28 April 2023

BY ELECTRONIC MAIL

Mr. Bryan Jolly and Mr. Daniel Mihoci
European Union Aviation Safety Agency
Konrad-Adenauer-Ufer 3
D-50668 Cologne, Germany

Dear Mr. Jolly and Mr. Mihoci:

The General Aviation Manufacturers Association (GAMA) is pleased to provide the attached technical feedback on an important element of EASA's Common Project 1 (CP1): specifically, the proposed requirement for reporting of an aeroplane's extended projected profile (EPP) via ADS-C contract downlink as part of the ATS B2 suite of air traffic management solutions.

GAMA in general vigorously supports the deployment of air traffic management tools and protocols that better equip air crews and air traffic controllers to conduct trajectory-based operations (TBO). Capabilities enabled by TBO, such as continuous climbs and descents, among other things, will enhance aviation's environmental sustainability and improve overall the efficiency of global air traffic management. However, many of our 140 member organizations worldwide, including several headquartered in the EU, have registered concerns about the current EPP requirements and the practical considerations for new aeroplanes to be delivered with the capability starting 31 December 2027. The attached technical document describes these concerns in greater detail.

To complement and emphasize the concerns noted in the attached, we would like to provide some further information shared with us by member companies. As a threshold matter, it is our hope that the mandate at issue will not advance without a clear technical harmonised workplan and roadmap.

The proposed EPP mandate would specifically precede the maturation of ATS B2 services such as required time of arrival/time-of-arrival-control with respect to a waypoint, dynamic required navigation performance, and similar elements of the full ATS B2 capability. Without those services fully defined and operational, with both ground infrastructure and airborne systems such as FMSes prepared to support them, an EPP downlink requirement effective at the end of 2027 would be premature at best. The agency as well as its international regulatory partners have stated that ATN B2 data link installations should include both CPDLC and ADS-C capabilities as defined in the applicable standards. And, that "Partial installations are not acceptable to avoid future limitations in the development of datalink worldwide." GAMA currently has concerns

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with an expanded mandate of ATS B2 due to the lack of readiness of the overall standards suite.

The agency's work on the *FUTURE CONNECTIVITY FOR AVIATION – EU/US task force White Paper, Dated 09/11/2022, Issue 1* document should help inform the pathway forward. As an example, the joint document identifies a "Full B2 mandate – B2b" convergence point of 2032 which introduces the question whether agency and industry resources would benefit from a shift in strategy from an interim ADS-C EPP mandate in 2028 to instead pursue the standards maturation and resolution of the technical challenges for airborne and ground equipage to enable the 2032 date? In addition to the technical challenges discussed in the attached GAMA document, we would welcome EASA's Industrialisation Forum exploring the benefits of a pathway to 2032 for full B2 services without an interim and possibly complicating ADS-C EPP mandate.

Besides the overall technical challenges, there are specific complications for the BA/GA community when attempting to comply with RTA in that the FMS must be capable of producing a Time of Arrival Control (TOAC) solution. Most general and business aviation FMSes do not have TOAC capability. TOAC solutions require complex computations and interactions with aircraft systems including performance management functions, speed management, auto-throttle, etc. There is currently no guidance (*e.g.*, A(M)C) describing certification pathways for RTA/TOAC. TOAC specifically is an advanced RNP function that is not well defined for either equipment requirements or airspace implementation.

Moreover, we would benefit from clearer information as to the datalink platforms that will be adopted through CP1. Options could include VHF datalink mode 2 (VDL2) *without* aeronautical operational communications (AOC) traffic (in which case AOC traffic would need to be offloaded from the VDL2 frequencies); Iris SATCOM links (although these are not acceptable for all aircraft); or a multilink arrangement involving VDL2 plus SATCOM, although a "centralized services" suite (incorporating CPDLC, ADS-C, Aeronautical Information Services, plus log-on functionalities) may be appropriate for such a solution.

GAMA appreciates the work underway by EUROCONTROL to develop the *EUROCONTROL Specification for Data Link Common Services for the Aeronautical Telecommunication Network (ATN), DOCUMENT IDENTIFIER: EUROCONTROL – SPEC – xxx, Edition: 0.5., 23/05/2023, Working Draft*. While this document is in its infancy, this specification takes a step forward to define what airborne and ground systems need to implement to provide the services within the scope of the document. GAMA expects the use of this Specification to complement *EUROCONTROL Specification 0116, EUROCONTROL Specification on Data Link Services* which helped inform the implementation of the data link implementation Regulation (EU) 29/2009. ATN B1 is similar to ATS B2 in that it defines a number of applications and services that can be used on the ATN. Specification 0116 defines what is actually needed to be implemented to comply with the mandate for air and ground systems to interoperate. With the maturation of the new EUROCONTROL Specification, EASA would be in a position to establish AMC and GM to certify airborne component of the agreed services for ATS B2.

