS-C, is likely to have a different transition plan compared to ANSPs that are only starting their ATS B2 deployment.

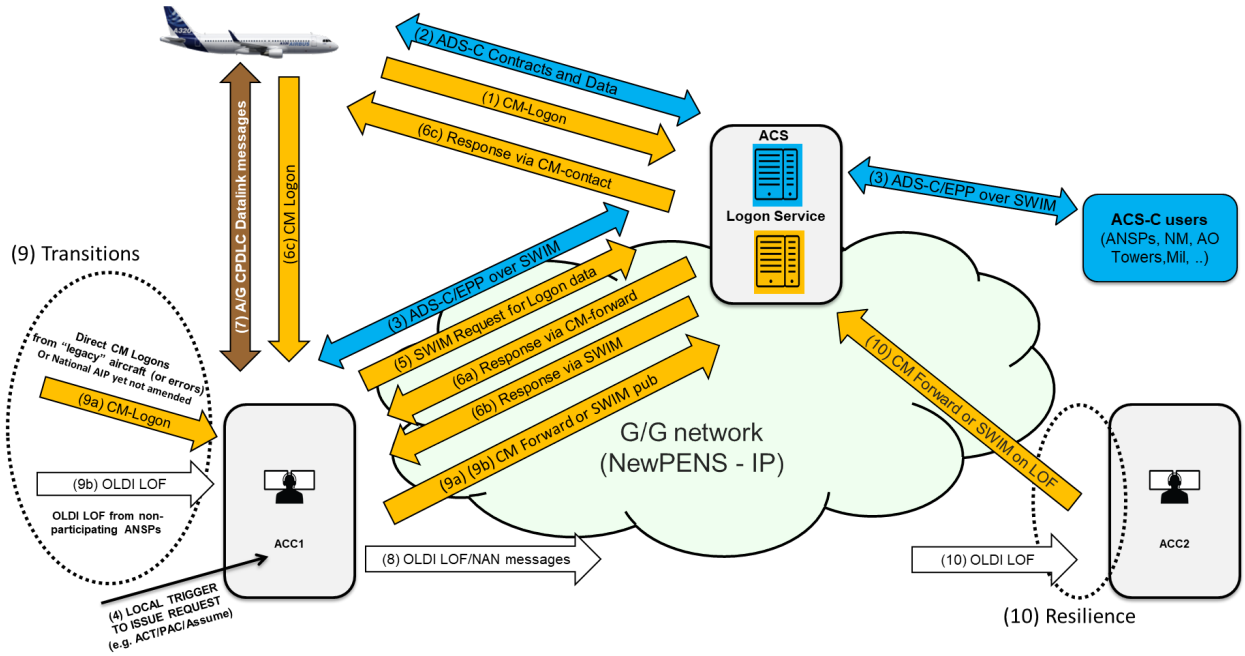

Figure 2 – Logon Service (transition options and resilience)

Section 3.3.1 provides further detail on a transition option for ANSPs and section 3.3.3 for airspace users.

GM-ITIS-0010 A new ICAO ground facility designator (GFD) **should** be defined, reflecting the pan-European characteristic of the Logon Service.

GM-ITIS-0020 When identifying an ICAO GFD for the Logon Service, an additional existing unused designator **should** be identified to facilitate the support of existing datalink equipped aircraft thereby avoiding unnecessary avionic reconfigurations.

Note: Such an approach will need to be assessed in terms of its impact on ATN routing and the number of Logon Service CM instances.

3.2. Guidance for the Logon Service Provider

3.2.1 General

Although the Logon Service is primarily an automated service, operators will be required to configure parameters, LS user access, activate/deactivate services (e.g. CM-contact), maintain the logon reject list, oversee monitoring and reporting tools.

GM-ITIS-0030 The LS provider **should** develop a training module for its operators covering:

- datalink logon overview (e.g. need, single logon approach, local vs common);
- Logon Service design, configuration and operation;
- CM services (i.e. CM-logon, CM-contact, CM-forward);
- SWIM service interfaces;
- processes to grant access to LS users; and
- processes to modify configuration parameters, data sets, logon reject list and activate/deactivate Logon Service procedures.

Note: Such processes would be subject to LS governance approval.

To enable the exchange of CM-forward information with ANSPs, the ground network needs to enable ATN/OSI routing between the Logon Service and ANSPs.

GM-ITIS-0040 The LS provider **should** ensure that the two-way ATN/OSI routing of ground end-to-end ATN data with ANSPs is enabled by its communications service provider(s).

Although the LS SWIM services are intended to be used by a limited number of users (e.g. ANSPs), they can be published in the European SWIM registry.

GM-ITIS-0050 The LS provider **may** publish its LS SWIM service description in the European SWIM Registry.

Notes:

1) *The publication in the registry does not imply LS user access to the Logon Service data which is subject to authorisation.*
2) *The Logon Service definition is already published in the registry. The LS provider can publish its service description, which might include additional constraints (e.g. EACP certificates for client authentication).*

3.2.2 Transitional arrangements

The long-term objective of the Logon Service is that all aircraft will log on to the Logon Service and that complete logon information is made available to all ANSPs (LS users). The multiple features of the Logon Service will support airborne and ground actors in achieving this objective over a transition period.

This implies necessary actions for ANSPs to interface with the Logon Service. However, each ANSP has a different ATM ground system architecture and a specific roadmap for the evolution of its ATM ground system. Therefore, ANSP transition plans are likely to be different in both content and timing.

GM-ITIS-0060 The LS provider **should** agree on specific transitional arrangements to support each ANSP participating to the Logon Service whilst ensuring a “single logon” for airspace users.

3.2.3 Coexistence with other CM-logon servers

The coverage areas of the Logon Service and the ACS are linked. Indeed, the ACS will not start ADS-C contracts unless the Logon Service has received logon information. However, during the transition period (and maybe permanently) the Logon Service coverage area is likely to be non-continuous and with some “holes” for those ANSPs who are either non-users of the Logon Service or who have not yet achieved their transition plan to forward logon information to the Logon Service (see Figure 3, case 3).

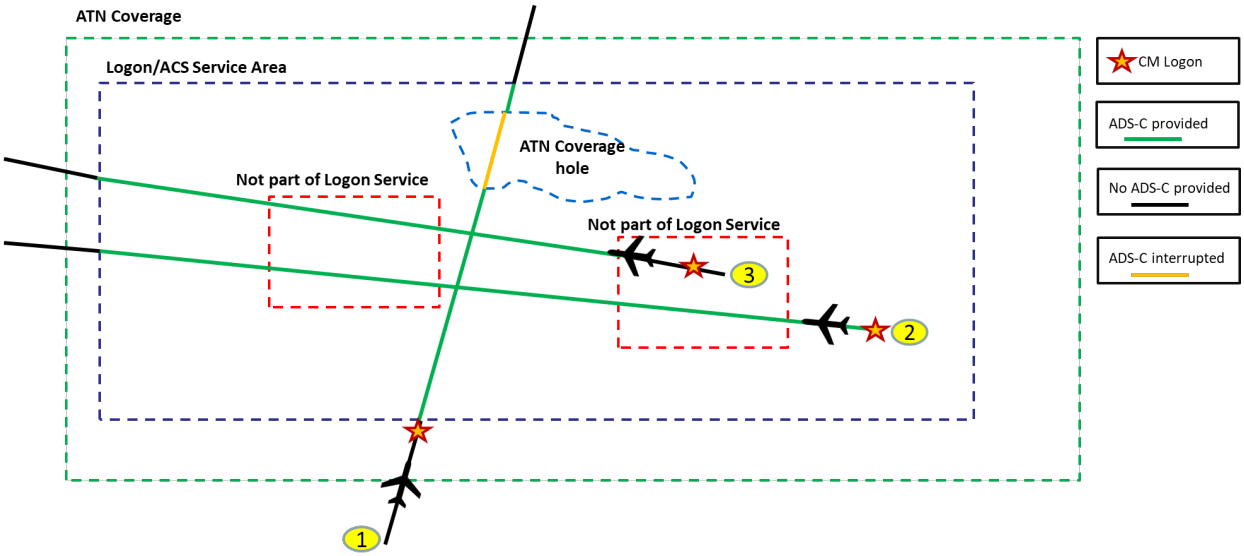

Figure 3 – Logon Service coverage area and continuity

Aircraft entering the Logon Service coverage area may have already performed the logon procedure with other CM logon servers of upstream ATSUs (see Figure 3, case 1).

Following the receipt of OLDI LOF messages, the forwarding process of logon information from ATSUs to the Logon Service should ensure that the logon information is available to the Logon Service at least a few minutes before the aircraft enters the Logon Service coverage area. However, OLDI LOF messages exchanges or such forwarding procedures can fail, so the Logon Service efficiency may be greatly improved if the Logon Service also receives logon information from adjacent CM logon servers much earlier.

GM-ITIS-0070 The LS provider **should** make use of the CM-forward or SWIM service interfaces as defined in [Ref 1][Ref 2] for the timely operational sharing of logon information with adjacent CM logon servers.

Note: Such arrangements would be subject to LS governance.

3.2.4 Degraded modes

For aircraft that have already performed the logon, a failure of the Logon Service will not affect those aircraft as CM dialogues are unmaintained. CPDLC should not be affected as logon information is shared through the OLDI LOF/NAN ground exchanges. It is only when flight crews perform a logon to a failed Logon Service, that this becomes apparent. Therefore:

- if flight crews logon (or re-logon) to the Logon Service, service failures will be detected by the aircraft as CM-logon is a confirmed service. As ANSPs will maintain their capabilities to receive CM-logon indications, a mitigating procedure is that the crew performs a logon to the controlling ACC. This procedure can be detailed in the AIP or instructed by the controller.
- if flight crews manually logon or re-logon to the ACC, the Logon Service failure will not be detected by the aircraft. It is the ACC's forwarding of logon information to the Logon Service that will fail.

By ensuring that each ACC always forwards any received logon information either from a direct CM-logon indication or an OLDI LOF message (as detailed in section 3.3.2.1), multiple attempts will be made by ACCs to forward logon information to the Logon Service as the flight progresses. This will mitigate the Logon Service failure and ease a return to normal Logon Service operations.

3.2.5 Notification of service availability

Each ANSP is responsible for publishing its logon procedures (e.g. coverage, addresses) in the national AIP and notifying of any service issues in NOTAMs. To be able to adequately perform this task, ANSPs need current information on Logon Service service availability (maintenance, failure, …). Therefore, the LS provider needs to send timely service availability information to the ANSPs to allow them to publish any required NOTAM(s).

GM-ITIS-0080 The LS provider **should** establish agreements with ANSPs (LS users) in order to exchange adequate and timely service availability information (e.g. coverage, addresses, maintenance, failure).

3.2.6 Cybersecurity and Safety

The SWIM TI specification allows two methods for client authentication (certificates/username-password) and requires server authentication via X.509 certificates. Therefore, it is up to the LS provider to decide which method is to be used for client authentication when LS users connect to the Logon Service SWIM interfaces as detailed in requirement LS-GDS-0040 of [Ref 2].

The CP1 AF5 regulation requires the establishment of a common PKI (i.e. the European Aviation Common Public Key Infrastructure - EACP[8]). However, it is stated that "*services can make use of the common PKI when it becomes operational in order to achieve the cyber security objectives appropriate for the service or services.*"

[8] https://www.sesardeploymentmanager.eu/swim-common-pki-publications

GM-ITIS-0090 The LS provider **should** make use of certificates for LS user access authentication on its ground SWIM interfaces.

Note: These certificates can be generated by EACP or an eligible local PKI.

GM-ITIS-0100 Once the EACP becomes operational, the LS provider **should** make use of it when certifying LS user access authentication on its ground SWIM interfaces.

Note: The EACP will build a Certificate Trust List (CTL) of eligible local PKIs following an assessment process[8].

EASA publishes numerous “easy access" webpages providing a comprehensive resource for providers on regulations referred by [Ref 1]:

- Easy Access Rules for Air Traffic Management/Air Navigation Services[9] (covering Regulation (EU) 2017/373);
- Easy Access Rules for Information Security[10] (covering Regulation (EU) 2023/203).

3.2.7 Testing the Logon Service

To test the Logon Service before it is put into service and for the ongoing resolution of technical issues or incidents, as well as post-operational analysis, two use cases need to be addressed.

The first use case corresponds to the need to test the Logon service.

GM-ITIS-0110 Before the Logon Service is put into service, the LS provider **should** verify the Logon Service against an acceptance test plan that at least covers the following points:

- all mandatory requirements applicable to the LS provider in the Logon and ADS-C common service specifications [Ref 1][Ref 2];
- all mandatory requirements applicable to the Logon Service in the Logon and ADS-C common service specifications [Ref 1][Ref 2];
- all air-ground and ground-ground ATN interfaces;
- all SWIM ground-ground interfaces and LS user interoperability testing; and
- interoperability testing with the ADS-C common service.

GM-ITIS-0120 The LS provider **should** develop a modular acceptance test plan corresponding to its implementation, the functional requirements of the Logon and ADS-C common service specifications [Ref 1] [Ref 2], and in agreement with the LS governance.

Note: A modular test plan could facilitate non-regression testing or the testing of new LS functionalities that have a limited scope.

GM-ITIS-0130 The LS provider’s test plan cases **should** include traceability to the requirements of the Logon and ADS-C common service specifications [Ref 1] [Ref 2].

[9] https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-air-traffic-managementair-navigation-services

[10] https://www.easa.europa.eu/en/document-library/easy-access-rules/first-easy-access-rules-information-security-regulations-eu

GM-ITIS-0140 The LS provider's air-ground test plan cases **may** be performed using air-ground simulation facilities, real avionics on a testbed, or with real aircraft operating in a real datalink environment.

The second use case corresponds to the need for LS users to benefit from a test platform of the Logon Service to be able to test the SWIM and CM-forward interfaces between their ground systems and the Logon Service before starting operations. Moreover, this test platform can also be useful for the resolution of technical issues or incidents, as well as post-operational analysis.

GM-ITIS-0150 The LS provider **should** ensure that a reference test platform of the Logon Service and its interfaces is made available for LS users.

GM-ITIS-0160 The LS provider **may** provide LS users with access to an available reference test platform over public internet.

3.3. Guidance for ANSPs

3.3.1 Service registration and access

The LS governance defines the policies regarding user registration, access, and data usage. The LS provider configures and operates the Logon Service. Authentication is required to access data through the Logon Service SWIM interfaces, meaning that user registration and accounts need to be pre-configured. Multiple accounts may need to be pre-configured to respond to specific ANSP operational or technical needs.

GM-ITIS-0170 ANSPs **should** detail their specific operational needs for Logon Service access with the LS provider.

3.3.2 Transition

The multiple features of the Logon Service will support airborne and ground actors in achieving the Logon Service target over a transition period.

This implies necessary actions for ANSPs to interface with the Logon Service and ANSPs to participate in the enlargement of the ADS-C service area. Indeed, existing ACC CM-logon connection management needs to be reviewed and modified, and a stepwise approach for this transition should be preferred.

In order to support this transition phase, the Logon Service provides multiple methods to share logon information (CM-forward, CM-contact, SWIM) with ACCs so that ANSPs can select the most suitable method, on a temporary or permanent basis.

As an example, the following transitional steps can be envisaged for an ANSP ACC:

- Setup and early transitions

Step 1: the Logon Service is put into service and ready to deliver services to ANSPs and the ACS.

Step 2: the ACC maintains flight crew logon to its local datalink system (as for CPDLC today) and in addition starts forwarding any received logon information (CM-logon requests or OLDI LOF) to the Logon Service by making use of CM-forward or the SWIM interface.

Step 3: the ACS is put into service and capable of establishing contracts with aircraft based on logon information forwarded to the ACS (by the participating ACCs, see step 2).

Step 4: the ACC becomes a user of the ACS to receive downlinked ADS-C/EPP data over the available SWIM interface.

- Achieving the target

Step 5: the ACC implements the SWIM request interface including the preferred response method (e.g. CM-forward, SWIM, CM-contact).

Step 6: ANSPs and national authorities update their respective AIPs to indicate that airspace users need to issue CM-logon requests to the Logon Service.

While implementing Steps 5 and 6, the ACC maintains the capability to process directly received CM-logon to accommodate aircraft that are not able to logon to the Logon Service (resilience, backwards compatibility, non-updated flight deck procedures) or even mis-directed logons.

Note: This is only one possible transition process; many others could be valid.

GM-ITIS-0180 For each ANSP, a transition process **should** be discussed and agreed between the ANSP and the LS provider.

During the transition phase it is possible that the flight crew issues a CM-logon request to the wrong ground facility such as an ACC instead of the Logon Service. The ACC could reject the request, make use of CM-contact, or preferably accept the request and forward the received logon information to the Logon Service.

GM-ITIS-0190 Even if their national AIPs instruct AUs to logon to the logon Service, ANSPs **should** process CM-logon indications and forward the received logon information to the Logon Service.

Note: This is for resilience of the Logon Service, for ground logon information sharing, and to allow time for AUs to complete their transition to the Logon Service (see section 3.1).

3.3.3 Information sharing with the Logon Service

3.3.3.1 Procedures relative to Logon information

A key principle of the Logon Service is that ANSPs are to forward any received logon information to the Logon Service which is then made available for all ANSPs and the ACS.

To enable the exchange of CM-forward messages with the Logon Service, the ground network needs to enable ATN/OSI routing between ANSPs and the Logon Service.

GM-ITIS-0200 ANSPs that make use of the CM-forward service to exchange information with the Logon Service **should** ensure that the two-way ATN/OSI routing of ground end-to-end ATN data with the Logon Service is provided by its communications service provider(s).

Note: there is no need to enable the exchange of CM-forward information between ANSPs.

The information transmitted by the Logon Service contains no indication regarding the origin of that information. Whether it originates from an aircraft that performed a CM-logon request with

the Logon Service or from an ANSP, the Logon Service will always provide all available logon information relating to the flight which may even include a departure date.

GM-ITIS-0210 Upon receipt of a OLDI LOF message or CM-logon indication, ANSPs **should** forward the received logon information to the Logon Service either by using the CM-forward service or through the SWIM "Logon Information Management Interface".

Note: As detailed in sections 2.1.3 and 3.5.3 of [Ref 1], there is an expectation that the Logon Service will receive updated logon information by ANSPs upon LOF reception. This will ensure that the Logon Service has received logon information and is making use of the latest available information. Refer to LS-FCT-0220 and LS-FCT-0390 of [Ref 1] and LS-GDS-0180 of [Ref 2].

GM-ITIS-0220 ANSPs **should** not inhibit the forwarding of received logon information to the Logon Service if the incoming LOF message is unacknowledged.

GM-ITIS-0230 ANSPs forwarding of received logon information to the Logon Service **should** not be constrained by any local logon list implementation.

Note: The complete information is to be forwarded to the Logon Service, whether or not the individual ANSP itself intends to use this information locally for datalink applications.

GM-ITIS-0240 For aircraft approaching their Area of Responsibility and for which logon information is absent, ANSPs **should** define their operational and technical triggers to generate a request to the Logon Service through its SWIM "Logon Information Management Interface" or "Asynchronous Logon Information Request Interface".

Notes:

1) *The triggers can be based on aircraft approaching their Area of Responsibility, OLDI ABI/PAC/ACT message receipt, aircraft distance to waypoints or co-ordination point (COP).*

2) *Such SWIM requests can be synchronous or asynchronous. Refer to LS-FCT-0280 and LS-FCT-0310 of [Ref 1], and LS-GDS-0240 and LS-GDS-0180 of [Ref 2].*

GM-ITIS-0250 The Logon Service may provide to ANSPs a departure date for a given flight (`dateTimeDepartureETD`) which **should** be ignored for operational purposes.

Note: Such information would be provided as part of a SWIM response or CM-forward; in accordance with [Ref 6] DLIC-IR 15, it is not to be used.

3.3.3.2 Procedures relative to CPDLC

The seamless operation of controller pilot datalink communications (CPDLC) depends on the:

- ground forwarding of OLDI LOF and NAN messages between the transferring ATSU (T-ATSU) and the receiving ATSU (R-ATSU); and
- uplinking of datalink messages (`UM183 CURRENT DATA AUTHORITY xxx` and `UM160 NEXT DATA AUTHORITY xxx`) indicating the CPDLC current (CDA) and next (NDA) data authorities.

Most ATSUs have experienced rejected CPDLC start requests, notified by downlinked datalink message `DM107 NOT AUTHORIZED NEXT DATA AUTHORITY`. Several causes can explain these events such as an uplinked NDA to the aircraft sent too late or the R-ATSU attempting to establish CPDLC too early. As access to logon information is a prerequisite for the R-ATSU to

be able to perform a CPDLC start request, the impact of the Logon Service on ground CPDLC procedures needs to be considered.

The Logon Service allows the T-ATSU to provide logon, CPDLC CDA and CPDLC NDA information, and the R-ATSU to request this information independently of the OLDI LOF/NAN message exchanges. Two key benefits associated with this information sharing have been identified as follows:

- a receiving ATSU (R-ATSU) could verify, independently of OLDI LOF/NAN exchanges, whether it has been correctly notified to the aircraft as CPDLC NDA. This could avoid the R-ATSU trying to establish CPDLC too early or unnecessarily. Indeed, if an expected OLDI NAN message was not received by the R-ATSU in due time, the R-ATSU can check with the Logon Service whether the T-ATSU notified that R-ATSU is the NDA. Therefore, even in the absence of the NAN message, the R-ATSU can perform CPDLC connection establishment in full confidence.
- the Logon Service could keep track of a flight's current CDA, supporting future implementations of the 4DTRAD service (in which CPDLC clearances originating from downstream ATSUs have to be delivered to an aircraft through the CPDLC CDA-ATSU).

GM-ITIS-0260 Once an ACC becomes the CPDLC CDA for a given flight, it **should** notify the Logon Service that it is the CPDLC CDA through the SWIM "Authority Management Interface".

Note: Refer to LS-FCT-0480 of [Ref 1] and LS-GDS-1070 of [Ref 2].

GM-ITIS-0270 When a CPDLC CDA uplinks the NDA message (`UM160 NEXT DATA AUTHORITY xxx`) to a given flight, it **should** notify the Logon Service which ACC is the CPDLC NDA through the SWIM "Authority Management Interface".

Notes:

1) *Refer to LS-FCT-0480 of [Ref 1] and LS-GDS-1140 of [Ref 2].*
2) *The CPDLC NDA can change in the event of re-routings and would need to be re-notified.*
3) *There is no need for the CPDLC CDA to notify the Logon Service that it is no longer the CPDLC CDA as this will be overwritten by the next CPDLC CDA.*

GM-ITIS-0280 If an OLDI LOF message for a given flight is not received in due time, the R-ATSU **should** request logon information from the Logon Service through the SWIM "Logon Information Management Interface" or "Asynchronous Logon Information Request Interface".

GM-ITIS-0290 For a given flight, the R-ATSU **should** wait for the receipt of an OLDI NAN message before performing a CPDLC start request.

Notes:

1) *NAN reception implies the aircraft knows that the R-ATSU is the CPDLC NDA.*
2) *In the event of NAN non-reception, ANSPs should have local rules in place to trigger the CPDLC start request, with a limited number of re-tries (e.g. 3).*
3) *The LOF and NAN timing can be specific to a given boundary between ATSUs and part of the LoA which are usually linked to OLDI notification (ABI) and/or coordination (ACT) message reception. Timing remains important as the CPDLC start request may still fail if R-ATSU is not identified as CPDLC NDA.*

GM-ITIS-0300 For a given flight, if an OLDI NAN message is not received in due time, the R-ATSU **should** request CPDLC NDA information from the Logon Service through its SWIM "Authority Management Interface" to verify it is the NDA before performing a CPDLC start request.

Not all ANSPs may be able to provide CPDLC CDA and CPDLC NDA information to the Logon Service. In addition, the Logon Service has no means to determine whether the received CDA and NDA information is still valid. Therefore, when ANSPs query the Logon Service for CDA or NDA information of a given flight, they should check the timestamp in the response which indicates the time at which the CDA or NDA information was provided.

GM-ITIS-0310 When requesting CPDLC CDA or CPDLC NDA information from the Logon Service through the SWIM "Authority Management Interface", ANSPs **should** verify the timestamp in the response to determine the accuracy of the data.

Note: Refer to LS-GDS-1210, LS-GDS-1260 and LS-CDA_NDA-Reply.xsd of [Ref 2].

3.3.3.3 Procedures relative to recording and monitoring

Although the Logon Service records all data, this data may be incomplete. In any event, ANSPs also need to record all data that they exchange in accordance with legal obligations.

GM-ITIS-0320 ANSPs **should** record all messages (CM application messages, SWIM service messages), including the SWIM and ATN PDUs, that are exchanged with the Logon Service over all network interfaces.

GM-ITIS-0330 ANSPs **should** retain data transaction information (i.e. the log files and the transferred DLIC data) for three (3) months and thereafter archive it for a period of five (5) years.

The Logon Service provides the authorised ANSP systems with a remote view of service configuration and real-time status information.

GM-ITIS-0340 ANSPs **should** make use of the Logon Service remote view of service configuration and real-time status information to monitor the status of the LS.

Note: Status information implies visibility of overall service availability, alarms, service degradation, planned maintenance, progress relating to service failure recovery actions, configuration parameters set by the operator, activated procedures for CM-contact request, termination timer sender (tts), etc.

3.3.4 Information Sharing with Airspace Users

Each ANSP is responsible for publishing the logon procedures (e.g. coverage, addresses) in the national AIP. This remains valid with the implementation of the Logon Service, and ANSPs will need to adapt their logon procedures regarding the Logon Services once relevant.

GM-ITIS-0350 Each ANSP **should** update the national AIP to be consistent with their transition process for the logon procedures, including the Logon Service GFD(s).

GM-ITIS-0360 Updates of the Logon procedures in the national AIPs **should** be initiated at the earliest possible time to give AUs a reasonable time to update their procedures and avionic databases.

Notes:

1) *The goal is to harmonise a "logon to the Logon Service" procedure. During the transition phase, geographical variations are unavoidable since ANSPs/ACCs will not switch to the LS common service at the same pace.*

2) *As it can take time for AUs to update their avionic databases with new addresses, an adequate period needs to be foreseen for existing ATN B1 and ATS B2 fleet to be updated.*

3) *To ease transition, to accommodate fleet capabilities in terms of backwards compatibility or to accommodate the harmonisation of AU flight deck procedures, ANSPs might request a dual logon (i.e. to the LS and "to the first ACC") for a limited period of time.*

Regarding Logon Service degraded mode (maintenance, failure, …), the LS provider will send adequate information to the ANSPs. This will allow ANSPs to publish the adequate NOTAM(s).

GM-ITIS-0370 Any temporary modification of the national AIP material regarding the Logon Service (coverage, degraded mode, …) **should** be published by the ANSPs by way of NOTAM.

Considering the potential degraded modes of the Logon Service described in section 3.2.4, a back-up procedure for flight crews could be specified in the national AIPs.

GM-ITIS-0380 ANSPs **should** publish in the AIP the following procedures in case of Logon Service logon failure: "logon to the first ACC" (for departing aircraft) or "logon to the current CDA" (for in-flight aircraft).

3.3.5 Training

The logon procedures are transparent for controllers working on CWP, as logon relies on flight crew actions and automation. However, new logon procedures require communication and ATM systems modifications. Furthermore, quality of service and post-operational analysis functions will also need to consider the new logon procedures to the Logon Service.

GM-ITIS-0390 ANSP personnel (e.g. ATSEPs and controllers) **should** be trained to understand the new logon procedures when they are implemented in the ACC communication and ATM systems.

3.4. Guidance for Airspace Users

Before each flight departs within or enters the European IFPZ, a flight plan needs to be submitted to the Network Manager. Once accepted, the processed flight plan is distributed to all concerned ATSUs.

Currently the Logon is performed at the first ACC after departure. With the Logon Service, a single GFD will be used for the first logon and the logon information will be shared with ACCs as well as the ACS. ACC systems will correlate the received logon information with the ground flight plan before starting CPDLC. The ACS does not perform such correlation before starting ADS-C.

GM-ITIS-0400 Airspace users **should** ensure that their flight operations department submits correctly formatted and completed flight plans (e.g. aircraft capabilities, 24-bit aircraft address, ADEP, ADES) to ensure successful ATSU flight plan correlation after crew logon, thereby enabling CPDLC services.

GM-ITIS-0410 Airspace users **should** ensure crew awareness that, even if they successfully performed a logon to an ATSU or to the Logon Service, ATSUs will not initiate CPDLC if flight plan correlation fails.

Note: The Logon Service does not perform FPL correlation, this is performed by ATSUs before starting CPDLC.

National AIPs will indicate to whom flight crews need to address the CM-logon request. The AIPs may include transitional measures and may even temporarily instruct AUs to logon locally or to the Logon Service ground facility designator (GFD). As described in section 3.1, the long-term objective is that all aircraft issue a single CM-logon request to the Logon Service, and that logon information will be made available to ATSUs.

GM-ITIS-0420 Airspace users **should** ensure that the airborne ATC centre database is updated with the Logon Service GFD(s).

Note: These are published in ICAO Doc [Ref 10] and national AIPs and made visible to crews as shown in Figure 4 (i.e. TESTEDUU).

Figure 4 – Airbus A320 datalink logon page

GM-ITIS-0430 Airspace users **should** ensure that their crews are trained on the:

- availability of the Logon Service;
- existence of transitional measures documented in national AIPs;
- benefit of performing the logon procedure during pre-flight preparations or before flying into SES airspace;
- possible limitations of ATN datalink coverage; and
- possible variations of the aircraft datalink capabilities of their fleet.

Notes:

1) *Pilots will only need to logon once to an ATSU or the Logon Service common address (see section 3.1 explaining the long-term objective of European datalink Logon Service).*
2) *For transitional purposes, an existing ground facility designator (GFD) may be re-allocated to the Logon Service (see section 3.1).*

3) *Depending on the aircraft type and avionic versions, the various CPDLC and ADS-C application versions can affect the crew datalink procedures.*

GM-ITIS-0440 Airspace users **should** describe mitigating procedures addressing a failure of the Logon Service in their operational procedures.

Note: A mitigation procedure could be that crews log on to the ATSU in the event of an unsuccessful logon to the Logon Service.

Airspace users need to be aware that when the initial logon is not performed by the crew, login information is not made available to the Logon Service. In such event, the Logon Service could attempt to uplink a CM-contact request to generate a CM-logon request to the Logon Service.

GM-ITIS-0450 Airspace users **should** ensure that the flight deck is notified of CM-contact requests.

Note: CPDLC is inhibited if there was no prior manual logon performed or until a manual logon is performed by the crew.

4. ADS-C Common Service (ACS) and Operational Procedures

4.1. Guidance for the ACS Provider

4.1.1 General

GM-ITIS-0460 The ACS provider **should** develop a training module for its operators covering:

- datalink logon overview (e.g. DLIC and ADS-C);
- ACS design, configuration and operation;
- ADS-C services (i.e. demand, event and periodic contract establishment);
- SWIM service interfaces;
- processes to grant access to ACS users; and
- processes to modify configuration parameters, data sets, lists and activate/deactivate procedures.

Note: Such processes would be subject to ACS governance approval.

GM-ITIS-0470 The ACS provider **should** publish its ACS SWIM service description in the European SWIM Registry.

Notes:

1) *The publication in the registry does not imply ACS user access to the ADS-C data which is subject to authorisation (see section 4.2.1).*
2) *The ACS service definition is already published in the registry. The ACS provider can publish its own service description, which might include additional constraints (e.g. EACP certificates for client authentication).*

4.1.2 Coexistence with other ADS-C servers

ADS-C ground implementations that are adjacent to the ACS coverage area could be in a position to share downlinked ADS-C data before the Logon Service receives logon information. Access to such ADS-C data may be of interest to ACS users.

Other reasons, such as the mitigation of service component failures, could also lead to such information sharing.

GM-ITIS-0480 The ACS provider **should** make use of the SWIM service interfaces as defined in [Ref 2] for the timely operational sharing of ADS-C downlinked data with adjacent ADS-C ground implementations.

Note: Such arrangements would be subject to ACS governance as they would require specific data sharing agreements.

4.1.3 Degraded modes

All ADS-C users depend on the availability of the ACS to receive ADS-C data. Service degraded modes or failure of the ACS will be notified to (or detected by) all ADS-C users via the SWIM service interface or remote service monitoring tools. Regarding this:

- no generic mitigation can be foreseen as most ANSPs connected to the ACS will not deploy the ADS-C contract management application at their centres.
- ANSPs that have logon information, are controlling the aircraft and have implemented the ADS-C contract management, may decide to establish an ADS-C contract.

It is to be noted that ED-228A [Ref 5] and ED-228B [Ref 7] ADSC-OR 15 requires aircraft to prioritise ADS-C contracts for ATSUs that are CDA or NDA. Therefore, depending on how prioritisation is implemented, the ACS ADS-C contract recovery with specific aircraft could be affected.

GM-ITIS-0490 The ACS provider ADS-C contract recovery procedure from a degraded mode or failure **should** take into account the possible CDA/NDA ATSU prioritisation that may be applied by some aircraft, and that some aircraft may already have reached the maximum number of simultaneous connections.

Note: This recommendation is to ensure that the recovery procedure is not delayed nor impaired by contract re-establishment with an aircraft.

4.1.4 Notification of service availability

Each ANSP is responsible for publishing ADS-C related services (e.g. coverage, addresses) in the national AIP and notifying of any service issues in NOTAMs. To be able to adequately perform this task, ANSPs need current information on ACS service availability (maintenance, failure, …). Therefore, the ACS provider needs to send timely service availability information to the ANSPs to allow them to publish any required NOTAM(s).

GM-ITIS-0500 The ACS provider **should** establish agreements with ANSPs (ACS users) in order to exchange adequate and timely service availability information (e.g. coverage, addresses, maintenance, failure…).

4.1.5 Cybersecurity and Safety

The SWIM TI specification allows two methods for client authentication (certificates/username-password) and requires server authentication via X.509 certificates. Therefore, it is up to the ACS provider to decide which method is to be used for client authentication when ACS users connect to the ACS SWIM interfaces as detailed in requirement ACS-GDS-0040 of [Ref 2].

The CP1 AF5 regulation requires the establishment of a common PKI (EACP[8]). However, it is stated that *"services can make use of the common PKI when it becomes operational in order to achieve the cyber security objectives appropriate for the service or services".*

GM-ITIS-0510 The ACS provider **should** make use of certificates for ACS user access authentication on its ground SWIM interfaces.

Note: These certificates can be generated by EACP or an eligible local PKI.

GM-ITIS-0520 Once the EACP becomes operational, the ACS provider **should** make use of it when certifying ACS user access authentication on its ground SWIM interfaces.

Note: The EACP will build a Certificate Trust List (CTL) of eligible local PKIs following an assessment.

EASA publishes numerous "easy access" webpages providing a comprehensive resource for providers on regulations referred by [Ref 1].

- Easy Access Rules for Air Traffic Management/Air Navigation Services[9] (covering Regulation (EU) 2017/373);
- Easy Access Rules for Information Security[10] (covering Regulation (EU) 2023/203).

4.1.6 Testing the ACS

To test the ACS before it is put into service and for the ongoing resolution of technical issues or incidents, as well as post-operational analysis, two use cases need to be addressed regarding ADS-C common service tests.

The first use case corresponds to be the need to test the ACS.

GM-ITIS-0530 Before the ACS is put into service, the ACS provider **should** verify the ACS against an acceptance test plan that at least covers the following points:

- all mandatory requirements applicable to the ACS provider in the Logon and ADS-C common service specifications [Ref 1][Ref 2];
- all mandatory requirements applicable to the ACS in the Logon and ADS-C common service specifications [Ref 1][Ref 2];
- all air-ground and ground-ground ATN interfaces;
- all SWIM ground-ground interfaces and ACS user interoperability testing; and
- interoperability testing with the Logon Service.

GM-ITIS-0540 The ACS provider **should** develop a modular acceptance test plan corresponding to its implementation, the functional requirements of the Logon and ADS-C common service specifications [Ref 1] [Ref 2], and in agreement with the ACS governance.

Note: A modular test plan could facilitate non-regression testing or the testing of new ACS functionalities that have a limited scope.

GM-ITIS-0550 The ACS provider's test plan cases **should** include traceability to the requirements of the Logon and ADS-C common service specifications [Ref 1][Ref 2].

GM-ITIS-0560 The ACS provider's air-ground test plan cases **may** be performed using air-ground simulation facilities, real avionics on a testbed or with real aircraft operating in a real datalink environment.

A second use case corresponds to the need for ACS users to benefit from a test platform of the ACS to be able to test the SWIM interfaces between ground systems and ACS before starting operations. Moreover, this test platform can also be useful for the resolution of technical issues or incidents, as well as post-operational analysis.

GM-ITIS-0570 The ACS provider **should** ensure that a reference test platform of the ACS and its interfaces is made available for ACS users.

GM-ITIS-0580 The ACS provider **may** provide ACS users with access to an available reference test platform over public internet.

4.2. Guidance for all ACS Users

4.2.1 Service registration and access

The ACS governance defines the policies regarding user registration, access, and data usage. The ACS provider configures and operates the ACS. Authentication is required to access data through the ACS SWIM interfaces, meaning that user registration and accounts need to be pre-configured. Multiple accounts may need to be pre-configured to respond to specific ACS user operational or technical needs.

GM-ITIS-0590 ACS users **should** detail their specific operational needs for ACS access with the ACS provider.

4.2.2 Service availability

The ACS SWIM "Service Status Monitoring Interface" provides ACS users with the service status of the ACS. This information can be relayed to the controller or responsible person.

GM-ITIS-0600 ACS users **should** make use of the ACS "SWIM Service Status Monitoring Interface" to determine the status of the ACS.

Note: This supports ATSU compliance to SR-GD-ADSC-2A and SR-GD-ADSC-13B requirements of [Ref 5] [Ref 7].

In the event of detected failures, there is a need to avoid excessive and simultaneous ADS-C contract establishment requests from ADS-C application capable ACS users.

GM-ITIS-0610 In the event of a detected failure of the ACS, only ACS users that have implemented the ADS-C application and that are ATSU CDA or ATSU NDA **should** establish ADS-C contracts with aircraft in their area of responsibility.

GM-ITIS-0620 During a detected failure of the ACS, ACS users **should** abort established ADS-C contracts with the aircraft once they are no longer ATSU CDA.

GM-ITIS-0630 Upon recovery of the ACS, ACS users **should** abort established ADS-C contracts with the aircraft.

4.2.3 Periodic contracts

The ACS ensures that only one periodic contract is initiated with a given aircraft, however, this contract can be updated in accordance with the ATS B2 standards. The ACS ADS-C periodic contract adjustment procedure (see section 4.5.4 of [Ref 1]) can adjust the contract reporting rate based on the phase of flight and/or have the aircraft provide TOA range information for a specific pre-configured waypoint.

GM-ITIS-0640 For an active periodic contract with a given aircraft, ACS users **should** be capable of receiving ADS-C reports at varying reporting rates which may include TOA range values for a waypoint.

Notes:

1) *ACS-DAT-0200 [Ref 1] recommends that the ACS applies a reporting rate of 3 minutes (climb/descent) or 5 minutes (en-route).*

2) *ANSPs may consider displaying a countdown to the next expected periodic contract on the controller HMI.*

The ACS does not verify whether a periodic report has been received within the time period of the reporting rate.

GM-ITIS-0650 For an active periodic contract with a given aircraft, ACS users **should** be capable of detecting and acting on the non-receipt of an ADS-C periodic report.

Note: This corresponds to ATSU compliance to requirement ADSC-OR 10 of [Ref 5] [Ref 7], which is not supported by the ACS.

4.2.4 Event contracts

The ACS does not establish event contracts that require the aircraft to transmit a baseline report. Indeed, the baseline report is to be sent by the aircraft when it has accepted an event contract that includes level change, airspeed change, ground speed change and EPP tolerance change.

No specific guidelines are provided to ACS users on detecting the absence of a baseline report.

Note: The detection of absent baseline reports corresponds to ATSU compliance to requirement ADSC-OR 18 of [Ref 5] [Ref 7], which is not supported by the ACS.

4.2.5 Non-compliance notifications

The ACS will always initiate ADS-C event and periodic contracts with the optional ADS-C data groups defined in [Ref 1].

For the purpose of ADS-C message set version 1 these options are:

- event: waypoint change, extended projected profile flight plan change; and
- periodic: ground vector, air vector, projected profile, meteorological information, extended projected profile, speed schedule profile, TOA range.

For the purpose of ADS-C message set version 3 these options are:

- event: waypoint change, extended projected profile flight plan change, active VHF change, hold status change, EPP holdentry lateral type change, EPP trajectory intent status change, EPP level constraint status change, EPP speed constraint status change; and
- periodic: ground vector, air vector, projected profile, meteorological information, extended projected profile, speed schedule profile B, TOA range.

The ACS will initiate demand contracts on the request of ANSPs with optional ADS-C data groups matching the ADS-C application version supported by the aircraft as defined in [Ref 2].

Aircraft implementations may not implement all the requested optional ADS-C data groups as requested by the ACS. In such cases, the aircraft will accept the contract but will provide a non-compliance notification and indicate which requested optional ADS-C data groups are not supported.

GM-ITIS-0660 ACS users **should** handle non-compliance notifications whereby not all requested ADS-C data groups will be present in ADS-C reports.

4.2.6 TOA range

The time of arrival (TOA) range is an optional ADS-C data group that can be present in any ADS-C reports of periodic or demand contracts. It provides the currently computed estimated time of arrival at a waypoint as well as the earliest and latest time of arrival at the waypoint. It also indicates whether a wind error model has been used.

The TOA range can be part of an ADS-C report relating to periodic contract. Indeed, when the ACS determines that an ADS message of a flight to a specific aerodrome of destination (ADES) includes an EPP waypoint matching a preconfigured [ADES, waypoint] pair, it will adjust the periodic contract to request the TOA range for the waypoint.

The TOA range can also be part of an ADS-C report relating to demand contract request.

GM-ITIS-0670 ACS users **should** be capable of receiving TOA range information as part of ADS-C reports relating to periodic and demand contracts.

4.2.7 Validating the received ADS-C data

The ACS publishes the received ADS-C data on its SWIM interfaces according to the XML schemas defined in [Ref 2] (also available on https://github.com/eurocontrol-swim/adsc-ground-distribution-service-schemas). In view of the multiple ADS-C application versions, each publication includes the version either in the application properties section of the AMQP bare message or in the body of a HTTP reply. ACS users will need to take the version into account when making use of the data.

GM-ITIS-0680 ACS users **should** process received ADS-C data considering the ADS-C application version.

In exceptional cases, the ACS may receive an ADS-C report with an older timestamp than a previously received ADS-C report. The ACS does not verify whether ADS reports are received in sequence before their distribution.

GM-ITIS-0690 ACS users **should** be capable of handling out of sequence or absent ADS-C reports.

Note: This supports ATSU compliance to requirements SR-GD-ADSC-14A, SR-GD-ADSC-15A, SR-GD-ADSC-15B, SR-GD-ADSC-24A and SR-GD-ADSC-24B of [Ref 5] [Ref 7].

GM-ITIS-0700 ACS users **should** be capable of handling the receipt of ADS-C reports with XML tags unsupported by their systems and determine whether the reports are to be partially or completely discarded.

Although, the ACS publishes all received ADS-C application service primitive exchanges with aircraft on its “SWIM Flight Status Data Publication Interface”, ACS users need to be aware that this is for informational purposes and that these can be out of sequence.

GM-ITIS-0710 ACS users **should** avoid developing state machine software or procedures that depend on the receipt of ADS-C application service primitives published by the ACS and use these for informational purposes solely.

The ACS validates received ADS messages by applying the application message integrity check (AMIC) checksum as defined in [Ref 6]. In exceptional cases, the checksum will be unable to detect non-provided information or meaningless information that was transmitted at source. For example, Figure 5, illustrates the receipt of an ADS-C report in which no EPP ETA waypoint nor flight level information were provided, which is displayed as empty FLs or ETAs containing zeros. It was identified that this occurred at the time a report was being generated (due to a demand contract) while the FMS process was already busy re-computing the EPP and couldn't provide the information. The subsequent, periodic report contained the updated EPP.

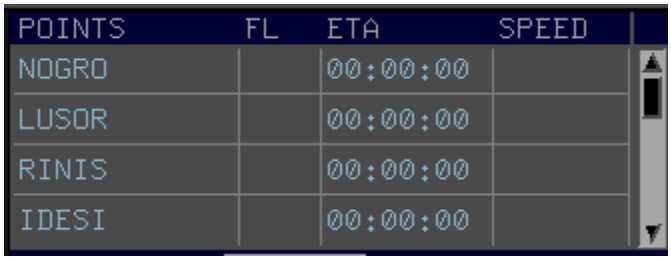

Figure 5 – MUAC displaying EPP data absence (empty cells and zeros)

The above-described example is likely to be resolved by a multi-processing or a software module update of the concerned avionics. However, similar cases can occur and may not be detected by the ACS AMIC algorithms.

GM-ITIS-0720 ACS users **should** always verify the appropriateness and completeness of received data and not just rely on the AMIC checksum performed by the ACS.

Note: This supports ATSU compliance to requirements SR-GD-ADSC-11B, SR-GD-ADSC-17A and SR-GD-ADSC-17B requirements of [Ref 5] [Ref 7].

The numerical variables of the EPP profile (FL, ETA, Speed) as well as the location of vertical types (ToC/ToD/crossover) are all heavily dependent on the correct entry of weather information, clearances and constraints by the flight crew.

GM-ITIS-0730 ACS users **should** always make use of ADS-C data with the understanding that the reliability of the received data depends on flight crews updating the FMS.

Note: ANSPs can refer to section 4.3.3.7 for guidance on data reliability.

Most systems will attempt to use the AIRAC database to match coordinates to an existing waypoint name, however this database is subject to change every AIRAC cycle.

GM-ITIS-0740 ACS user systems **should** always make use of the latest AIRAC database when matching or converting LatLong coordinates to waypoint names.

4.3. Guidance for ANSPs

4.3.1 General

As ANSPs qualify as ACS users, the guidance developed in section 4.2 is relevant to ANSPs.

GM-ITIS-0750 ANSPs **should** develop a computer-based training module for controllers introducing ADS-C covering:

- history (e.g. oceanic vs continental);
- ADS-C data groups (e.g. projected profile vs extended projected profile, optional groups);

- ADS-C application versions;
- system design and operation;
- the use of demand contract requests and their positive or negative outcome;
- dependency on pilot FMS updates;
- HMI changes; and
- known issues/situations to avoid (i.e. human factors considerations).

GM-ITIS-0760 ANSPs **should** train controllers on the impacts which open and close clearances have on the reliability of EPP data.

Note: Closed clearances will allow aircraft to continue operating in a managed mode, thereby improving the reliability of the ADS-C EPP trajectory information.

GM-ITIS-0770 ANSP controllers **should** always use ADS-C data as a supporting tool to increase awareness and cross-check with other available information before making operational decisions.

4.3.2 Information sharing with the ACS

4.3.2.1 General

The ACS does not perform flight plan correlation as foreseen by the ATS B2 standards [Ref 5] but does verify if an existing flight plan for a given flight is available with the Network Manager (ACS-FCT-0650 of [Ref 1]).

GM-ITIS-0780 ANSP systems **should** attempt to correlate flight information of ACS established ADS-C contracts with their existing flight plan information.

Note: This supports ATSU compliance to SR-GD-ADSC-20B and SR-GD-ADSC-20C requirements of [Ref 5] [Ref 7].

4.3.2.2 Procedures relative to demand contracts

The ACS ensures that only one demand contract is initiated with a given aircraft, as the ATS B2 standards specify that only one on-going demand contract can exist between peers.

Depending on the given aircraft capabilities, different ADS-C application versions may or may not be supported. The ADS-C application version in use for a given flight can be obtained from the Logon Service SWIM “Asynchronous Logon Information Publication Interface” or “Logon Data Publication Interface”, or from the ACS SWIM “Flight Status Data Publication Interface” or “Data Publication Interface”.

Note: Refer to LS-GDS-3000, LS-GDS-4390, ACS-GDS-3420 and ACS-GDS-4060 of [Ref 2].

GM-ITIS-0790 ANSP systems **should** ensure that demand contract request parameters submitted to the ACS correspond to those of the application version supported by the aircraft.

Note: This supports ATSU compliance to SR-GD-ADSC-23A requirement of [Ref 5].

GM-ITIS-0800 For a given aircraft, ANSP systems **should** be designed to present controllers with demand contract request parameter options that are compatible with the aircraft ADS-C application version.

Note: See Figure 22 which provides an example screenshot of the TOA range selection window for controllers which will lead to the creation of a demand contract request.

ANSPs can submit their demand contract request to the ACS via the SWIM "Demand Contract Request Interface" which may return a positive or negative outcome. In the event of a negative outcome, the interface will indicate a reason (missing logon information, existing pending demand contract, no active contract, ADS-C application version mismatch or that the aircraft is on the ACS Reject list) as described in section 3.2.5.1.1 of [Ref 2].

GM-ITIS-0810 ANSP systems **should** be designed to handle and display negative outcomes of demand contract requests issued by controllers.

Note: See ACS-GDS-0130 to ACS-GDS-0210 of [Ref 2]. This supports ATSU compliance to SR-GD-ADSC-1B and SR-GD-ADSC-5A requirements of [Ref 5].

GM-ITIS-0820 When the ACS demand contract request interface indicates that there is an already existing contract being processed with the same aircraft, ANSP systems **should** determine if the existing demand contract already satisfies the controller's request or re-submit the demand contract request after a time interval.

Note: ANSPs could make use of the ACS SWIM "Flight Status Interface" to determine whether the latest demand contract report for a given flight meets the controllers' needs and is sufficiently recent (see ACS-GDS-0610 of [Ref 2]).

The ACS initiation of demand contract requests, on behalf of ANSPs, is de-synchronised with avionic data processing cycles. Depending on avionic implementations, this can lead to the absence of expected ADS-C report data fields, such as the empty EPP ETA value case described in section 4.2.7.

GM-ITIS-0830 In the event of a negative outcome or inappropriate data content, ANSP systems **should** wait 40 seconds before re-submitting demand contract requests to ensure the aircraft avionics have had sufficient time to compute updated information to be downlinked.

Notes:

1) *As avionic system update cycles are of the order of 20 seconds, submitting multiple demand contract requests within the same time interval is wasteful and can be counterproductive, as described in section 4.2.7.*

2) *ANSPs could consider displaying a wait period indication or inhibit functionality on the controller HMI.*

4.3.2.3 Procedures relative to TOA Range (demand and periodic)

This section describes the use of the TOA range function with ADS-C demand and periodic contracts.

GM-ITIS-0840 When making demand contract requests to the ACS with a TOA range relating to a specific waypoint, the ANSP systems **should** ensure that the complete LatLong coordinates and non-flight-related ToC/ToD/crossover points are provided, as specified in the SWIM interface specification [Ref 3].

Notes:

1) *The ACS will reject demand contract requests with a TOA range parameter that do not include the complete LatLong coordinates of the waypoint.*

2) *TOA range requests to points which are characterised solely by vertical types (without a lateral type parameter) may be rejected by the aircraft.*

3) *The aircraft will reject the demand contract request if the TOA range request relates to a waypoint that is not on the route (i.e. as known to the aircraft navigation database, see Table 6-6 [Ref 7]). This also applies to LatLong points (abeam points, uplinked LatLong points).*

GM-ITIS-0850 ANSPs **should** request the ACS provider to configure [ADES, waypoint] pairs for the ACS periodic contract TOA range adjustment.

GM-ITIS-0860 ANSPs **should** ensure the pre-configuration of [ADES, waypoint] pairs within their AoI with the ACS provider on behalf of AMAN operators.

GM-ITIS-0870 ANSP systems that have implemented the ADS-C application **should** ensure that the complete LatLong coordinates are provided when making use of the TOA range function.

Note: Flight-related ToC/ToD/crossover points cannot be referred to.

4.3.2.4 Procedures relative to recording and monitoring

Although the ACS records all data, this data may be incomplete. In any event, ANSPs also need to record all data that they exchange in accordance with legal obligations.

GM-ITIS-0880 ANSPs **should** record all messages (ADS-C application messages, SWIM service messages), including the SWIM and ATN PDUs, that are exchanged with the ACS over all network interfaces.

GM-ITIS-0890 ANSPs **should** retain data transaction information (i.e. the log files and the transferred ADS-C data) for three (3) months and thereafter archive it for a period of five (5) years.

GM-ITIS-0900 ANSPs **should** make use of the ACS remote view of the service configuration and real-time status information to monitor the status of the ACS.

Note: This supports ATSU compliance to SR-GD-ADSC-2A, SR-GD-ADSC-3A and SR-GD-ADSC-13B requirements of [Ref 5].

4.3.3 ADS-C data display

4.3.3.1 Display of trajectories and discrepancies

4.3.3.1.1 Display of aircraft capabilities

GM-ITIS-0910 ANSP systems **should** ensure that controllers are visually aware of the aircraft which are ADS-C datalink capable and their ADS-C connection status (i.e. established ADS-C contracts).

Notes:

1) *ANSP systems are to provide an indication of ADS-C contract establishment (SR-GD-ADSC-1A and SR-GD-ADSC-1B of [Ref 5] [Ref 7]).*

2) *The connection status could include the ADS-C application version information.*

Below Figure 6 and Figure 7 show the MUAC HMI track symbols and labels providing controllers with the aircraft capabilities and connection status for both CPDLC and ADS-C.

Figure 6 – MUAC track label with ADS-C status

	CPDLC capable
	CM logon received (no CDA received)
	CM logon received and ADS-C connected
	CPDLC connected (CDA received), no ADS-C connected
	CPDLC connected (CDA received) and ADS-C connected

Figure 7 – MUAC datalink track label symbols

Below Figure 8 shows the datalink indicator of the label for ITEC.

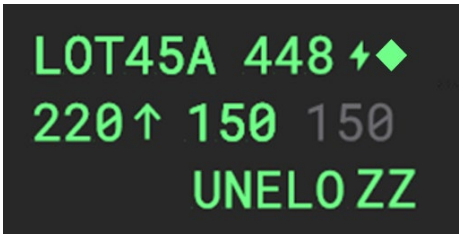

Figure 8 – ITEC datalink track symbol with CPDLC and ADS-C status

Two separate symbols are used for datalink on the top-right of the label. The lightning symbol has several colour variations for indicating the status of the CPDLC connection (CM logged but no CPDLC connection, CPDLC connected with no pending action, CPDLC uplink message sent with pending downlink response, CPDLC downlink message received with pending uplink response, and Error/Unable on UNABLE reception to uplink message, operational timeout or other errors.), plus a supplementary indication to indicate if it is a FANS or ATN connection. The diamond symbol is for indicating the status of ADS-C. On the latest prototype, the filled diamond signifies that EPP data has been received, which may be enhanced to reflect the difference between ADS-C contract status, ADS-C application version and ADS-C data receipt.

4.3.3.1.2 Display of EPP trajectory

CP1 AF6 requires that ATC systems allow controllers to display the route of the downlinked trajectory. Depending on the controller working position HMI, this can be a combination of a displayed route and a displayed list of waypoints.

GM-ITIS-0920 ANSP systems **should** allow controllers to display the full or partial EPP and the ground flight planned trajectory.

Note: A partial display means that a segment within the AoI of the controller is displayed.

GM-ITIS-0930 ANSP systems **should** allow controllers to differentiate the EPP from the ground flight planned trajectory when either or both are displayed.

Figure 9 shows the MUAC HMI displaying both EPP (magenta) and the ground flight planned trajectory (blue) in the horizontal plane in different colours. The flight levels are displayed numerically. These are displayed once the controller hovers over a designated area of the track data block.

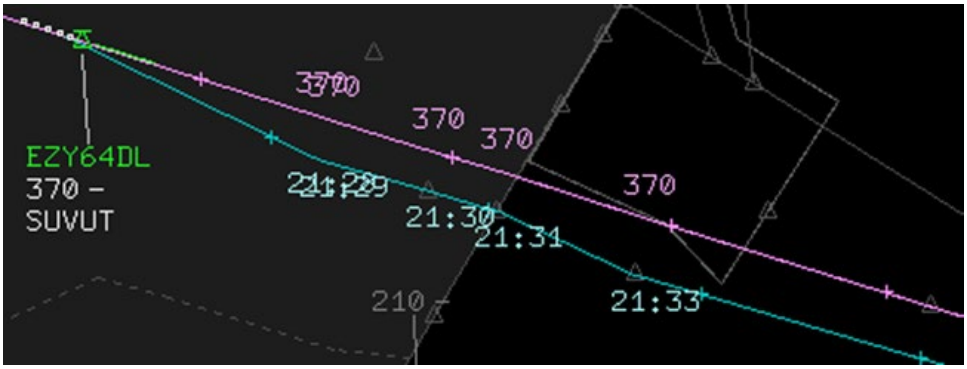

Figure 9 – MUAC display of EPP (magenta)

Figure 10 shows the HMI for the EPP display for ITEC, where only the EPP information is presented. For the shown PANSA Environment, the EPP is displayed in pink, whereas DFS displays the EPP in blue.

Figure 10 – ITEC display of EPP (pink)

GM-ITIS-0940 ANSP systems **should** allow controllers to simultaneously display multiple aircraft EPP on the HMI.

To enhance the EPP displayed trajectory, additional information can be shown to increase controller awareness. Indeed, as shown in Figure 5, flight levels are displayed and in Figure 6 estimated time of arrival, waypoint names and flight levels are displayed. The display of other key lateral or vertical types could also increase controller awareness.

GM-ITIS-0950 ANSPs **should** select additional EPP content to be displayed on the *route of the downlinked trajectory* for controller awareness.

Note: Such EPP content can be flight levels, ETA at waypoints, top of climb, top of descent.

GM-ITIS-0960 ANSPs **may** select EPP content to be displayed on the ground flight planned route for controller awareness (e.g. cross-over points, top of climb (ToC), top of descent (ToD)).

GM-ITIS-0970 ANSP systems **should** display the cross-over, top of climb (ToC) and top of descent (ToD) waypoints on the displayed EPP trajectory.

Figure 11 shows the MUAC HMI displaying the ToC (upwards magenta triangle with horizontal line above) and the flight level.

Figure 11 – MUAC overlay display of EPP content (ToC vertical type)

4.3.3.1.3 Display of discrepancy warnings

CP1 AF6 requires that ATC systems provide a warning to controllers in case of a detected discrepancy between the downlinked aircraft trajectory and the ground system trajectory elaborated using the filed flight plan route. Section 4.3.5 provides further guidance on how to detect a discrepancy.

GM-ITIS-0980 ANSP systems **should** warn controllers of discrepancies within their own airspace.

Notes:

1) *ANSPs will need to adapt this recommendation to their local environment and working methods.*

2) *Discrepancies can be detected in two or three dimensions.*

GM-ITIS-0990 ANSP systems **may** warn controllers of discrepancies in areas adjacent to their sector.

GM-ITIS-1000 Notifications of discrepancy warnings to controllers **should** be visual.

Note: Different visual warnings could be used to support ANSP working methods.

GM-ITIS-1010 Discrepancy warnings **should** cease once the controller has taken action or the conformance monitoring conditions detecting the discrepancy no longer apply (see section 4.3.5).

Note: As described in section 4.3.5, it may take time for the resolution of discrepancies be reflected in downlinked ADS-C reports.

MUAC provides a visual notification to controllers by displaying a “?” on the label when a discrepancy between ground and EPP trajectory is detected. The warning is to the controlling sector and the next-in-sequence sector, to avoid controllers having to handle too many or irrelevant warnings. This is shown in Figure 12.

Figure 12 – MUAC discrepancy warning

ITEC provides a visual notification of discrepancy warnings on the label as shown in Figure 13. The “ADS-C diamond” turns to pink if there is any (2D or 3D) discrepancy for the flight relevant for the controller. If there is a 2D discrepancy, an icon (three dots on PANSA) is shown next to the next waypoint name, and a “1” (for Type1 2D discrepancies) or “2” (for Type2 2D discrepancies) is shown accordingly next to the ADS-C diamond. Additionally, if the next waypoint is part of the discrepancy, the name is shown in pink.

The differences between ITEC Type1 and Type2 2D discrepancies are further described in Annex B.8.

Figure 13 – ITEC discrepancy warning

4.3.3.1.4 Display of discrepancies

GM-ITIS-1020 Controllers **should** be able to visualise the nature of the discrepancy.

Note: This can be achieved by displaying and comparing both trajectories on the HMI or highlighting specific elements.

ITEC highlights the specific discrepancy segment on the EPP by making use of thick segments as shown in Figure 14.

Figure 14 – ITEC highlighting of discrepancies with thicker segments

Figure 15, shows the EPP discrepancy with a thicker pink segment compared to the blue coloured ground flight planned trajectory on ITEC.

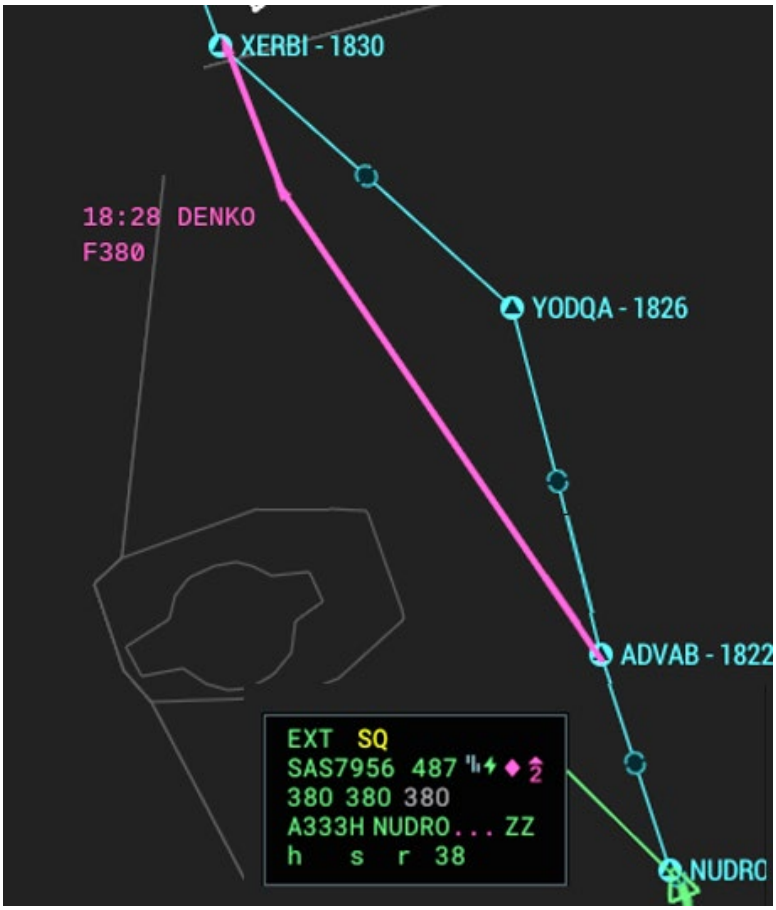

Figure 15 – ITEC highlighting of EPP discrepancy vs ground flight planned trajectory

4.3.3.2 Display of extended projected profile (EPP) content

The extended projected profile is an optional ADS-C data group that can be present in any ADS-C contract report. It is to be noted that the ACS will request EPP changes when initiating an event contract.

In addition to the EPP displayed trajectory on the HMI, the ANSP system can extract all EPP data within the received ADS-C report and display this to the controller. Indeed, the EPP data contains a sequence of waypoints by LatLong coordinates and for each waypoint may include a

level, name, estimated time, estimated speed, vertical type, lateral type, level constraint, speed constraint, and time constraint. The EPP data also contains the current gross mass (currently not envisaged to be displayed to controllers) and the trajectory intent status (its display is currently under evaluation).

GM-ITIS-1030 ANSP systems **should** allow controllers to visualise the data content of the downlinked EPP clearly indicating the related aircraft identification to avoid any possible confusion.

GM-ITIS-1040 ANSP systems **should** provide controllers with a minimal set of tools to hide/show specific EPP content and provide an indication of the time of data reception.

GM-ITIS-1050 ANSP systems **should** display EPP waypoints by their name or a short version of the LatLong coordinates.

GM-ITIS-1060 ANSP systems **should** display the most meaningful waypoint lateral and vertical types to avoid overloading controllers with information.

Note: ED-228A [Ref 5] defines 10 lateral types and 9 vertical types, ED-228B [Ref 17] defines 3 additional lateral types. See below sections 4.2.4.1.2 and 4.2.4.1.3.

In addition to the waypoint coordinates, the abeam waypoint lateral type of ED-228B [Ref 7] will contain the name of the original waypoint to which the abeam point is related. A simple naming scheme could be used to facilitate controllers working with such waypoints. For example, the coordinates of an abeam waypoint of a waypoint named “SOPOK” could be displayed as a waypoint named “ASOPOK”.

GM-ITIS-1070 ANSPs **should** develop a naming convention for abeam waypoints to facilitate controller display and the uplinking of clearances.

Figure 16 shows the MUAC HMI dedicated flight information message window that the controller can open to display the content of the most recently received EPP data and its time of receipt. A description of the window content is described below.

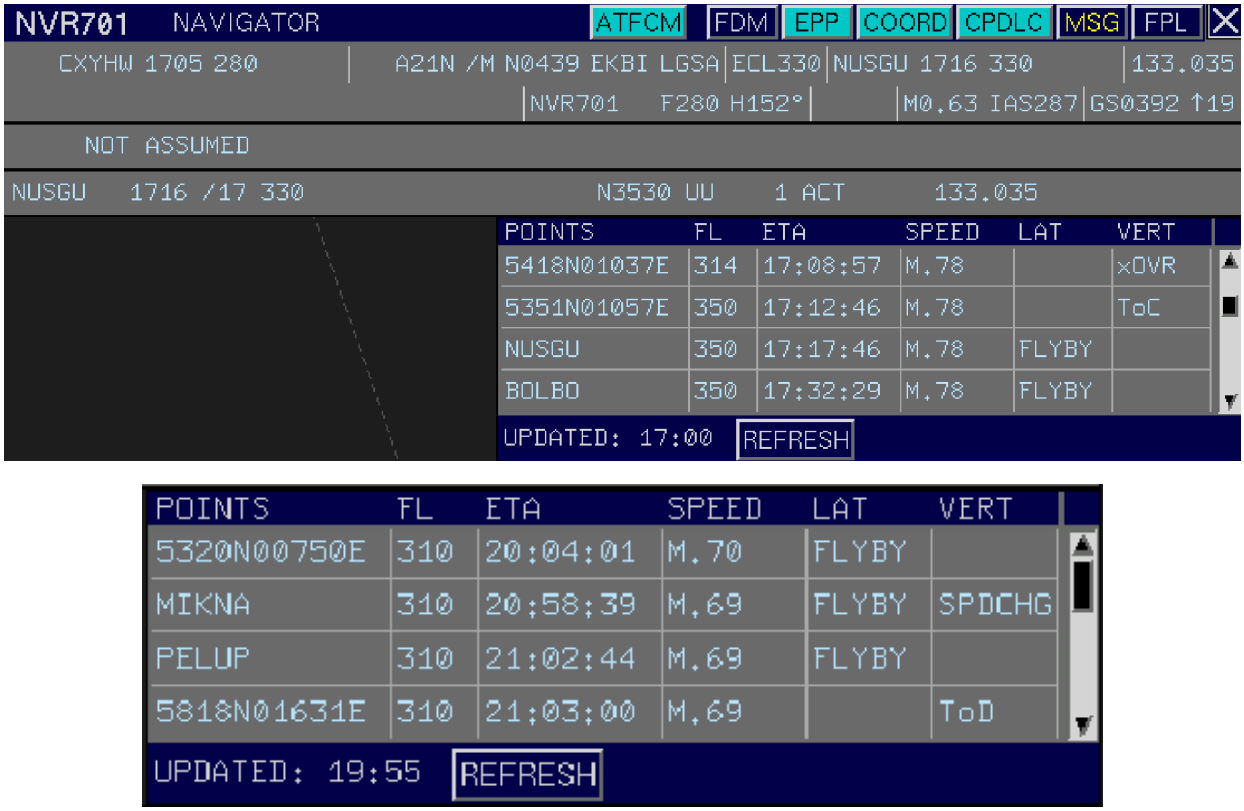

Figure 16 – MUAC EPP sub-window of the Flight Information Message (FIM)

- **POINTS**

This column shows the name of the navigational fix or the abbreviated LatLong coordinates (if no fix name exists). MUAC does not show the full coordinates to controllers, as it does not bring any operational value.

Notes:

1) *Typically, waypoints in LatLong coordinates only are those with a vertical type such as top of climb, top of descent, crossover, start of level, etc.*

2) *Lateral waypoints which are still ahead of the aircraft but will not be overflown (i.e. due to a "direct to" clearance) will generate "pilot-defined waypoints" abeam of the original waypoints. These points are only translated for the ground system as "fly-by" type lateral waypoints without a name, therefore they only show up as coordinates on the controller's screen.*

In the EPP window, MUAC controllers can hide all points which are downlinked without a point name (LatLong) and if they only have FlyBy and/or FlightPlanWayPoint lateral types, without any vertical type (e.g. ToD, crossover will almost always be a LatLong without a point name). These points should still be shown on the extrapolated EPP profile. Filtering in the EPP window provides the controller with a more easily digestible data table and an immediate view on the name of the next waypoint that the aircraft is navigating to.

- **FL (Flight Level)**

The downlinked intended flight level of the aircraft at the given geographical location. The current Airbus system always expresses altitudes in flight levels, even below the transition level.

- **ETA**

The downlinked intended estimated time of arrival of the aircraft at the given waypoint.

- **SPEED**

The downlinked aircraft intended speed in MACH or IAS – depending on whether the waypoint is above or below the crossover level/altitude.

- **LAT and VERT (Lateral and Vertical types)**

This column characterises the waypoint in an abbreviated form. Waypoints can have multiple lateral and/or vertical types, their use is further described in sections 4.2.4.1.2 and 4.2.4.1.3.

Figure 17 shows the EPP tabular window on ITEC that the controller can open to display all the content of the most recently received EPP data. The displayed column headings are similar to the MUAC window, with the following layout differences:

- when EPP waypoints do not include a `name` field, the POINT-NAME column is left empty;
- currently, no column displays the lateral or vertical types;
- the CONSTRAINT column can include level and speed constraints;
- lateral intent flags are shown on the bottom right (LVS- Indicating Lateral/Vertical/Speed Managed, Time Non-Managed); and
- the ADS-C speed schedule profile (nominal speeds) is shown on the right column.

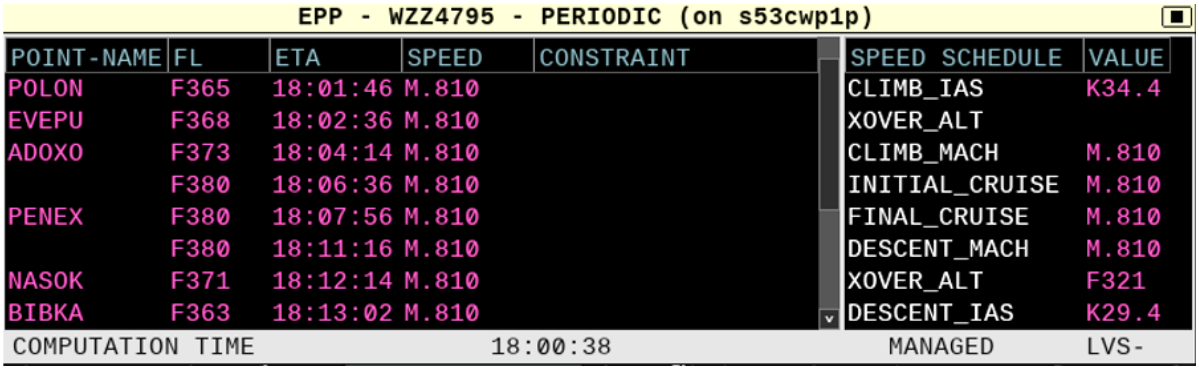

Figure 17 – ITEC EPP tabular window

GM-ITIS-1080 ANSP systems **may** display the trajectory intent status or its impact on the EPP to the controller.

Note: The display of such information is still under evaluation.

In Figure 18, the information is displayed on the bottom right part of the EPP Tabular Window. In this figure, the trajectory intent status is shown as Lateral+Vertical+Speed managed and not time-managed (i.e. no RTA).

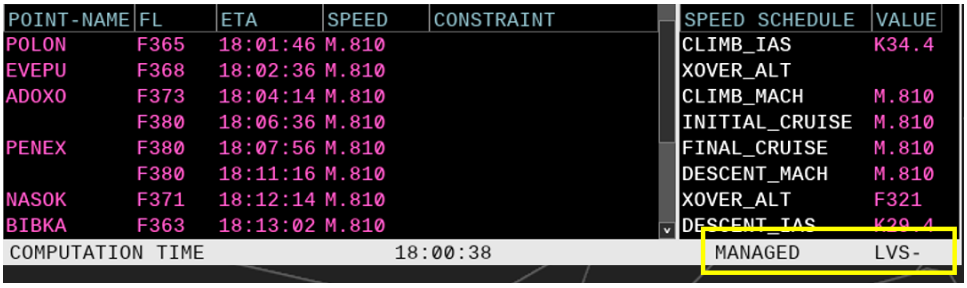

Figure 18 – ITEC display of trajectory intent status

The above examples and the potential of 128 waypoints in the EPP, underlines the need to avoid overloading controllers with information and ensuring visual consistency between the displayed trajectory and tabular windows.

GM-ITIS-1090 Within the display of the EPP content, ANSP systems **may** filter LatLong waypoints that do not have a vertical type relevant to the controller (e.g. start of level change) and not followed by discontinuity nor by an ABEAM lateral type (Rev B).

GM-ITIS-1100 ANSP systems **may** visually link the selection of EPP content and the displayed trajectory to provide visual consistency for controllers.

Figure 19 shows a MUAC filtering feature using the 'SHOW LL' button (located on the bottom right corner). De-selecting the 'SHOW LL' button will filter out all waypoints without a name, that have no relevant lateral nor vertical type attributes, before the aircraft reaches the next known waypoint GRUDA. Figure 20 shows that when the controller hovers the mouse pointer over any point in the EPP sub-window, the HMI will simultaneously display a pink filled circle on the ADS-C flight leg indicating the position on the EPP trajectory.

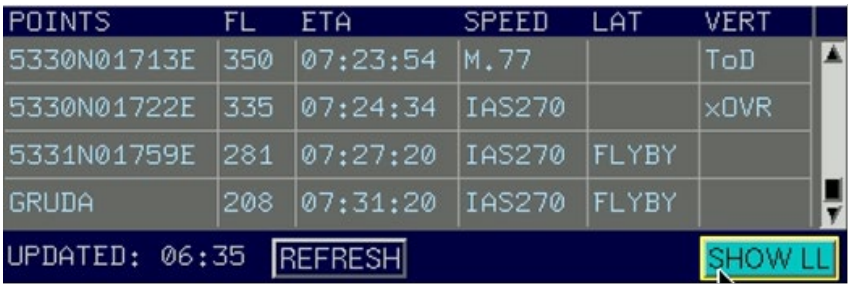

Figure 19 – MUAC EPP sub-window LatLong waypoint toggle

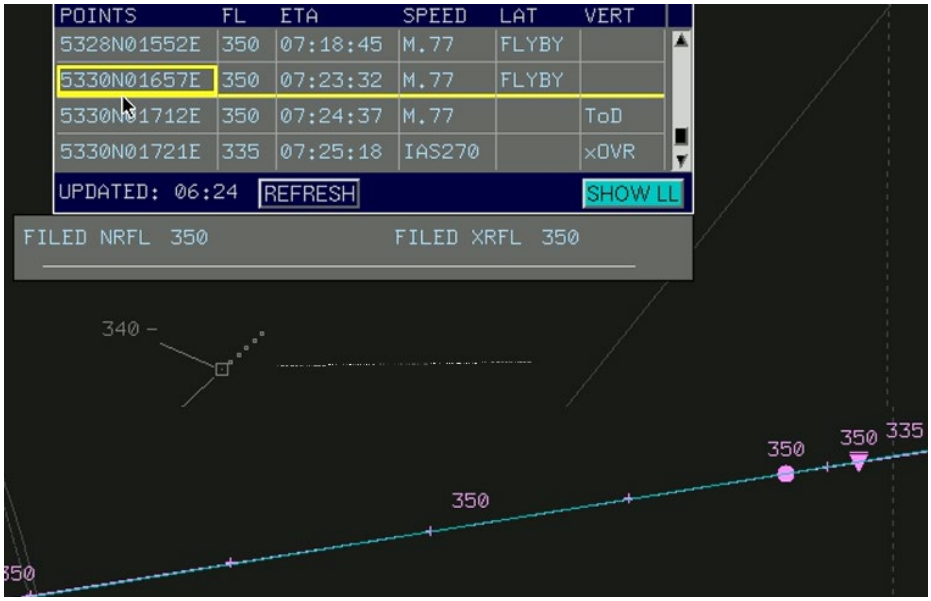

Figure 20 – MUAC Linking EPP trajectory and sub-window selection

4.3.3.3 Display of speed schedule profile

The speed schedule profile is an optional ADS-C data group that can be present in any ADS-C periodic or demand contract report. The use of the speed schedule is further explained in section 4.2.4.4.

GM-ITIS-1110 When the speed schedule profile is provided as part of an ADS-C report, ANSP systems **should** provide tools for the controller to display speed schedule information for a given aircraft.

Figure 21 shows the MUAC HMI window that the controller can open to display recently received speed schedule information (min-max values). Specific rules are defined to display the range of speeds of interest which depend on the phase of flight and aircraft position. In particular, the speed range matching the aircraft capabilities are highlighted in magenta, so that the controller is aware of them before giving a speed clearance.

Figure 21 – MUAC speed schedule display on the Flight Information Message (FIM)

On the ITEC display shown in Figure 22, the speed schedule (nominal, preferred values) for all phases of flight is displayed on the right part of the EPP tabular window. If a value is missing, the value field is left blank.

EPP - WZZ4795 - PERIODIC (on s53cwp1p)

POINT-NAME	FL	ETA	SPEED	CONSTRAINT
POLON	F365	18:01:46	M.810	
EVEPU	F368	18:02:36	M.810	
ADOXO	F373	18:04:14	M.810	
	F380	18:06:36	M.810	
PENEX	F380	18:07:56	M.810	
	F380	18:11:16	M.810	
NASOK	F371	18:12:14	M.810	
BIBKA	F363	18:13:02	M.810	

SPEED SCHEDULE	VALUE
CLIMB_IAS	K34.4
XOVER_ALT	
CLIMB_MACH	M.810
INITIAL_CRUISE	M.810
FINAL_CRUISE	M.810
DESCENT_MACH	M.810
XOVER_ALT	F321
DESCENT_IAS	K29.4

COMPUTATION TIME 18:00:38 MANAGED LVS-

Figure 22 – ITEC speed schedule display in the EPP tabular window

<u>Note:</u> The crossover altitude shown on the XOVER_ALT row is not a computation from the speed values but comes from the FL field of the points marked as crossover on the EPP. Here, first "XOVER_ALT" is not filled as no climb crossover point was received.

4.3.3.4 Display of the TOA range

The TOA (Time of Arrival) range is an optional ADS-C data group that can be present in any ADS-C periodic or a demand contract report.

For periodic contracts, the waypoint will have been pre-configured on the ACS and the ANSP system can make use of the data.

GM-ITIS-1120 ANSP systems **may** provide tools for the controller to visualise TOA range information received within periodic contract reports.

Note: As such waypoints may be outside of the ANSP's AoI they could be filtered out.

Demand contracts can be established once the controller needs to ask the FMS of the aircraft about the calculated earliest and latest time of arrival over a given waypoint. Such demand contract requests are forwarded to the ACS through its SWIM interface.

GM-ITIS-1130 ANSP systems **should** provide tools for the controller to request a TOA range for a given aircraft at a given waypoint.

Note: ANSP systems will forward the controller request to the ACS through its SWIM "Demand Contract Request Interface" [Ref 2] which will initiate the ADS-C demand contract request.

GM-ITIS-1140 ANSP systems **should** provide tools for the controller to visualise TOA range information received within demand contract reports if it corresponds to one of their requests.

GM-ITIS-1150 ANSP systems **may** provide tools for the controller to visualise TOA range information received within demand contract reports requested by other ACS users.

GM-ITIS-1160 ANSP systems **should** be designed to handle the receipt of multiple TOA range information reports for one or more waypoints provided in demand or periodic contract reports.

Note: ANSPs need to be aware that TOA range information can be periodically received or can result from another ACS user demand contract request, and if unhandled, could overwrite the existing displayed TOA range information.

Figure 23 shows the MUAC DATALINK/TOA RANGE menu for a demand contract request. Controllers can also request a TOA RANGE by clicking on the waypoint inside the tabular window where the EPP waypoints are listed.

Figure 23 – MUAC TOA range request selection on the Flight Information Message (FIM) window

Figure 24 shows the MUAC HMI window displaying the ADS-C reported TOA range at the NOGRO waypoint (top-left) in response to a demand contract request. Figure 25 shows the display of multiple TOA range values.

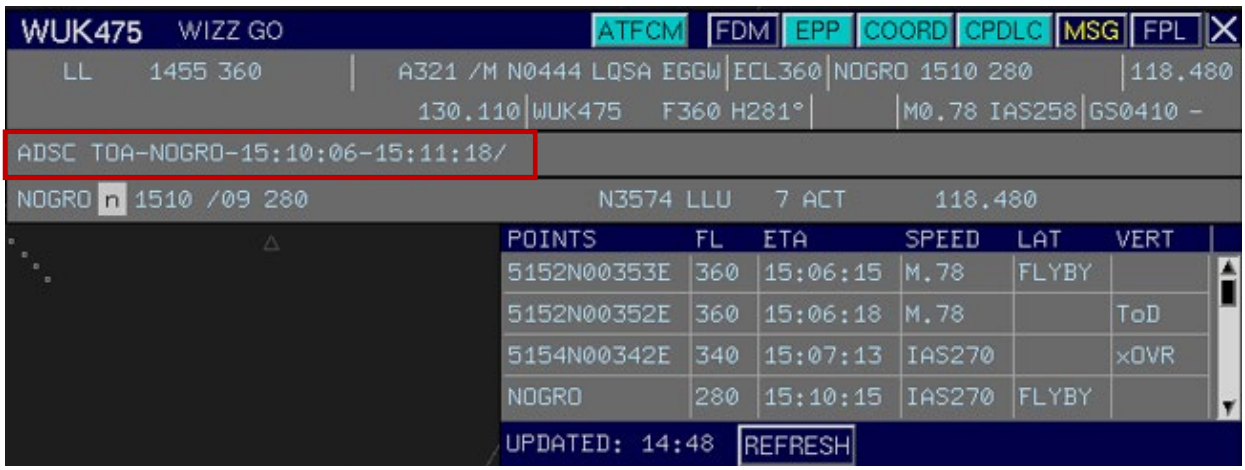

Figure 24 – MUAC display of the TOA range on the Flight Information Message (FIM) window

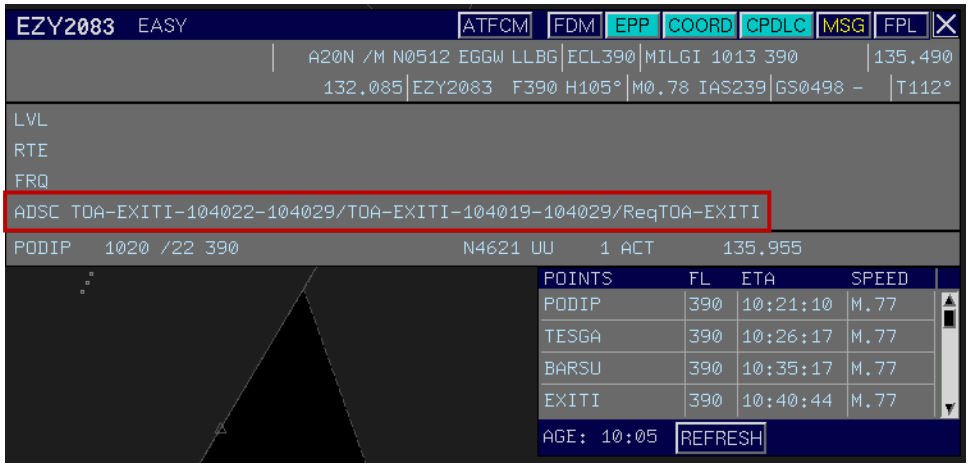

Figure 25 – MUAC multiple TOA range request

4.3.3.5 Display of meteorological information

Meteorological information is an optional ADS-C data group that can be present in any ADS-C contract report. ANSPs could process ADS-C meteorological information separately or as another source of meteorological data.

This was experimented in the context of SESAR PJ38 for the purpose of flow management positions and controller working positions. Figure 26 shows the DSNA extended AMAN HMI display used by the flow management position controller providing ADS-C wind information. Figure 27 shows the demonstration platform display for en-route controllers which has been updated to integrate ADS-C wind information.

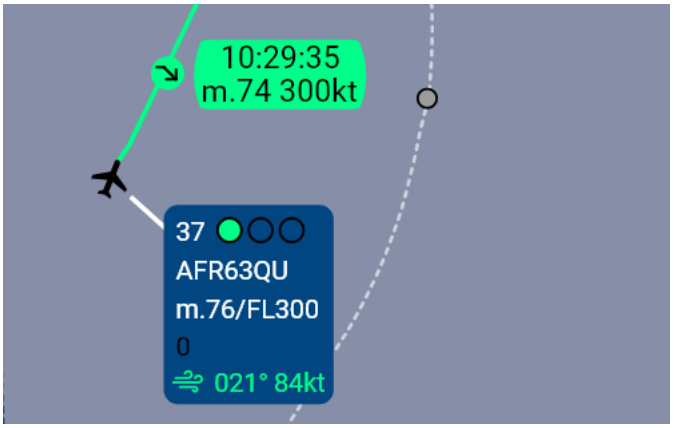

Figure 26 – DSNA IODA extended AMAN HMI used by the FMP controller

Figure 27 – DSNA demonstration platform HMI screenshot (PJ38)

4.3.3.6 Display of the air and ground vectors

The air and ground vectors are optional ADS-C data groups that can be present in any ADS-C contract report. When interfacing with the ACS this data may be present in ADS reports for periodic or demand contracts. At present, the display of such information to controllers is not foreseen.

4.3.3.7 Display of data reliability

The ADS-C data displayed to the controller can be characterised in terms of its reliability. Indeed, there is more confidence in the data when the pilot is flying in managed mode, and this can be reflected in the HMI. Furthermore, a colour-coding scheme or counter could reflect the age of the EPP (i.e. if it was received earlier than a pre-configured time) to give an indication of its reliability.

GM-ITIS-1170 ANSP systems **may** apply HMI features to convey data reliability to the controllers.

For example, Indra has worked with DFS within SESAR 2020 PJ18 Solution 56 on the concept of “Reliability” by colour-coding the presented EPP information.

2D information is considered unreliable, if either:

- the received EPP trajectory intent status is not lateral managed mode, or
- the aircraft is following a heading clearance; or
- the track of the flight is not in lateral conformance against the flight plan route updated with the ATCO clearances.

Additionally, 3D information is considered unreliable, if either:

- 2D information is unreliable (per previous conditions); or
- the received EPP trajectory intent status is not vertical managed mode.

This unreliability of the information is reflected on the HMI by using a colour scheme.

- 2D unreliable information can affect the general presentation of the EPP trajectory, the warning and presentation of 2D discrepancies, and vertical type icons (TOC, TOD, SOD, SOL, SOC) which are shown in yellow; and

- 3D unreliable information can affect the warning and presentation of 3D discrepancies, and vertical type icons (TOC, TOD, SOD, SOL, SOC) which are shown in yellow.

On Figure 28, the track of the flight is in lateral conformance against the flight plan, is not following a heading clearance, and the EPP is not in lateral managed mode (as can be seen on the "-VS-" indicator). As a result, it is 2D unreliable, therefore the trajectory, warnings and labels are displayed in yellow.

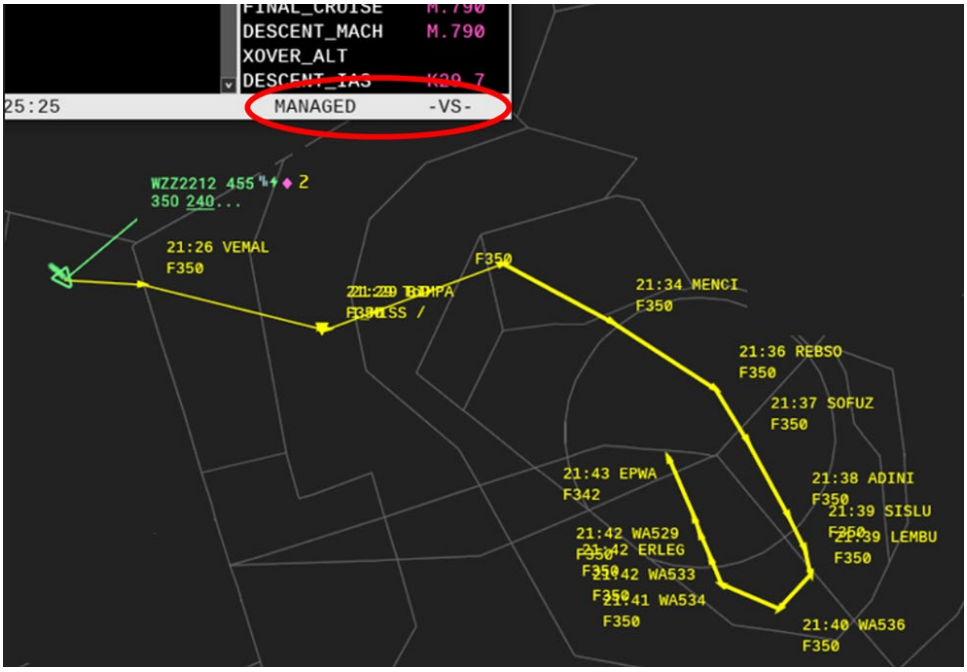

Figure 28 – ITEC presentation of 2D Discrepancy while "2D Unreliable"

Below in Figure 29, we can see a case where it is 2D reliable, so the EPP trajectory is displayed in pink – but as the TOD is 3D unreliable, it is displayed in yellow.

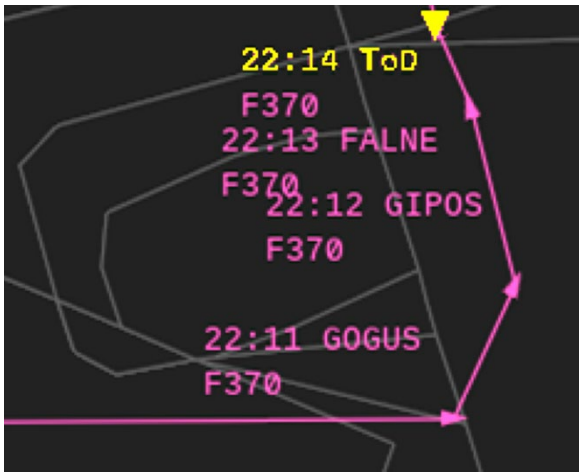

Figure 29 – ITEC presentation of ToD while on "3D Unreliable"

4.3.4 ADS-C data use

4.3.4.1 Using EPP trajectory intent status

The EPP content can include a trajectory intent status which gives an indication of whether the aircraft is navigating based on lateral, vertical, speed or time parameters. As these relate to the autopilot modes, it also allows the ground in determining a level of confidence in the received data.

All of these modes can take the state “managed” – which means the aircraft is managing itself based on the parameters in the FMS; or “selected” – which means that the pilot has chosen to override the FMS-proposed trajectory.

- Lateral selected mode is typical for aircraft flying on a radar heading;
- Vertical selected mode is typical for aircraft flying on a vertical rate or an open manoeuvre not aligned with the FMS;
- Speed selected mode is typical for aircraft flying at an ATC speed restriction; and
- Time selected mode is typical for aircraft flying without an active RTA.

The state of each mode is communicated in the EPP `trajectoryintentstatus` as a Boolean value. When one or more are set to `true`, the ground can assume that the crew has engaged the autopilot. When all are set to `false`, it is unknown if the autopilot is engaged but is equivalent to being off.

GM-ITIS-1180 As the trajectory intent status requires an extended understanding of piloting, ANSP systems **should** interpret the status for the controller and present EPP content in terms of a level of confidence.

Notes:

1) *For example, in the case of a received EPP containing the status “`lateralFlightManaged=false`”, there is a lack of confidence in displaying the top of climb point to the controller as this might be incorrect due to the lack of lateral navigation.*
2) *HMI features such as a colour-coding scheme could be applied to reflect the level of confidence as described in section 4.3.3.7.*

When establishing ADS-C event contracts with aircraft implementing ATS B2 standards revision B [Ref 7], the ACS will include the ‘EPP trajectory intent status change’ parameter in the contract request. Therefore, ANSPs will have a more reliable indication of the change in trajectory intent status indicator as this will be immediately downlinked in the EPP event reports.

4.3.4.2 Using EPP waypoint lateral types

Each EPP waypoint can optionally contain one or more lateral types, which characterises or describes the aircraft’s behaviour at the position. Although a waypoint can have multiple lateral types associated with it, operational experience shows that the great majority have at least two associated lateral types, one typically being a flight plan waypoint.

- ED-228A [Ref 5] defines 10 lateral types: offset start, offset end, offset, offset reached, return to parent path initiation, overfly, flyby, fixed radius transition, flight plan waypoint, followed by discontinuity.

- ED-228B [Ref 7] defines 3 additional lateral types: hold-entry, abeam, along track waypoint. In the case of revision B, waypoints with the “abeam” lateral type will contain the name of the original waypoint they are abeam of, when their parent waypoint is a navigation database waypoint. This way the controller can relate to that original flight plan waypoint.

It is likely that the HMI can only support the display of one or a limited number of these types, so it is recommended to display them based on their importance to ATC by setting a list of priorities.

GM-ITIS-1190 ANSPs **should** define a prioritisation scheme for the use of lateral types so that the most relevant are displayed to the controller, especially in cases where the HMI can display a limited number of such types.

Below is the list of priorities (high to low) as used at Maastricht UAC developed for the ATS B2 revision A standards, together with the abbreviations used on the controller HMI for better description of the lateral types. This prioritisation has been necessary as MUAC only displays one lateral point per waypoint and may not be applicable for other centres. Operational experience of each lateral type is provided below.

1. Overfly – OVRFLY
2. Offset Start – OFFSTA
3. Offset Reached – OFFREA
4. Return To Parent Path Initiation – OFFRTN
5. Offset End – OFFEND
6. Offset – OFFSET
7. Followed by Discontinuity – DISCON
8. Flyby – FLYBY
9. Fixed Radius Transition – FLYFRT
10. Flight Plan Waypoint – WAYPT

Overfly: experience shows that the overfly lateral type is typically provided for waypoints in lower airspace, where the aircraft is required to pass directly over the waypoint.

Offset Start: this lateral type indicates the waypoint where the aircraft will turn away from the FPL route. Offset points can be used to display to controllers the exact trajectory the aircraft will follow on an offset track (e.g. deviating due to weather or avoiding wake turbulence).

GM-ITIS-1200 ANSP systems **should** use offset data to improve conflict detection processes.

Figure 30 to Figure 33 show the display on the MUAC HMI of an extrapolated EPP flight profile in the horizontal plane matching the content of the received EPP waypoints with offset lateral types.

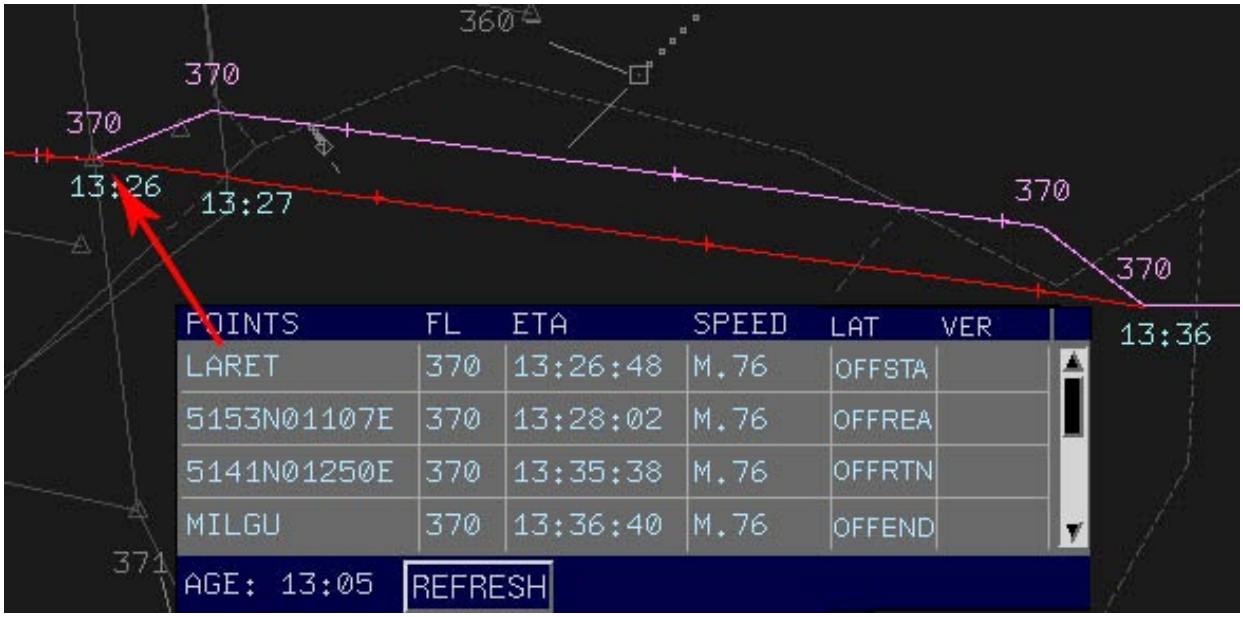

Figure 30 – Flight Information Message (FIM) window with EPP-sub-window at MUAC with offset start

Offset Reached: this lateral type indicates the waypoint on the offset track where the aircraft ends its turn to follow a leg parallel to the original FPL route.

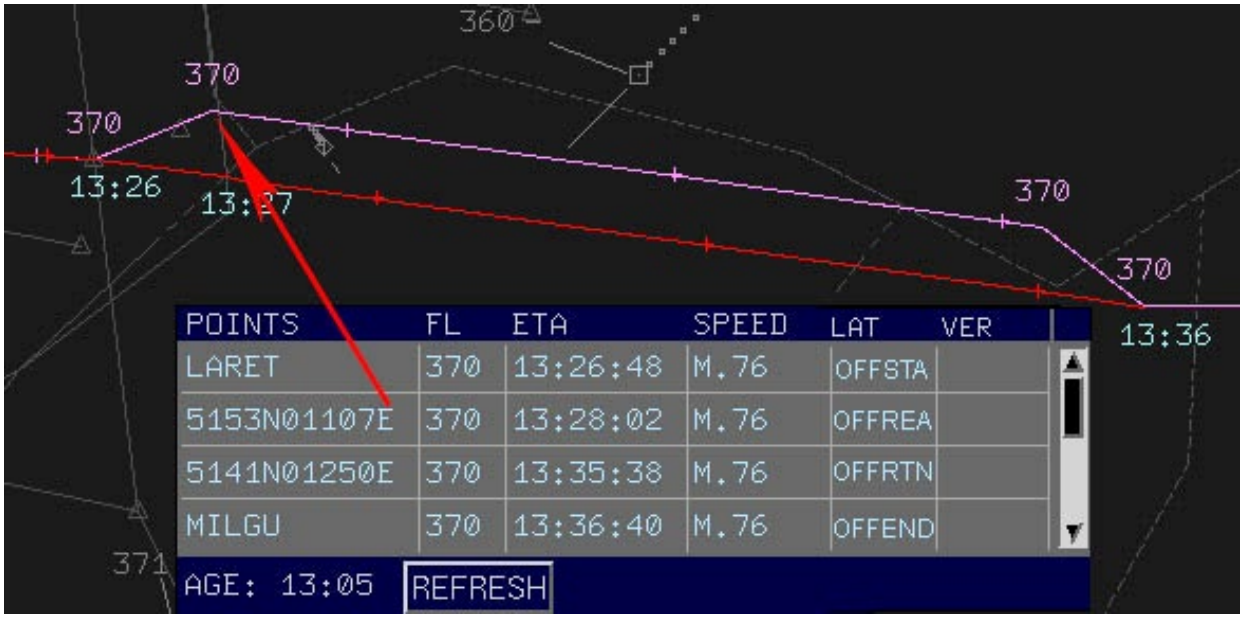

Figure 31 – Flight Information Message (FIM) window with EPP-sub-window at MUAC with offset reached

Return to Parent Path Initiation: this lateral type indicates the waypoint on the offset track where the aircraft starts its turn towards the original FPL route.

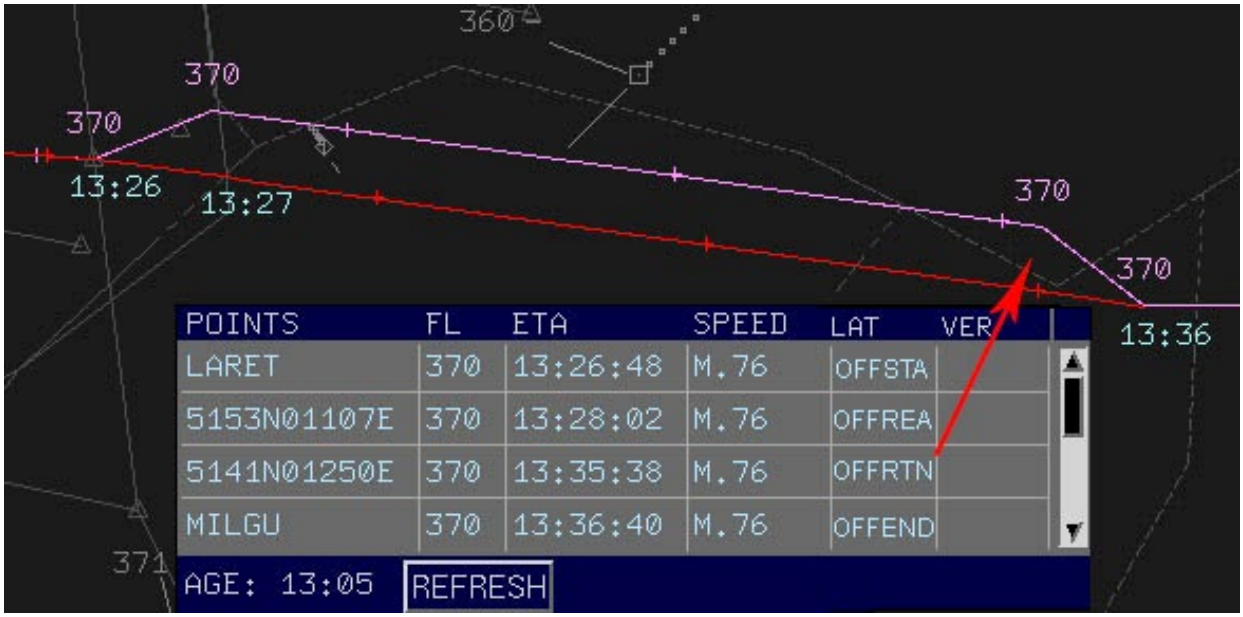

Figure 32 – Flight Information Message (FIM) window with EPP-sub-window at MUAC with offset reached

Offset End: this lateral type indicates the waypoint where the aircraft returns to the original route.

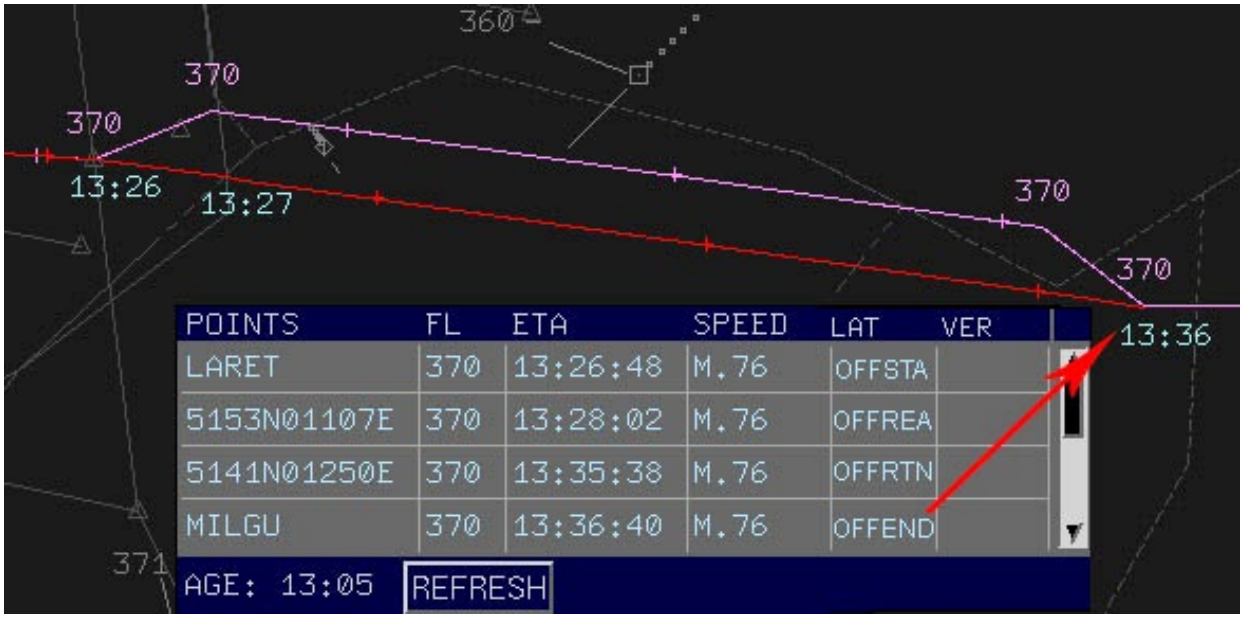

Figure 33 – Flight Information Message (FIM) window with EPP-sub-window at MUAC with offset end

Offset: this lateral type indicates a waypoint on the offset track. It can be an extrapolation (abeam) of a point originally on the route, where no change of the offset-profile happens. In other words, at an offset point the aircraft just keeps flying parallel to the original track.

Followed by Discontinuity: this lateral type indicates a waypoint where the aircraft's FMS can't connect to the next waypoint in the FMS flight plan (e.g. due to a re-routing or due to the presence of a procedural manual leg coded in the navigation database).

Note: An EPP waypoint with the `followedByDisco` lateral type might also contain other lateral types (e.g. `Flyby`). For example, an aircraft follows that route A-B-C-D-E-G and receives a

UM79 CLEARED TO F VIA D E, the reported lateral types of F might be `flyby` *(by default) and also* `followedByDisco` *if it can't connect to G.*

While route discontinuity is a normal temporary situation for the flight crew to resolve, it is recommended to show a warning to the ATCO for awareness that the aircraft might need re-clearance.

GM-ITIS-1210 ANSP systems **should** display a visual notification to controllers when EPP content includes a waypoint with a lateral type `followedByDisco`.

Figure 34 shows the MUAC HMI window on which the controller is notified of a discontinuity in the EPP trajectory by using a different colour (yellow).

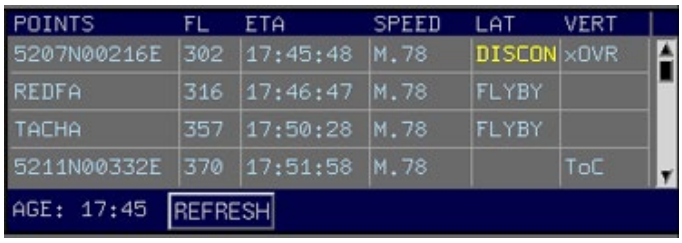

Figure 34 – Lateral Type "Followed by Discontinuity" Visual Warning at MUAC

Flyby: experience shows that the flyby lateral type is provided for the majority waypoints, therefore this type can be considered as the "default" waypoint lateral type.

Fixed Radius Transition: technically this lateral type is a flyby with a turn radius. Fixed radius transition types are always associated with airways or curved legs within published Terminal (Departure/Arrival) procedures, to ensure that aircraft (with varying performance) that fly along the airway follow the path prescribed by the authorities, with a higher degree of repeatability without relying on each aircraft's FMS for calculating the transition path between legs. It should be noted that it is not possible for pilots to create such waypoints or to modify the specified radius. Experience shows that the fixedRadiusTransition type is typically provided for waypoints in lower airspace.

Flight Plan Waypoint: this lateral type is used by the FMS to define the aircraft's lateral route. In many cases it is a fix point from the navigation database, but sometimes it is a waypoint created by the flight crew or data link defined waypoint (e.g. LatLong waypoint, along track offset waypoint, place bearing distance waypoint). Unless they match a previously created flight plan waypoint, waypoints that are used to manage a lateral offset (start of offset, end of offset, offset reached and return to parent path) are not identified as flight plan waypoints.

ATS B2 standards revision B define the additional following waypoint lateral types:

Hold-entry: this lateral type indicates a waypoint where the aircraft will enter into a pre-programmed hold.

Abeam: this lateral type indicates a waypoint which is the extrapolation of a point which will no longer be overflown e.g. due to a direct routing. Abeam points contain the name of the original waypoint they are abeam of – when their parent waypoint is a navigation database waypoint.

Along track waypoint: this lateral type indicates a waypoint which is along the aircraft's trajectory but does not relate to a flight plan waypoint. These waypoints can be used for climb/descent clearance restrictions more easily than using LatLong coordinates. They can

contain the name of their parent waypoint, when their parent waypoint is a navigation database waypoint.

GM-ITIS-1220 ANSPs that display waypoints that have the 'along track waypoint' lateral type **should** ensure that their controllers are aware that such waypoints are not flight plan waypoints, but waypoints associated with a distance from the given waypoint.

4.3.4.3 Using EPP vertical types

Each EPP waypoint can optionally contain a vertical type, describing the aircraft's behaviour at the position.

The vertical types are: top of climb, top of descent, start of climb, start of descent, start of level off, start of speed change, end of speed change, speed limit or cross over altitude.

GM-ITIS-1230 In addition to the display of cross-over points, ToC and ToD, ANSPs **should** define which vertical types in ADS-C reports are the most relevant to be displayed to the controller (especially in cases where the HMI can display a limited number of such types).

Top of Climb (ToC): this vertical type indicates the waypoint where the aircraft intends to enter the cruise phase. There is only one ToC in the whole EPP profile even if there are different flight levels requested at different phases of the cruise and it is always accompanied by a start of level vertical type.

During operations at MUAC, it has been observed that:

- the ToC is highly dependent on factors such as the correct entry of winds, mass and cost index (CI) into the FMS.
- while the aircraft is in lateral selected mode (ie. heading select), the reported waypoint position of the ToC is updated only after a significant time in heading (i.e. when the hypothesis of an immediate return to NAV trajectory is given up)[11]. In either case, the reported ToC information remains invalid until the aircraft rejoins its route. This can potentially cause unsafe scenarios if controllers don't build in buffers.
- any change of the cost-index or upper winds influence the ToC – an aircraft might even "push" the ToC in front of it for 30-40 nm if the conditions are such (i.e. incorrectly entered winds).
- any changes of the ToC are only shown to the ATCO when the next EPP data refresh arrives (provided that the aircraft is in lateral managed mode) – there is no event contract trigger for ToC-associated parameters on RevA aircraft (unless EPP tolerance be set on the LatLong of the latest ToC received). This can also lead to the ToC being displayed "behind" the aircraft.
- Certain aircraft operators change their thrust settings even at higher levels during flight, which means that the ToC can "jump" back in certain cases. One operator allows the use of derated thrust 2 on A330-900 aircraft until the rate of climb is above 500 fpm – once the rate of climb goes below 500 fpm, derated 1 climb thrust is selected and the trajectory

[11] The FMS always makes the hypothesis of a return to NAV mode (equivalent to lateral managed mode) with a 45° capture of the path. However, the "jump" will occur when the aircraft is sufficiently far from the path, that flight plan waypoints stop being sequenced and thus the FMS predictions reflect a "U-turn" to resume the flight plan.

is updated at the next EPP update. MUAC has observed a ToC shift of ~6 minutes when an aircraft has changed its climb thrust from derated 2 to derated 1.

GM-ITIS-1240 ANSPs **should** ensure that controllers:

- are presented with a display of the EPP ToC for better awareness of the climb profile;
- are made aware of the possible shortcomings in making use of the EPP ToC; and
- are advised not to base separation on EPP ToC solely.

Note: EPP ToC is to be used for awareness only. Even if the "best" downlinked climb performance shouldn't always be trusted, it still gives a good hint at "bad" climb performance: e.g. aircraft where the climb performance is visibly worse than it would be normally expected, based on the aircraft type. If crews do not update the "Cruise FL" in the FMS, this will lead to unreliable EPP content in terms of the EPP TOC position.

Figure 35 shows the MUAC HMI displaying the ToC (upwards magenta triangle) on the extrapolated EPP trajectory in the horizontal plane.

Figure 35 – MUAC display of the top of climb (ToC) vertical type

Top of Descent (ToD): this vertical type indicates the waypoint at which the aircraft intends to start its descent towards its final destination. The ToD is always accompanied by a start of descent vertical type.

Every time an Airbus aircraft is cleared to a new lower level:

- if the distance to the newly computed ToD is greater than 40 NM;
- if newly entered cleared flight level is above FL200; and
- if no altitude descent constraint exists above that cleared flight level,

the aircraft will re-cruise at the cleared flight level and downlink the new ToD in the EPP.

In other cases, the aircraft will be considered as being in the descent phase and no new ToD will be downlinked in the EPP.

Figure 36 shows the MUAC HMI displaying the ToD (downwards pointing purple triangle) on the extrapolated EPP trajectory in the horizontal plane related to the first published restriction (IDESI@FL220).

Figure 36 – MUAC display of the top of descent (ToD) vertical type

Figure 37 shows that a new EPP downlink has been received updating the ToD after the flight crew has entered the MUAC exit restriction of NOGRO@FL280. Note the change of FL at NOGRO from 321 to 280 and the new waypoint coordinates of the ToD.

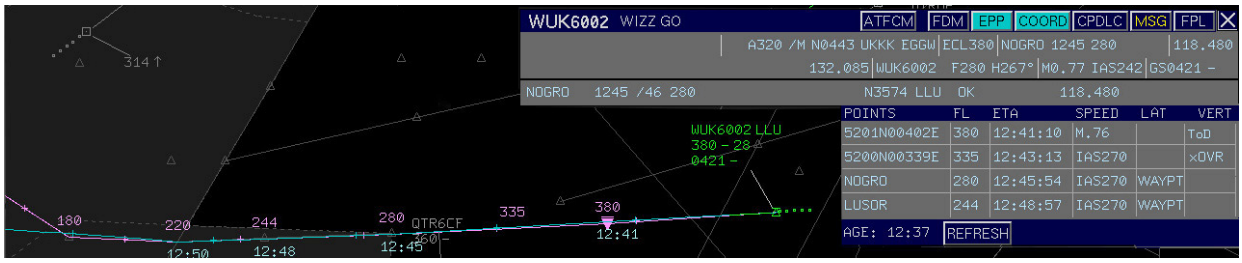

Figure 37 – MUAC display of an updated ToD

Figure 38 shows that a new EPP downlink has been received updating the ToD from the cleared FL290 to further down, while the aircraft is in descent from FL350 to FL290.

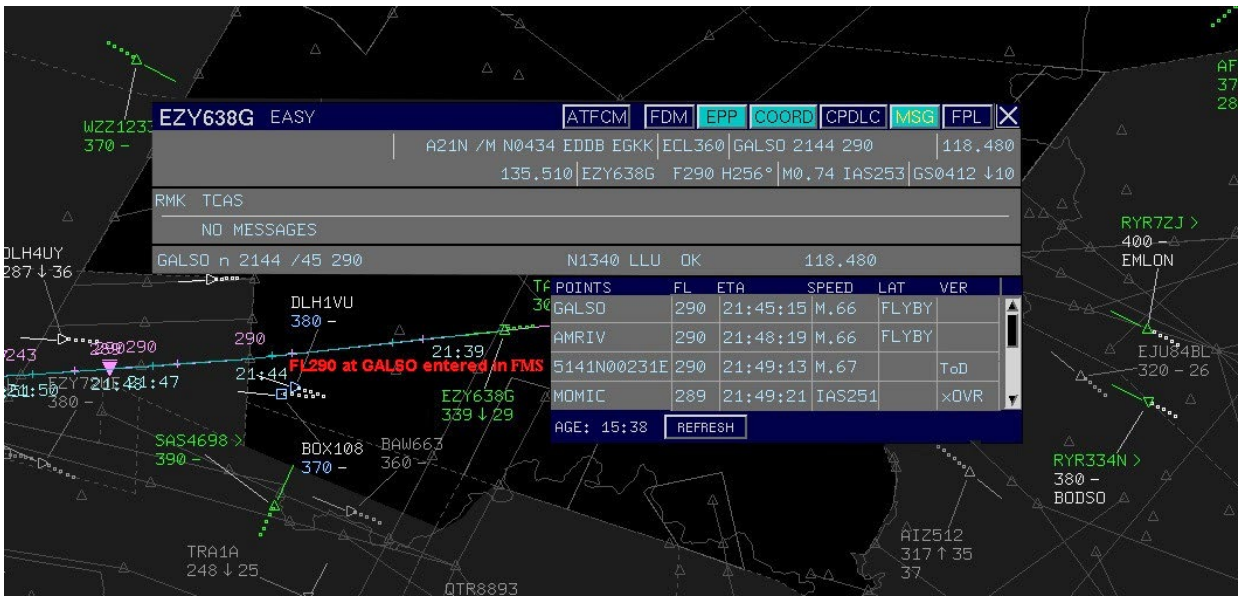

Figure 38 – MUAC display of the updated ToD

GM-ITIS-1250 ANSPs **should** ensure that controllers:

- are presented with a display of the EPP ToD for better awareness of the descent profile;
- can make use of the ToD to clear the pilot to descend according to the EPP; and
- are made aware of the possible shortcomings in making use of the EPP ToD.

Start of Climb: this vertical type waypoint locates the intersecting point between a level segment and a climb to the next planned level. This type is typically provided for waypoints in lower airspace and is more relevant for SID procedures but can also appear in other cases such as planned cruise changes and manually entered altitude constraints.

On ITEC, the start of climb (SoC) can be displayed on the EPP as shown in Figure 39, or on ground flight planned trajectories. The level constraints of the SID procedure cause two levelled segments on the FMS trajectory, translating on the appearance of a SoL and SoC at FL40, and another SoL and SoC at FL50, depicted with diamonds.

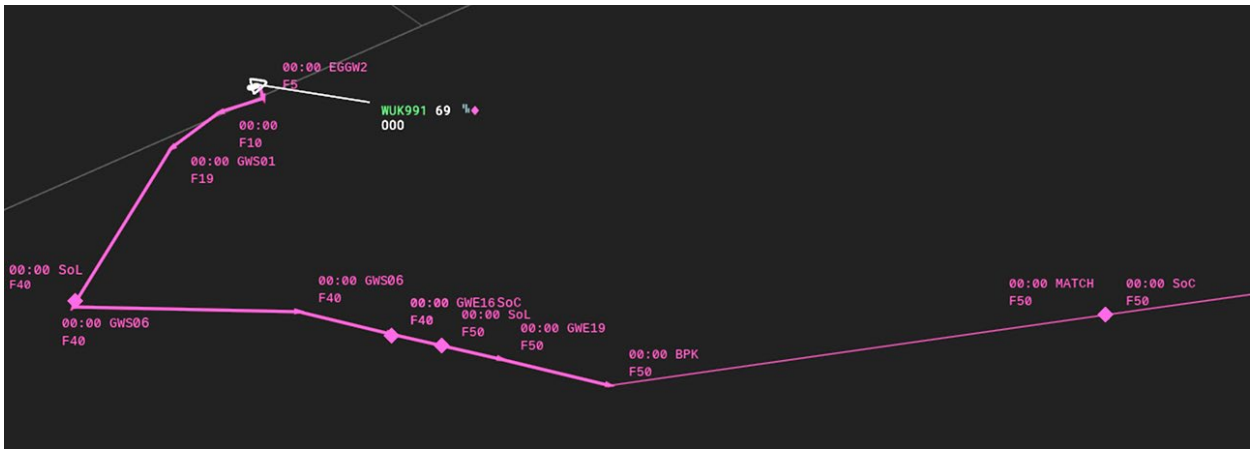

Figure 39 – ITEC display of the SoL/SoC

Start of Descent: this vertical type waypoint locates the intersecting point between a level segment and a descent to the next planned level. This type is typically provided for waypoints in lower airspace and is more relevant for STAR procedures, but can also appear in other cases such as planned cruise changes and manually entered altitude constraints, where it can indicate a pseudo “top of descent”.

Notes:

1) *The ToD vertical type is always accompanied by a start of descent.*
2) *MUAC does not yet display the* `startOfDescent` *vertical type parameter, as to date there is no operational experience with it.*

On ITEC, the start of descent (SoD) can be displayed on the EPP or ground flight planned trajectories as shown in Figure 40. On the displayed trajectory on the left, the SoL shows the planned level (i.e. FL80) on the point, whereas on the right the SoD shows the level of the next SoL (i.e.FL35).

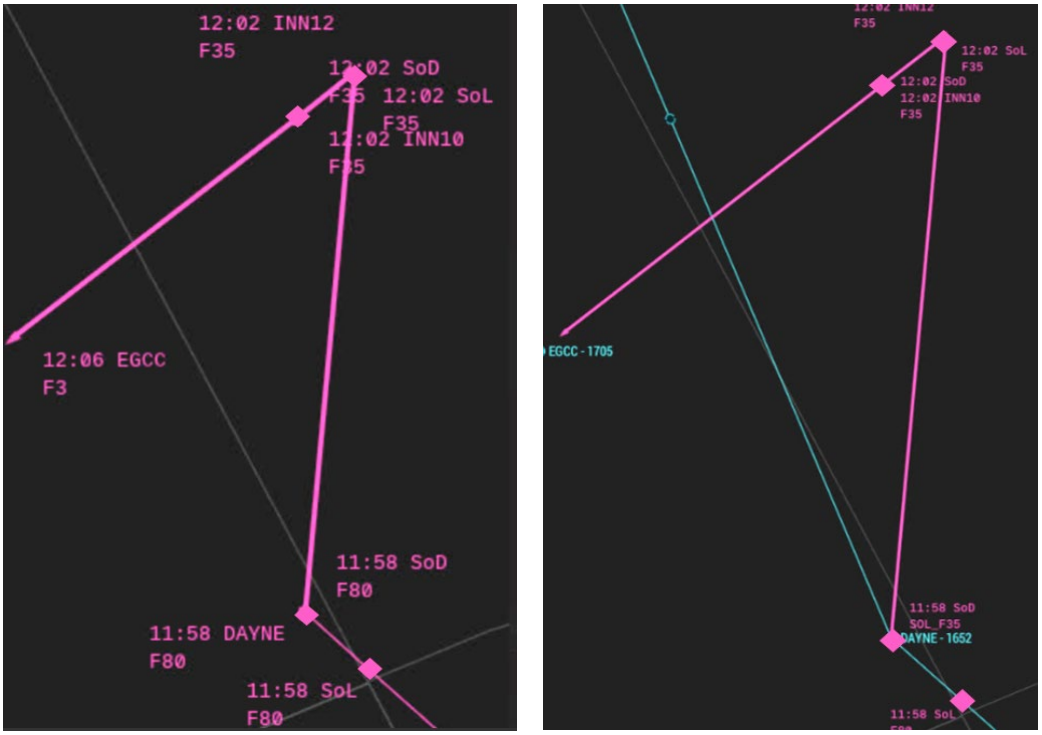

Figure 40 – ITEC display of the SoL/SoD

Start of Level: this vertical type indicates that the waypoint is locating the intersecting point between a climb or descent segment and a new level segment at which the aircraft will level off. This vertical type can possibly be used to indicate a pseudo "top of climb" for climbs after the ToC – e.g. when there is a planned cruise level change or the cruising FL is changed tactically due to performance. The start of level could also be used to ascertain if the aircraft will be at level before a desired time/position. This would allow avoiding imposing an additional restriction (rate of climb/descent).

Notes:

1) *The TOC vertical type is always accompanied by a start of level.*
2) *For a scenario with different flight levels before reaching the cruise level, the* `StartOfLevel` *vertical type is foreseen to be used. MUAC does not yet display the* `startOfLevel` *vertical type parameter, as to date there is no operational experience with it.*

The display of the SoL on the trajectory on ITEC is shown in Figure 39 and Figure 40.

Start of Speed Change: this vertical type indicates a change of speed at the waypoint. It is currently not displayed nor used. It may be suitable for AMAN or manual sequencing procedures.

End of Speed Change: this vertical type indicates the end of speed change at the waypoint. It is currently not displayed nor used. It may be suitable for AMAN or manual sequencing procedures.

Speed Limit: this vertical type indicates the speed limit at the waypoint and is usually 250knots at FL100. It is currently not displayed nor used.

Cross Over: this vertical type indicates the waypoint in climb where the constant speed target will change from Indicated Air Speed (IAS) to Mach and at the waypoint in descent where the

speed target will change from Mach to IAS. This is displayed to controllers (see Figure 16) and is used as indication of the target speed at which the aircraft will fly.

4.3.4.4 Using EPP current gross mass

In general, current TPs estimate initial mass based on assumptions of the Take-off-Weight, as neither the payload nor the fuel are known, and have to be estimated. However, significant errors might be made on those assumptions (especially on the payload estimation), and so, any improvement on the information of the mass is very useful to improve the accuracy of the ground trajectory prediction.

In SESAR2020 PJ18 Solution 53B, the usage of EPP gross mass was validated as one of the inputs to enhance the accuracy of trajectories that rely on a full performance model implementation (e.g. the EUROCONTROL BADA model).

The results of the validations showed that the use of the EPP gross mass information received while the aircraft is in flight can enhance the trajectory predictions, alleviating the impact of the drift caused by the fuel consumption algorithm.

GM-ITIS-1260 ANSP systems **may** use the EPP gross mass to improve the accuracy of their ground trajectory prediction (TP).

Note: ANSPs may have multiple systems performing ground TP calculations. Despite the positive results of the validations with regard to the use of the EPP gross mass, ANSPs need to carefully evaluate its use for enhancing the ground TP accuracy depending on the specific system. In operations, the TPs are sometimes fine-tuned for a specific purpose (e.g. sector sequence calculation) and the introduction of a new input, e.g. gross mass, could have a side effect on these calculations and may result in worsening the results instead of improving them as expected.

4.3.4.5 Using EPP to compute calibration coefficients

Currently, the computation of trajectories is performed on the basis of the aircraft performance data such as the baseline BADA thrust & drag physical model. However, such models lack information about the specific flight and aircraft capabilities.

The FMS implements a more detailed performance model, with additional information which is fine-tuned for the specific aircraft type, version and engine, and is also aware of maintenance activities and flight-specific de-rating and idle policy. As a result, a ground trajectory prediction can compare a received EPP profile with an equivalent BADA profile, computing an array of “calibration coefficients” as shown in Figure 41. This allows adjusting of the performance model, by adjusting the rate of climb/descent (ROCDs) to enhance the vertical accuracy of ground trajectory predictions.

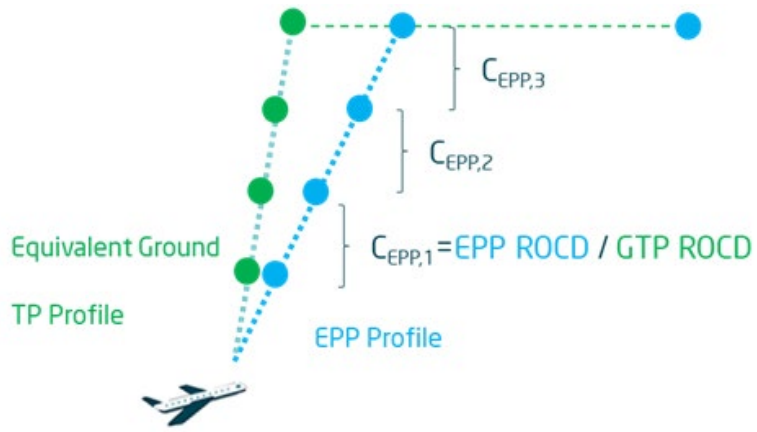

Figure 41 – EPP calibration coefficients scheme

In SESAR2020 PJ18 Solution 53B, the usage of EPP calibration coefficients was validated as one of the inputs to enhance the vertical accuracy of trajectory predictions that rely on a full performance model implementation (e.g. the EUROCONTROL BADA model).

The results of the validations showed that the use of the EPP calibration coefficients while the aircraft is flying in vertical managed mode can enhance the ground TP predictions and improve long-term planning and conflict detection.

GM-ITIS-1270 ANSP systems **may** use the calibration coefficient derived from the downlinked EPP vertical performance to improve the accuracy of ground trajectory prediction.

Note: As long as the aircraft flies on vertical managed mode, the EPP vertical performance gives a very good estimation of aircraft vertical intentions.

4.3.4.6 Using EPP supplementary information

When establishing ADS-C event contracts, ED-228B [Ref 7] defines supplementary event types for EPP changes.

The ACS will include the ‘EPP holdentry lateral type change’, ‘EPP trajectory intent status change’, ‘EPP level constraint status change’, ‘EPP speed constraint status change’ when establishing ADS-C event contracts using application version 3.

Note: No specific guidance has been prepared for this edition of the guidelines.

4.3.4.7 Using the speed schedule

The speed schedule provides the nominal speed assigned by the aircraft and min/max range values that the aircraft can fly during a given flight phase (CLIMB/CRUISE/DESCENT). It is dependent on the aircraft type, gross weight and some other variables such as the current cost index (CI) setting. Therefore it can change over time. The maximum speed is dependent on the aircraft type, while the minimum speed is dependent on the type and weight combination.

The speed schedule assumes the use of managed states of the aircraft. It provides different speed combinations for different flight phases:

- CLIMB: climb CAS(before crossover)/MACH after the last constraint.
- CRUISE: ECON SPD/MACH.
- DESCENT: descent CAS(after crossover)/MACH.

When establishing ADS-C demand and periodic contracts, ED-229B [Ref 8] defines an additional speed schedule parameter to request the reporting of the planned final approach speed.

RTA impact on the speed schedule

It must be considered that if an RTA (required time arrival) is entered by the pilot, the downlinked nominal speed will reflect the speed associated to the RTA, not the one to ECON SPD/MACH. If the pilot manually overrides the speeds in the FMS pages, this is also taken into consideration for the downlink.

GM-ITIS-1280 ANSPs **should** ensure that controllers are made aware that the speed schedule is affected by any RTA entry and that the pilot can override the FMS speed schedule.

Use of speed schedule for separation

Controllers should keep in mind that the speed value contained in an EPP is only an intention and that the aircraft's first objective is "energy management". This means that in a steep descent or when encountering different winds than those known to the FMS, the aircraft might speed up well above the downlinked speed schedule, but it will endeavour to then reduce the speed to the speed schedule.

For Airbus aircraft a typical speed deviation of ECON +20kts or VMO-10kts can be expected, depending on the FMS type above FL100. Below FL100, the "managed speed" (that does not refer yet to the ECON mode) can be exceeded by more than 5 kts as priority might be to fit with the vertical profile first.

GM-ITIS-1290 Controllers **should** not use the speed schedule for tight separation and always allow a buffer for the aircraft to fly faster than the downlinked speed schedule.

Note: This is particularly relevant for quick descents.

A benefit of the speed schedule profile for controllers is that they no longer need to work with typical static speed information (e.g. a B738 will cruise at M0.79), they can work with a direct display of the aircraft performance which is very important when having to pre-sequence traffic.

Use of speed schedule for ANSP system trajectory prediction

In SESAR2020 PJ18 Solution 53B, the usage of ADS-C speed schedule nominal speeds was validated, providing enhancements on the accuracy of trajectories that rely on the usage a full performance model implementation, as in the full EUROCONTROL BADA model.

The results of the validations showed that the use of the speed schedule information received while the aircraft is in flight can enhance the ground TP predictions by replacing BADA APF speeds by the speed schedule speeds and can improve long-term planning and conflict detection.

GM-ITIS-1300 ANSP systems **may** use the speed schedule nominal speeds to improve the ground trajectory prediction.

Note: As long as the aircraft flies on speed managed mode, the speed schedule nominal speeds gives a very good estimation of aircraft speed intentions.

4.3.4.8 Using the TOA range

The ADS-C TOA (Time of Arrival) range data group allows the controller to ask the FMS of the aircraft about the calculated earliest and latest time of arrival over a given waypoint. The function will return two different time values, which can be used as an indication of the extent to which

the aircraft can speed up or slow down. However, the TOA range response incorporates an uncertainty factor, and experience shows that this might result in a reported TOA range that is incompatible with the ETA for the given waypoint of the EPP.

Figure 42 – TOA range vs EPP discrepancies

In Figure 42, it can be seen that while the TOA Range response indicates the time range of 22:01:05-22:03:08 for earliest and latest arrival times over the fix NOGRO, the actual EPP ETA is 11 seconds earlier than the earliest TOA Range time due to the built-in uncertainty factor. Figure 43 illustrates how the ETA is calculated introducing this uncertainty factor.

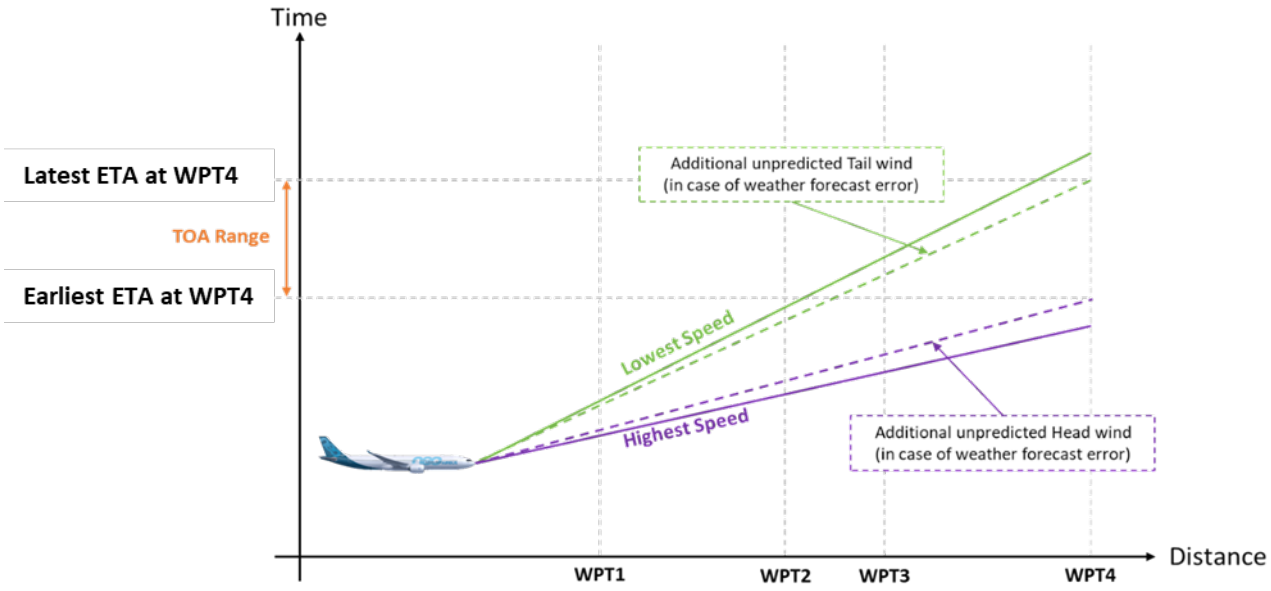

Figure 43 – Airbus ETA calculation for TOA range

As a general rule, the further the waypoint is away from the current aircraft position, the lower the accuracy of the reported ETA of waypoints in EPP becomes. This is primarily due to wind forecast errors.

The TOA range provides very good awareness of the capability of an aircraft to reach a given waypoint within a time window. It is to be noted that the earliest and latest ETAs are computed so that the aircraft can meet a time constraint within +/- 10 seconds with a 95% success rate. This method of computation integrates possible wind errors compared to the forecasted wind grid uploaded in the avionics.

In any event, the TOA range should be used in combination with the reported waypoint ETA in the EPP in order for the controller to provide instructions that are as close as possible to the ETA in the EPP.

GM-ITIS-1310 ANSPs **should** ensure that their system design teams and controllers are made aware of potential discrepancies between the reported TOA range and the EPP ETA for a given waypoint.

4.3.4.9 Using the projected profile

The 'projected profile' is an optional ADS-C data group that can be present in ADS-C contract reports providing the 'next' and 'next+1' waypoints. For a given aircraft, the ACS will establish a periodic contract requesting this data group and will establish an event contract with the 'waypoint change' parameter.

The projected profile does not include waypoints which are not in the navigation database (i.e. defined by a fixed LatLong, a place/bearing/distance). In particular, waypoints that are solely characterised by a vertical type (e.g. ToC/ToD/Cross-over) are not included.

The projected profile can be used to determine which flight plan waypoints within the EPP have been overflown to improve conformance monitoring (see section 4.3.5).

4.3.4.10 Using meteorological information

ANSP systems can be enhanced with the addition of ADS-C meteorological information to improve ground trajectory prediction calculations, flow management or pre-sequencing.

In the context of SESAR PJ18, MUAC and KNMI (Dutch Meteorological Institute) identified that the ADS-C meteorological information could be used as an additional source to improve meteorological models.

4.3.4.11 Using air and ground vectors

Note: The use of this information is for further assessment.

4.3.4.12 Using active VHF data

The 'active VHF data' is an optional ADS-C data group that can be present in demand or event ADS-C contract reports that are established using ADS-C application version 3 (i.e. ATS B2 standards revision B [Ref 7, 8]).

The ACS will include the 'active vhf change' parameter when invoking ADS-C event contracts using application version 3.

When more than one frequency is provided, the specific frequency that is used for ATC communications remains unknown.

Note: No specific guidance on the use of VHF data has been prepared for this edition of the guidelines.

4.3.4.13 Using holding information

The 'holding information' is an optional ADS-C data group that can be present in demand or event ADS-C contract reports that are established using ADS-C application version 3 (i.e. ATS B2 standards revision B [Ref 7, 8]).

The ACS will include the 'hold status change' parameter when invoking ADS-C event contracts using application version 3.

Note: No specific guidance on the use of holding information has been prepared for this edition of the guidelines.

4.3.4.14 Other data groups

In addition to the ADS-C data groups described in this section, ACS users can request the uplinking of demand contracts requests with other parameters such as the 'runway occupancy data'. These can be present in ADS demand reports published by the ACS.

Note: This would apply for aircraft implementing ADS-C message set version 3. No specific guidance has been prepared for this edition of the guidelines.

4.3.5 Conformance Monitoring

4.3.5.1 General

ATS B2 standards [Ref 5] foresee the use of conformance monitoring as part of the 4DTRAD service. By using ADS-C data, conformance monitoring aims to detect any discrepancies between the downlinked 4D trajectory intent and the 4DTRAD clearance as early as possible.

Note: SR-GDS-ADSC-31C, SR-GDS-ADSC-31D and SR-GDS-ADSC-31E of [Ref 5] detail the data elements used for conformance monitoring which includes amongst others the EPP.

CP1 AF6 slightly differs in that it aims to detect discrepancies *"between the downlinked aircraft trajectory and the ground system trajectory elaborated using the filed flight plan route"*. In addition, it requires that ATC systems must provide a warning to controllers in case of detected discrepancies.

These guidelines provide recommendations for conformance monitoring as validated by European projects matching current operations and the CP1 AF6 requirements.

GM-ITIS-1320 Taking into consideration their operational environment, ANSPs **should** determine whether they will perform conformance monitoring in 2 or 3 dimensions.

Notes:

1) *By referring to 'route' CP1 AF6 implies 2D conformance monitoring.*
2) *The detection of discrepancies and warnings to controllers correspond to requirements SR-GDS-ADSC-31A and SR-GDS-ADSC-31B of [Ref 5].*

4.3.5.2 2D conformance monitoring

This section provides guidance on 2D conformance monitoring by applying a 2D discrepancy detection algorithm. ANNEX B provides example implementations of these recommendations.

GM-ITIS-1330 When designing a 2D trajectory discrepancy detection algorithm, ANSPs **should**

- define an area to make the comparison of the air and ground routes e.g. ANSP area of responsibility (AOR) or area of interest (AOI);
- consider that the controller instructions to pilots are not immediately visible in the received EPP data and therefore grace periods need to be foreseen to avoid raising false discrepancies;
- extract the air route from the EPP trajectory and ground route from the ground flight plan trajectory;

- pre-process the extracted air and ground routes to remove unnecessary data before comparison;
- define a corridor/geometric model along the ground route to compare both routes;
- define a range within which deviations are considered to be discrepancies (e.g. 2NM); and
- identify when or where the 2D discrepancy detection algorithm needs to be initiated (e.g. when the flight is entering the AoR, certain internal flight status).

Note: A grace period allows time for the pilot to receive and implement the clearances given by the controllers into the FMS and time for the FMS to compute and transmit an ADS-C report that reflects those changes.

As part of the above pre-processing step, the 'waypoint change' event combined with 'next' and 'next +1' waypoints in the projected profile can be used to identify and remove already overflown waypoints. However, the projected profile does not include certain waypoints (see section 4.3.4.9), therefore the aircraft may have already overflown other waypoints reported in the EPP.

GM-ITIS-1340 When using 'projected profile' data to remove overflown waypoints, controlling ANSP systems **may** request the uplinking of a demand contract to receive an updated EPP to improve the comparison of the EPP trajectory and the ground route from the ground flight plan trajectory.

Note: The system of the controlling ANSP can detect that the aircraft has overflown waypoints that are not reported in projected profile and then trigger an automatic demand contract, requesting the latest EPP to avoid including unnecessary waypoints in the 2D conformance monitoring and the raising of nuisance alerts.

GM-ITIS-1350 When designing the HMI for the 2D conformance monitoring, ANSPs **should**

- identify which controllers need to be warned of the discrepancies (e.g. under control of the controller);
- limit nuisance alerts to controllers (e.g. filtering discrepancies outside AoR or below controlled airspace); and
- consider the safety implications of providing a means to the controller (e.g. HMI functionality, button) allowing him/her to inhibit discrepancy warnings.

GM-ITIS-1360 ANSPs **should** perform 2D conformance monitoring when the following events occur:

- a new EPP is received; or
- a ground flight plan route modification is performed as a closed clearance.

Note: Typically, after a route modification, a grace period is foreseen before performing conformance monitoring.

In specific cases, the controller may already be aware of imminent discrepancies, therefore warning the controller of such cases can lead to nuisance alerts.

GM-ITIS-1370 ANSP systems **may** inhibit warnings or 2D conformance monitoring in the following operational situations:

- a ground flight plan route modification performed as an open clearance (e.g. radar heading); or
- the track of the flight is out of lateral conformance against the ground flight plan route updated with the controller clearances.

GM-ITIS-1380 ANSP systems **should** automatically remove any displayed discrepancy warnings once it is computed that the air and ground routes are aligned within the defined area for the comparison.

GM-ITIS-1390 ANSP systems **may** automatically terminate 2D conformance monitoring for a given flight, once it leaves the defined area for the comparison or has been transferred to the next unit.

4.3.5.3 3D conformance monitoring

Notes:

1) *3D conformance monitoring is not mandated by CP1 AF6 but may be addressed by a future edition of these guidelines following European research project outcomes or operational trials (e.g. SESAR2020 PJ18 Solution 56 and SESAR3 ATC-TBO).*
2) *Currently, two aspects of 3D conformance monitoring have been investigated by SESAR2020 PJ18 Solution 56: the comparison of EPP predicted flight levels vs. an issued vertical clearance at a point, and the comparison of EPP predicted flight levels and level constraints vs. STAR procedure constraints.*

An example of 3D discrepancy warnings on the ITEC label is shown in Figure 44:

- The three pink dots mean that the EPP predicted flight level does not match a given “CFL-LEVEL BY (WAYPOINT)” clearance.
- The pink STAR name BIMPAU means that the EPP does not match some of the STAR flight level constraints or that the EPP predicted flight levels are not compliant with the STAR level constraints.

Figure 44 – ITEC EPP 3D discrepancy warning

4.3.6 Developing Operational Procedures Using ADS-C Information

When processing ADS-C data, the CP1 AF6 regulation only refers to conformance monitoring, display of trajectories and warnings. Many use cases that are not mandated by CP1 can be developed once an ANSP system receives the ADS-C data. The subsections below provide an overview of the use cases which are currently in operational use at MUAC and which may be beneficial for other ANSPs as well.

4.3.6.1 TOD

The display of the ToD increases controller awareness and handling of aircraft approaching descent. For example, in Figure 45, the displayed ToD at FL380 can be used to appreciate if an aircraft needs to be descended earlier due to other crossing traffic at lower levels or if the downlinked optimal descent profile would be clear of traffic, with a higher rate of descent, while still meeting the exit restriction.

Figure 45 – MUAC operational use-case of ToD

4.3.6.2 TOC

The accuracy of the ToC highly depends on crews correctly entering information into the FMS (e.g. wind, current gross mass), autopilot modes, cost index changes (which trigger an EPP flight plan change event for ATS B2 standards revision B), climb thrust changes (e.g. changing from derated 2 to derated 1 thrust and vice-versa). Therefore, it needs to be used with caution and treated only as an intent.

The display of the ToC gives an idea to controllers whether the aircraft's climb performance, is not-as-good as expected compared to usual approximations based on the aircraft type, route length and upper winds. Indeed, when the ToC is displayed much further along the route than expected, this immediately draws the attention of controllers, and they will treat the aircraft accordingly (i.e. not to expect a high rate of climb for future instructions). However, should this ToC information turn out to be inaccurate, the controller will see that the aircraft has a better climbing rate which is never an issue.

The display of the ToC can help controllers estimate when they can turn traffic onto a direct track by relying on the climb profile, as long as the profile coincides with expectations.

Figure 46, shows that WUK4BN can reach its ToC of FL370 well in advance of the crossing point with BAW8NT which is cruising at FL360, indicating that vertical separation could be achieved.

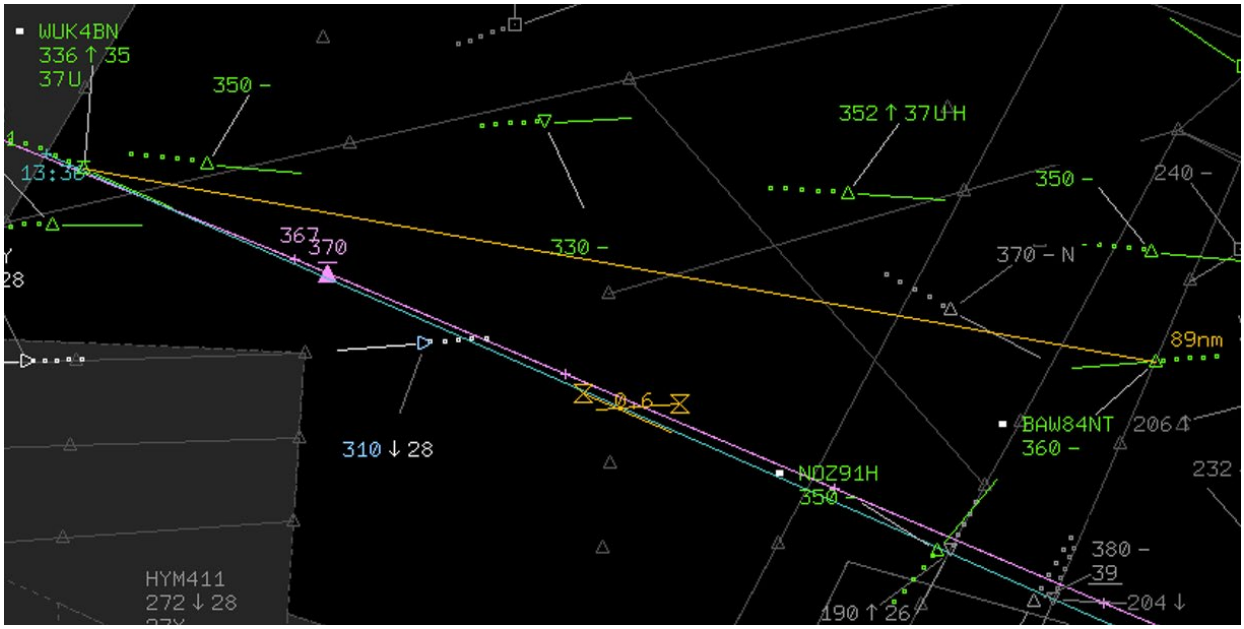

Figure 46 – MUAC operational use-case of ToC

The display of the ToC can also help controllers to estimate if they need to initiate climb coordination with neighbouring sectors or if the aircraft in question will be level before the transfer of control point.

4.3.6.3 EPP flight levels

Downlinked ADS-C EPP waypoints can include a flight level which is very useful for controllers. Indeed, due to multiple reasons, an aircraft's cruising flight level regularly differs from the level provided in the ground FPL. With the downlinked ADS-C EPP flight levels, controllers can better plan their traffic according to the FMS flight levels instead of those of the ground FPL, as long as these are operationally acceptable (i.e. no ATFCM issues).

By only referring to the ground FPL, a controller might move other traffic out of the way to accommodate an additional aircraft at its filed Requested Flight Level (RFL) of e.g. FL390, while on that day the aircraft is not able higher than FL370 – causing additional workload for the controllers involved and potentially increasing fuel burn for the other aircraft. This can be avoided once the controller is aware of the FMS cruising FL that is downlinked in the EPP flight level.

Downlinked ADS-C EPP waypoints can also be used to make better sector occupancy predictions at local and network levels. For example, in Figure 47, if the flight is filed at FL360, but the requested flight level is FL380, the controller can use this information to either provide a better service by allowing the aircraft to climb to the higher level earlier and/or by using this information to deconflict the aircraft from other traffic e.g. at FL360 by climbing it to FL380.

Figure 47 – MUAC operational use-case of EPP flight levels

It may also occur that the FPL is filed at FL380, but in the EPP the highest FL is 360. The controller can then be aware that he doesn't need to try to accommodate the aircraft at the higher level (with possibly other traffic on the same trajectory, which would require speed restrictions), because the final cruising level is FL360. In this case the aircraft might not enter the top-sector FL365+ and it should not be counted there or only tentatively (depending on local implementation), which also supports sector-load management.

4.3.6.4 Speed schedule

The speed schedule can be used to inform the controller about the possible minimum/maximum speeds of the aircraft per flight phase.

The speed schedule could be used to further reduce holding times in case of the AMAN/XMAN-scenarios by applying a speed reduction earlier to absorb more delay whilst en-route, thereby saving more fuel and emissions.

See also section 4.3.6.8 on TOA range.

4.3.6.5 EPP Speeds

Through the EPP downlinked speed values, controllers have a better and earlier awareness of the planned speeds both for the cruise phase and the arrival phase. Aircraft speeds can vary highly depending on many values, most importantly the cost index (CI). Through the use of the ADS-C EPP downlinked speed values, controllers can have a greater amount of time to pre-plan their traffic by taking the aircraft speeds into consideration.

For example: two inbound aircraft could be exactly at the same distance from the exit fix and doing the same Mach-number but could be requesting different transition speeds (e.g. 245 and 290 kts). In this –situation, the controller can then appreciate the high-speed difference and apply early speed-control accordingly (e.g. by not speeding up the aircraft which will be much slower on transition).

4.3.6.6 EPP waypoints for cross-boundary direct routing awareness

Controllers can be made aware of the cleared routing of the aircraft even when they are with the upstream ATSU with whom there is no available DCT information exchange via OLDI (e.g. REV on route, DCT in ACT).

For example, in Figure 48, flight EZY6892 has been given a direct clearance to the SURAT instead of the planned PETIL. The Copenhagen FIR can identify this clearance by looking at the downlinked EPP.

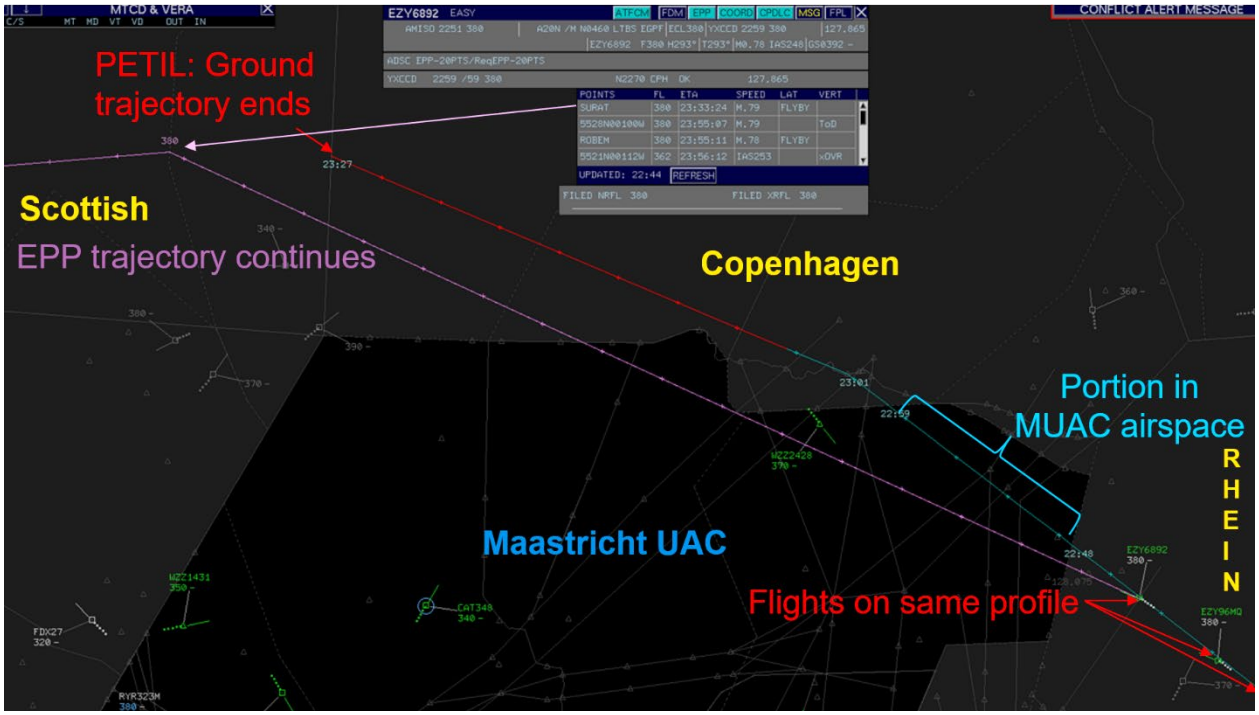

Figure 48 – MUAC operational use-case for cross-boundary routing awareness

4.3.6.7 EPP waypoints for the monitoring of clearances

ADS-C EPP downlinks can be used to verify if flight crews have correctly implemented direct and route clearance instructions both on voice and CPDLC. This can help controllers to be aware of eventual pilot entry mistakes sooner and without the need for additional monitoring and workload.

For example, the CPDLC UM79 CLEARED TO [position] VIA [route clearance] messages regularly cause incidents around the world, because flight crews might get confused and treat the message as a DIRECT TO instruction as opposed to a route clearance with multiple points. With the downlinked trajectory, these situations can be avoided or spotted earlier than observing the aircraft turning into the wrong direction.

The upper screenshot of Figure 49, shows that the controller cleared the aircraft to EVADI VIA ALASA as well as the subsequent downlinked EPP indicating the correct pilot entry. In contrast, the lower screenshot shows that the controller cleared the aircraft to MOPIL VIA a LatLong position and the subsequent downlinked EPP.

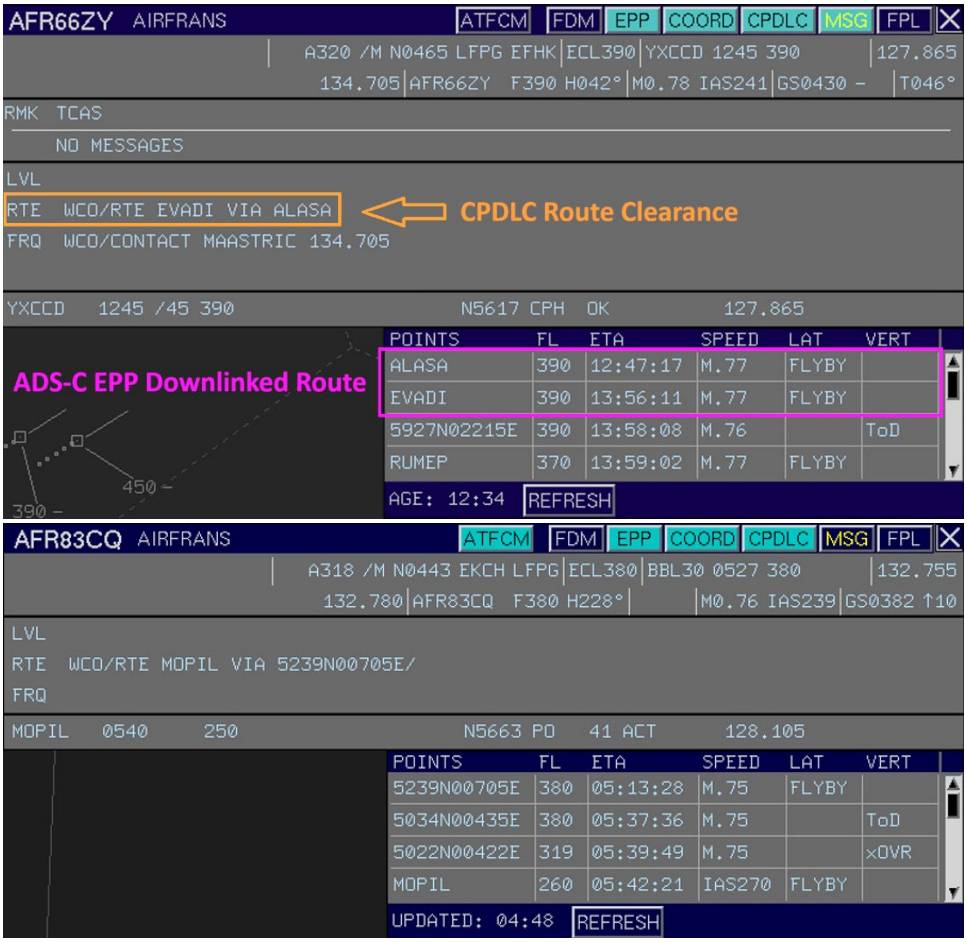

Figure 49 – MUAC operational use-case for monitoring clearances via EPP

4.3.6.8 TOA Range

The TOA range parameter in ADS-C demand contracts can be used by the controller for several use cases as it provides the earliest and latest times to cross over a point.

Based on the TOA range time information, the controllers can then instruct the pilot to reach a waypoint by a desired time via voice or CPDLC (the use of RTA/CTA functionality is being investigated by MUAC).

As an example, it can be used to check whether an aircraft which is already cleared through a military area becoming active can still accelerate to leave the area in time or whether it needs to be re-routed. This data can also be shared with military coordination partners, who can more easily assess, and potentially approve, airspace crossings even a few minutes after the activation of an area has occurred, thanks to the fact that they will know the exact exit time of the aircraft from the area.

In Figure 50, the TOA range indicates that the aircraft can reach the JUIST waypoint ahead of the advanced activation time of the military airspace (i.e. 09:53:35 vs 09:55:00). The controller can then issue a speed instruction to the aircraft to ensure it reaches JUIST in time.

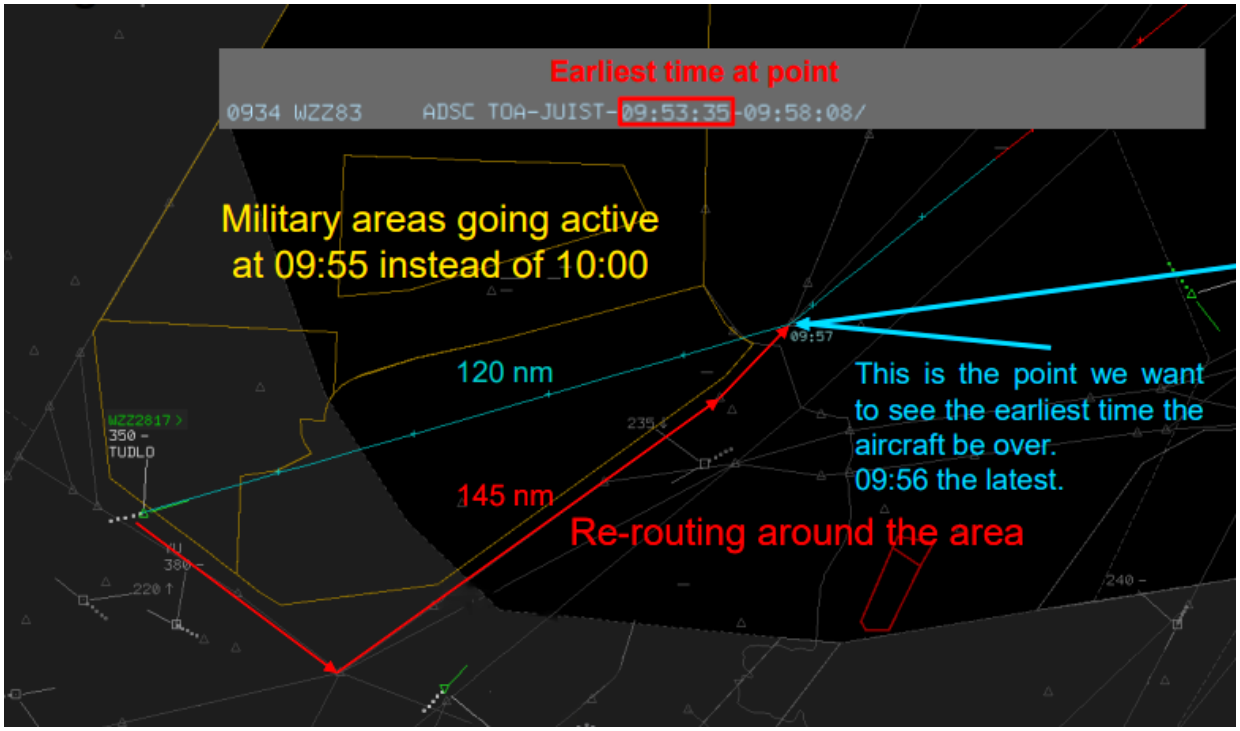

Figure 50 – MUAC operational use-case for monitoring clearances via EPP

The TOA functionality can also be used to properly sequence aircraft at a certain fix for arrival management purposes. Indeed, the earliest and latest ETA in the TOA range is a good means to assess the capability of a flight to modify its speed to reach the waypoint at a given time. In the frame of SESAR PJ38, NATS investigated its use to improve flow management in the approach to the London TMA.

4.3.7 Sharing information with Airspace Users

Each ANSP is responsible for publishing the ADS-C procedures (e.g. coverage, addresses, …) in the national AIP. This remains valid with the implementation of the ACS, and ANSPs will need to adapt their ADS-C procedures regarding the ADS-C common service once this becomes relevant.

GM-ITIS-1400 Each ANSP **should** update the national AIP to be consistent with their transition process for the ADS-C procedures, including the ADS-C common service address(es).

GM-ITIS-1410 Updates of the ADS-C procedures in the national AIPs **should** be initiated at the earliest possible time to give AUs a reasonable time to update their procedures and avionics databases.

Notes: As it can take time for AUs to update their avionics database with new addresses, an adequate period needs to be foreseen for existing ATS B2 fleet to be updated.

Regarding ACS degraded mode (e.g. maintenance, failure), the ACS provider will send adequate information to the ANSPs. This will allow ANSPs to publish the adequate NOTAM(s).

GM-ITIS-1420 Any temporary modification of the national AIP material regarding the ACS (e.g. coverage, degraded mode) **should** be published by ANSPs by way of NOTAM.

Considering the potential degraded modes of the ACS, ANSPs that have implemented ADS-C could establish ADS-C contracts as described in section 4.2.2. Such capabilities can be published.

GM-ITIS-1430 ANSPs that have implemented ADS-C capabilities and can mitigate ACS failures **should** publish their procedures in their national AIP or by way of NOTAM(s) when relevant.

During MUAC operations, it has been observed that route restrictions are not always published and are therefore unknown to airspace users. This means that they will not be entered into the aircraft's FMS and controllers are then unable to clear the aircraft according to the EPP trajectory.

GM-ITIS-1440 ANSPs **should** ensure that route restrictions (lateral, vertical or speed) are published as far as practicable, including those documented in letters of agreement (LoA).

Note: This is being further investigated in SESAR 3 Network TBO Project and HERON.

4.4. Guidance for Airspace Users

This section provides guidance for airspace user flight crews of aircraft exchanging ADS-C information with the ACS. ADS-C contracts are per definition managed by the ACS after a successful logon has been performed. In the case of an ACS failure, it is possible that ADS-C capable ATSUs will attempt to establish ADS-C contracts.

Note: Airspace user ground operational facilities may consider interacting with the ACS to receive downlinked data as ACS users as described in section 4.2.

GM-ITIS-1450 Airspace users **should** develop a training module for flight crews on ADS-C covering:

- history (e.g. oceanic vs continental);
- system design and operation;
- the need for crews to update the FMS with the current flight conditions and most recently received information;
- the ability of multiple ATSUs to establish ADS-C contracts (e.g. to mitigate an ACS failure); and
- human factor considerations.

*Note: Airspace users **could** develop a 'supplementary guide' to be made available for crews interested in further detailed information such as: ADS-C data groups (e.g. projected profile vs extended projected profile) or FMS calculations and the derived downlinked trajectory.*

When receiving ADS-C ground requests including waypoint coordinates (e.g. TOA range), the avionics will refer to the navigation database to match coordinates to an existing waypoint name to determine if it is on the EPP.

GM-ITIS-1460 Airspace users **should** ensure that pre-flight procedures include checking that ADS-C is ready, commonly indicated "ARMED" when no contract is active and "CONNECTED" or "ON" with at least one contract active.

GM-ITIS-1470 Airspace user crews **should** not switch ADS-C to "OFF" or manually terminate connections unless instructed by ATC.

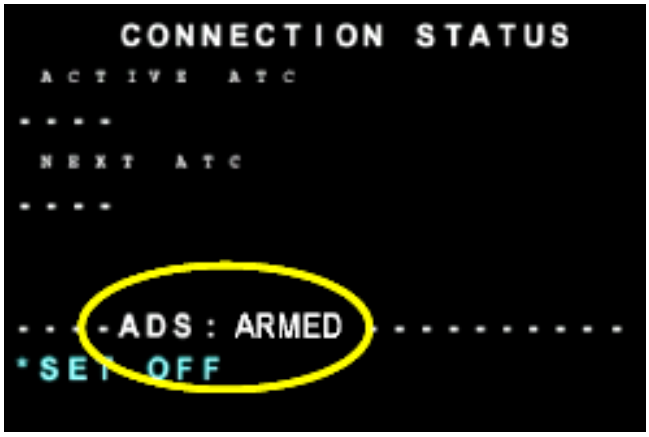

Figure 51 – Airbus A320 ADS-C connection status page

GM-ITIS-1480 Airspace users **should** provide their crews with pre-departure digital tools to upload the FMS with the operational flight plan (OFP) and predicted wind information details so that the downlinked ADS-C data is complete and error-free.

An accurate EPP depends on crews flying in lateral and vertical 'managed mode', wherethe FMS provides LNAV and VNAV inputs to the auto flight system, as requested by operational procedures. Airspace users must emphasise to their crews the importance of regularly updating the FMS with the latest available information.

GM-ITIS-1490 To ensure that the downlinked EPP contains the latest available information, when possible, crews **should** update the FMS with:

- flight path changes including altitude/flight level data for the remaining flight segments after it has been instructed or cleared by ATC;
- most recent wind data for cruise and descent flight phases; and
- any new descent speeds assigned by ATC, so that the FMS can calculate the correct profile.

The top of descent (ToD) profile calculated by the FMS might not be the best one due to unknown ATC constraints. It is only when the controller gives an ATC clearance, and that clearance is reflected in the FMS, that the downlinked profile will reflect the constraints.

GM-ITIS-1500 Airspace users **should** ensure crews are made aware that the FMS calculated top of descent profile can be inaccurate when it does not yet reflect local constraints.

As long as the aircraft is within ATN datalink coverage, ADS-C contracts remain active until they are aborted by the ACS or the airspace user. As the ACS is not necessarily aware that an aircraft has landed, it may not be able to abort active contracts. A practice would be to terminate active ADS-C contracts after landing.

GM-ITIS-1510 If an auto termination of open ADS-C contracts after end of flight is not supported by their avionics, Airspace users **should** ensure their flight crews are made aware that they need to terminate ADS-C connections after landing, so that ADS-C contracts are aborted and do not remain unnecessarily active.

4.5. Guidance for the Network Manager

For the purpose of this edition, the Network Manager can refer to guidance provided in sections 4.2 and 4.3.4.

ANNEX A– Abbreviations

Abbreviation	Definition
ACC	Area Control Centre
ACS	ADS-C Common Service
ADEP	Aerodrome of Departure
ADES	Aerodrome of Destination
ADS-C	Automatic Dependent Surveillance – Contract
AF6	ATM Functionality 6
AIP	Aeronautical Information Publication
AMIC	Application Message Integrity Check
AMQP	Advanced Message Queuing Protocol
ANSP	Air Navigation Service Provider
AoR	Area of Responsibility
ASN.1	Abstract Syntax Notation 1
ATC	Air Traffic Control
ATN	Aeronautical Telecommunication(s) Network
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
AU	Airspace User
CDA	Current Data Authority
CFL	Cleared Flight Level
CM	Context Management
CONOPS	Concept of Operations
COP	Co-ordination Point

Abbreviation	Definition
CP1	Common Project 1
CPDLC	Controller-Pilot Datalink Communications
DLIC	Data Link Initiation Capability
DRNP/IM	Dynamic Required Navigation Performance/Interval Management
EACP	European Aviation Common PKI
ED	EUROCAE Document
EPP	Extended Projected Profile
ETA	Estimated Time of Arrival
FPL	Flight Plan
GFD	Ground Facility Designator
HTTPS	HyperText Transport Protocol Secured
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organization
IFPZ	IFPS Zone (IFPS is the Integrated Initial Flight Plan Processing System).
IP	Internet Protocol
KPI	Key Performance Indicator
LNAV or L-NAV	Lateral Navigation
LOF	Logon Forward (On-Line Data Interchange (OLDI) message)
LS	Logon Service
NAN	Next Authority Notified (OLDI message)
NDA	Next Data Authority
NOTAM	Notice to Airmen
NM	Network Manager

Abbreviation	Definition
NSAP	Network Service Access Point
OEP	Operational Excellence Programme
OLDI	On-Line Data Interchange
PDU	Protocol Data Unit
PER	Packed Encoding Rules
RFL	Requested Flight Level
RTA	Required Time of Arrival
RTCA	Radio Technical Commission for Aeronautics (US)
SDM	SESAR Deployment Manager
SES	Single European Sky
SESAR	Single European Sky ATM Research (Programme)
SWIM	System-Wide Information Management
TOA	Time of Arrival
TSAP	Transport Service Access Point
TTS	Termination Timer Sender
VNAV or V-NAV	Vertical Navigation
XER	XML (Extensible Markup Language) Encoding Rules

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ANNEX B – Example 2D Conformance Monitoring

This Annex describes the MUAC 2D conformance monitoring of air and ground routes (FPL updated with all subsequent controller clearance inputs, i.e. direct inputs). The approach taken by ITEC is similar; however, its specific steps are described in section B.8.

B.1 Performing the comparison

The comparison takes place under the following conditions:

- A new EPP is received, or an internal grace period timer expires (the grace period is a time set after ground route modification; when the controller uplinks a new direct/route the grace period is set to 60 seconds, when the controller makes an input that the clearance was given via voice, the grace period is set to 30 seconds)
- the flight is not on a radar heading (ATCO input), and
- the track of the flight is in lateral conformance against the flight plan route updated with the ATCO clearances.

Before the comparison, the EPP trajectory is pre-processed to extract the air route within the defined area for the comparison. At this moment, some certain waypoints are disregarded as they are not considered relevant for the comparison. These are waypoints with no `name` (i.e. not fixes) for which:

- the `vertical-type` is different from `topOfClimb`, `topOfDescent`, or `crossover`; and
- their <u>only</u> `lateral-type` is `followedByDisco`.

<u>Note</u>: If a waypoint has more than one lateral type, and one of them is not `followedByDisco`, then the EPP waypoint is not discarded.

Following the disregarding of waypoints, segments (S'j) are built between 2 consecutive remaining waypoints (Wj) as shown in Figure B.1.

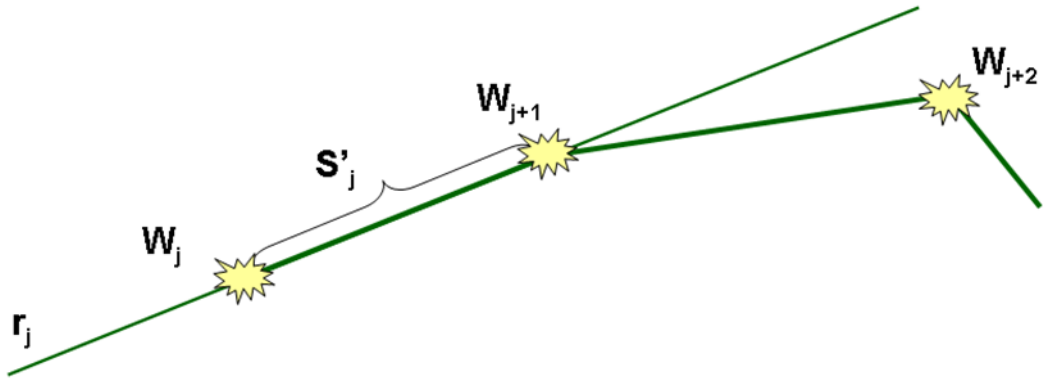

Figure B.1 - Waypoint segment creation

In a similar manner, the ground route is also pre-processed before the comparison. The ground route points taken for the comparison are those within the defined area, meaning the points between the “first route point” before the area of interest (AOI) to the “first route point” after the area of interest. If the flight is already inside the AOI and there are some route points already overflown, they are removed and only the “last-route-point-overflown” is kept for the 2D comparison. This is done to avoid nuisance alerts during the comparison due to the first EPP waypoint being considered as overflown on the ground while it is still part of the last EPP received.

With that portion of the ground route, segments (Si) are built between 2 consecutive route points (Pi) in a similar manner as with the EPP waypoints (see Figure B.2).

B.2 Building the corridor around the ground route

Once the segments are built between 2 consecutive route points (Pi). As shown in Figure B.2, a parallelogram (Pz) is built around each of those segments (Si), creating a “corridor” around the given segment. A parallelogram of a configurable width, currently set to 2NM each side of the segment, is created.

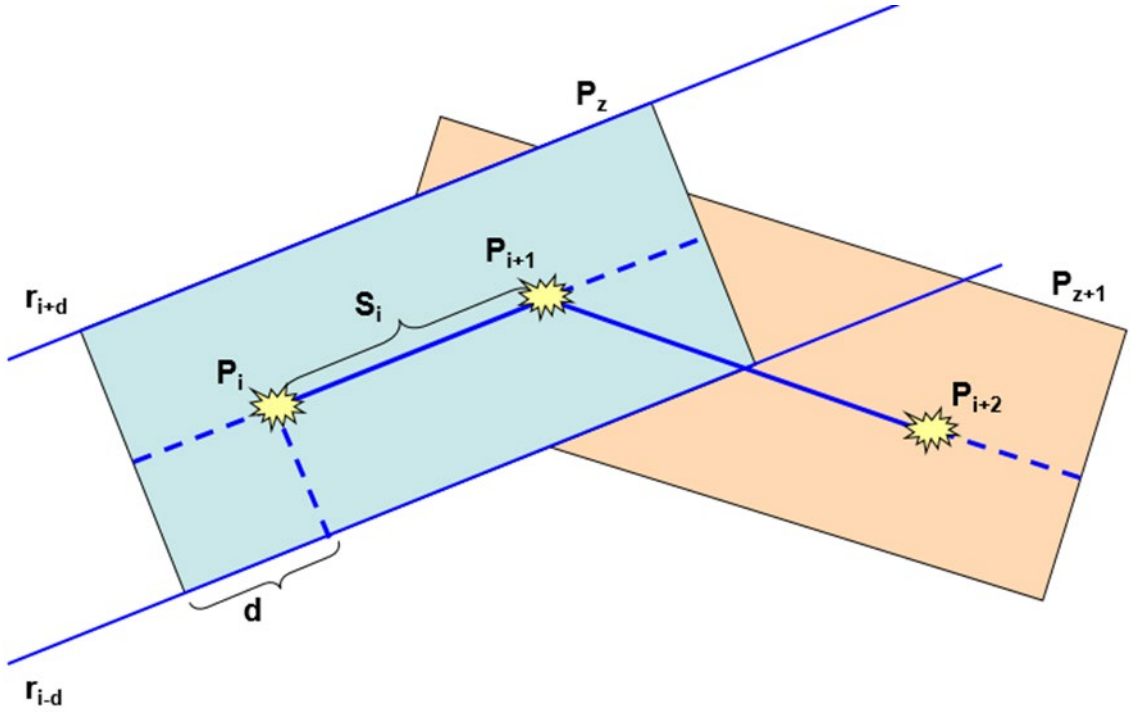

Figure B.2 - Parallelogram creation around the ground route segments

B.3 2D comparison

Once the corridor of parallelograms is built around the route segments, the algorithm checks whether the EPP segments (S’j) are completely inside the corridor: this is done through calculating crossing points (Cp) between the EPP segments and the parallelograms. If the crossing point is between two parallelograms, then the segment is inside the corridor, otherwise it means that that part of the segment is outside.

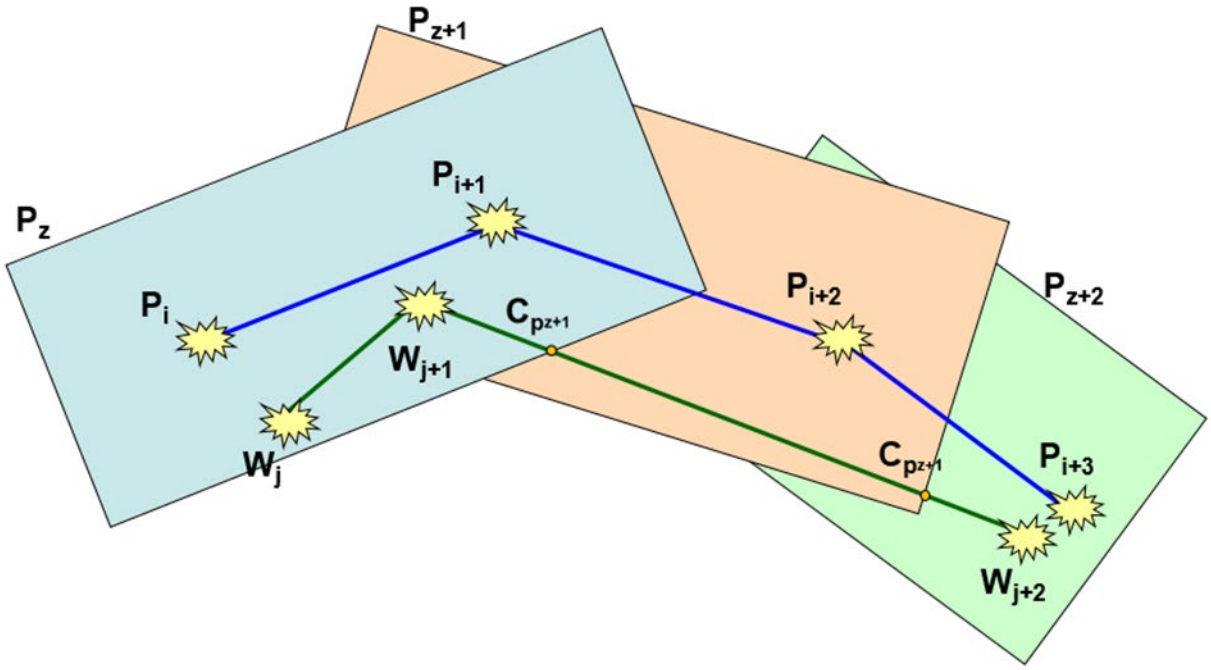

Figure B.3 – First example of EPP segment (green) inside the corridor

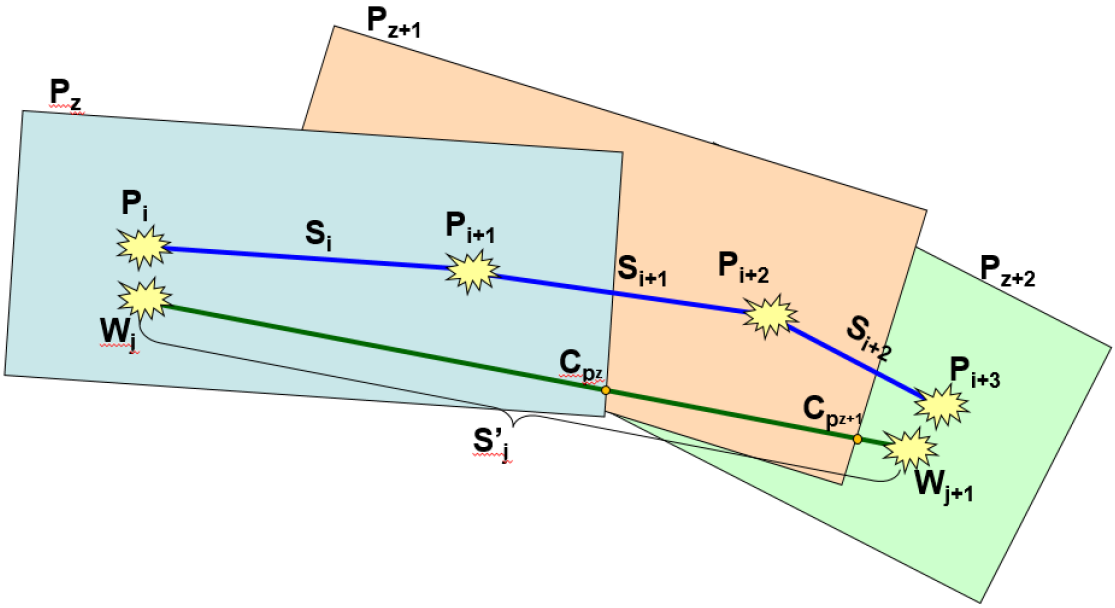

Figure B.4 – Second example of EPP segment (green) inside the corridor

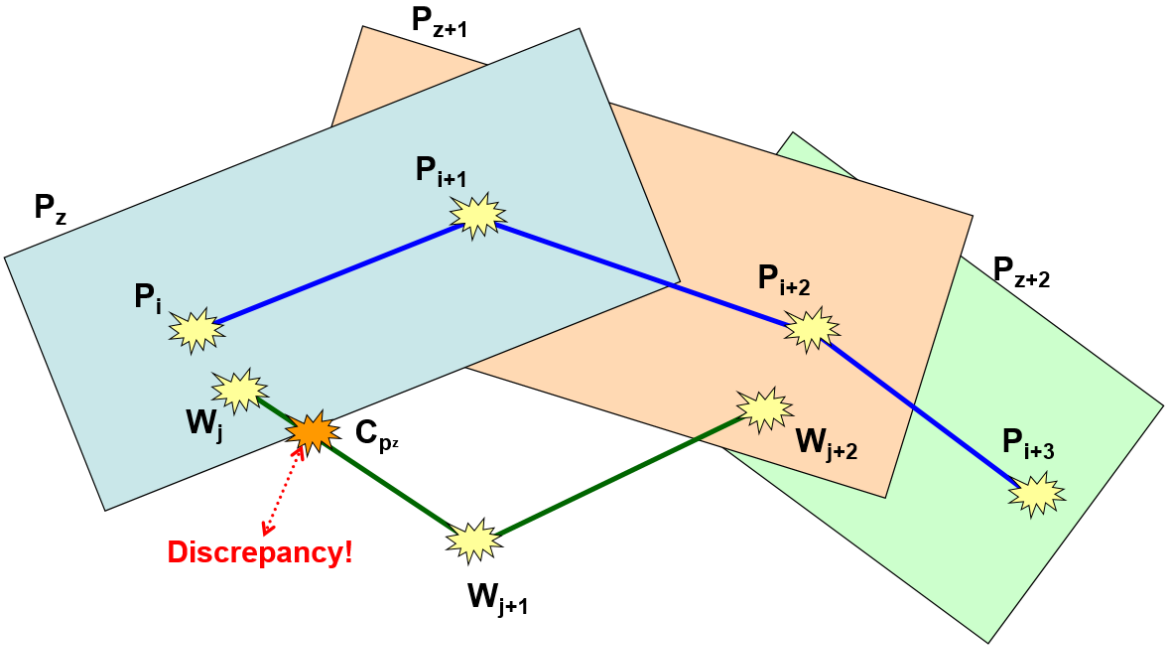

Figure B.5 – Example of EPP segment (green) and waypoint outside the corridor

If all EPP segments are completely inside the corridor, then it is considered that both the ground and the air route are aligned (see Figure B.4). However, if a part of any EPP segment is outside the corridor (see Figure B.5), then it is considered that the air and ground routes are discrepant, and a warning is raised.

Special attention needs to be given to aircraft exiting the area of interest. When this occurs, finding EPP segments outside the corridor doesn't mean that the air and ground routes are discrepant. It needs to be checked how the aircraft is exiting the area by determining the crossing point (Cp) location of the EPP segment corresponding to the first waypoint (Wj+1) outside of the AOI.

If the crossing point (Cp) is on the green line of the last parallelogram as shown in Figure B.6, the routes are aligned. Otherwise a discrepancy warning is raised.

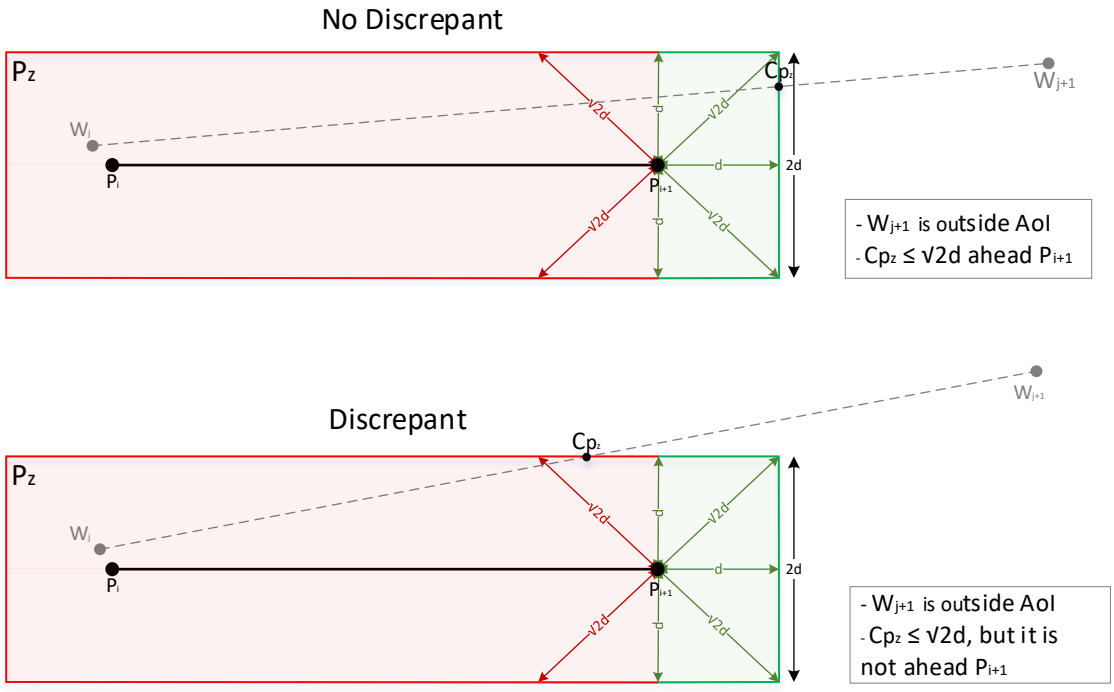

Figure B.6 – Example of discrepancy detections when the EPP trajectory is beyond the AoI

B.4 Discrepancy warnings

When the result of the 2D comparison is that the air and ground route are discrepant, a discrepancy warning shall be raised to the controllers. For that, the result of the comparison is distributed to all controller working positions (CWPs), where additional filtering is done before displaying the discrepancy warning indicator in the label of the aircraft.

In MUAC, discrepancies are only shown to the:

- sector in control of the flight;
- next sector (downstream sector);
- first sector if the flight is not yet assumed.

This limits the number of warnings being displayed to controllers. Warnings are provided to controllers that have an interest and on which they can react to align the air and ground routes.

Figure B.7 – Discrepancy indicator "?" when air and ground routes are not aligned

B.5 Grace periods

Grace period timers are set every time a direct (DCT) or graphical-route-modification (GRM) input is performed by the controller to allow time for pilots to execute the clearance. The timers are activated regardless of whether the route modification is performed through voice or CPDLC. These timers are configurable, and they are set to a longer period when the clearance is done via CPDLC to give the message the time to reach the aircraft, for the pilots to react and to execute the instruction.

Currently, the timers used in MUAC are set to 30s for voice clearances and 60s for CPDLC clearances.

Whenever a grace period expires (meaning that no EPP has been received during the period), the algorithm is performed to verify this.

Whenever an EPP is received while a grace period is ongoing, the timer is stopped, and the comparison algorithm is executed to check whether the ground route and the EPP (air route) are aligned.

B.6 Suspension of discrepancy-detection due radar heading

When a heading input is made by the controller, the computation algorithm is stopped to avoid rendering nuisance alerts. The old route is usually kept and downlinked with every EPP update until the aircraft is cleared back on own navigation. The computation of the 2D algorithm is resumed once a direct or route input is performed by the controller.

B.7 Suspension of discrepancy-detection due to track out-of-conformance

Ground systems monitor the track of flights against their planned trajectory updated by controller inputs to see whether the aircraft complies with its calculated trajectory. When the aircraft deviates from the calculated trajectory, an alert is raised to the controller. This is referred to as being “out-of-conformance”. Usually ground systems monitor the flights for: lateral, vertical and longitudinal deviations.

Whenever the flight is out of 2D conformance (lateral conformance), the 2D comparison algorithm is stopped to avoid giving nuisance alerts, as an alert with higher priority should already be displayed for the lateral out of conformance. The computation of the algorithm is resumed once the flight is in back in lateral conformance again.

B.8 ITEC 2D Conformance Monitoring

ITEC applies the same algorithm for the detection of corridor 2D discrepancies as MUAC, to compute what on ITEC is called “Type2 2D discrepancies”.

Additionally, ITEC FDP checks whether the EPP contains all the waypoints present in the ground route and raises what is called a “Type1 2D discrepancy” warning (see Figure 15) if any point is missing. In such cases, the following logic determines which type of discrepancy warning is notified to the controller:

- If the EPP segment still stays inside the 2D corridor of the ground route, a low-level Type1 discrepancy warning is shown on the screen.
- If the EPP segment goes outside of the 2D corridor due to the missing waypoint, a high-level Type2 discrepancy warning is shown on the screen.

When a Type1 discrepancy warning is notified, it means that there is no 2D corridor problem. However, the controller is aware that the waypoint missing on the EPP could cause problems when communicating with the pilot. References to the point could be misunderstood, a “direct-to” clearance to it could cause route discontinuity problems, etc.

MUAC FDPS only computes the first discrepancy found within its relevant area, and then stops. On ITEC FDP, after finding the first Type1 or Type2 discrepancy, the process does not stop. The algorithm is executed again after the first discrepancy and can currently compute up to 5 discrepancies between the ground and EPP routes at a given time. These discrepancies can be notified and shown to the same or different CWPs.

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ANNEX C – Document Update Procedures

It is necessary to periodically check these EUROCONTROL Guidelines for consistency with referenced material, notably ICAO SARPS and relevant regulations. The Guidelines may also evolve following feedback from field experience.

The main objectives of a regular review are:

a) to improve the quality of the Guidelines (e.g. clarity, testability, etc.);

b) to verify that the level of detail published is adequate;

c) to make all stakeholders aware of the latest developments.

The update process for the guidelines is expected to be initiated by stakeholders, who may provide change proposals either through existing working arrangements (e.g. established working groups) or by sending a formal Change Request (CR) to the generic email address: standardisation@eurocontrol.int.

The CR needs to provide, at a minimum, the following elements:

- Originator information (name, organisation, contact details);
- Guideline title, number and edition date;
- Page, chapter, section (subsection) where the issue appears;
- Description of the issue and reason for change;
- Specific change proposal text (incl. potential alternatives, if any).

Main steps towards a revised edition:

- EUROCONTROL will assess each CR in coordination with content owners to establish the urgency and impact (major, minor or editorial);
- A resolution proposal will be prepared and, if needed, discussed with the originator;
- Agreed changes will be integrated into a revised “Proposed Issue” version, which includes a summary of changes in the document record;
- The “Proposed Issue” will be consulted using appropriate working arrangements.

Note: Identified errors which may cause potential problems when implementing, may be corrected directly via a separate “Corrigendum”.

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