We are also concerned about the substantial costs and practical limitations associated with retrofits of aircraft that were type-certificated before the effective date of 31 December 2027 but that were manufactured and received their individual certificates of airworthiness after that date. We would have similar concerns if, in future, the operating fleet must be retrofitted to support EPP reporting. Data transmitted as part of an EPP report via ADS-C downlink would originate from the airplane's flight management system (FMS), and while airframe and avionics manufacturers can ensure that new-production aircraft incorporate the FMS and datalink software features necessary to support the EPP report mandate, retrofits and changes to existing designs would involve extensive costs, at minimum.

We appreciate your kind consideration of the foregoing and of the attached whitepaper. We look forward to continued collaboration on CP1 and beyond to continue to match the global air traffic management network. To support the collaboration, GAMA is interested in participating in EASA's CP1 Industrialisation Forum.

If you have any questions regarding our comments, please do not hesitate in contacting me at jhennig@gama.aero.

Respectfully,

Jens C. Hennig
Vice President – Operations, Safety, and Security

GAMA Position on European EPP DLS Mandate and Associated Regulatory Aspects

Background

EU Commission Regulation 2021/116 (1 February 2021) establishes the Common Project One (CP1) which supports the implementation of the European Air Traffic Management Master Plan.

CP1 is built upon the concept of enabling ATM functionality (AF) technologies. CP1 contains 6 enabling ATM functionalities, AF1 through AF6.

AF6 is the portion of CP1 which applies to the airborne system. AF6 enables initial trajectory information sharing (i4D) which is claimed to improve the use of target times and trajectory information. AF6 will be realized by the airborne system in the form of the ADS-C (Automatic Dependent Surveillance-Contract) EPP (Extended Projected Profile) report which is a part of the ATS B2 suite of applications.

Per the Regulation, the EPP report must be supported by aircraft which will operate above FL285, and which have an individual certificate of airworthiness (CofA) on or after 31 December 2027. These impacted aircraft will also be subject to EU Commission Regulation No 29/2009 which requires the equipage of ATN B1.

Therefore, an aircraft which operates above FL285 and with a CofA after 31 December 2027 will be mandated to support ATN B1 CPDLC (or an equivalent capability) and the EPP reporting capability from ATS B2. Throughout the rest of this document, these set of capabilities will be referred to as the "EPP mandate."

Implementation

In real world application, support for AF6 will require an aircraft to accept an ADS-C uplink request from an ATC facility. The uplink request will specify the ADS-C report type (i.e., EPP) and when the aircraft should send the report (e.g., periodic, on demand).

Regulatory

Although AF6 only requires EPP support for the airborne system, EASA and the FAA do not currently provide a path forward to certify a configuration targeted to just the EPP portion of the ATS B2 standards.

While no published version of EASA CS-ACNS currently recognizes the EPP report or ATS B2, EASA has released a pre-draft revision which recognizes and defines ATS B2. Included within this draft is the following excerpt (emphasis added):

> *"ATN B2 installations should **fully support** those requirements applicable to aircraft systems for **all services identified** in these standards.*
>
> *ATN B2 data link installations should include **both CPDLC and ADS-C capabilities** as defined in the applicable standards. **Partial installations are not acceptable** to avoid future limitations in the development of datalink worldwide."*

The FAA's AC 20-140C similarly defines an ATS B2 system as being comprised of fully implementing CPDLC and ADS-C.

Based on the above discussion, at this time there only appears to be a regulatory path forward which includes certifying the entire ATS B2 system.

EPP vs ATS B2

From a programmatic standpoint it would be ideal for the airborne side to have the entire ATS B2 system implemented and certified. Avionics upgrades come few and far between. Even once those updates become available, each airline/operator may choose to equip at different times, or may never equip. A common and full featured equipage of the airborne equipment (i.e., full ATS B2) would allow each European ANSP to upgrade their ATM capabilities over time and independent from other ANSPs.

From the airborne perspective this may be less than ideal. Per the EPP mandate, the only ATS B2 capability that is required is the EPP report. To support EPP there would have to be some structure to allow the avionics to logon to the ground system and logic to support the ADS-C contract requests and then to build the EPP report. Although not insignificant, the scope of work to support this EPP capability is much less than the entire ATS B2 suite of capabilities.

The scope of the EPP report as defined in RTCA/DO-351A (EUROCAE/ED-229A) section 5.3 is shown in Figure 1. The avionics will downlink this report per the requirements of the uplink contract from the ATC system, such as on a defined interval, on occurrence of specified event, or an on-demand request. The report will extract data from the active flight plan in the aircraft's FMS and sensor data.

Included in the EPP report are the following required data:

- Time the report was assembled
- Indexed number of each waypoint included in the report
- The latitude and longitude of each waypoint

The following data may be included in the EPP report if it is available/applicable:

- Expected altitude at the waypoint
- Name of the waypoint in the active flight plan
- Estimated time of arrival at the waypoint
- Estimated speed at the waypoint
- Vertical profile status (e.g., top of climb, top of descent) at the waypoint
- Lateral profile status (e.g., flyby, offset path) at the waypoint
- Altitude constraint at the waypoint
- Speed constraint at the waypoint
- Required time of arrival at the waypoint

Additionally, each report downlink may include the aircraft's current gross mass and trajectory type (e.g., lateral managed, vertical managed, speed managed, or time managed).

```
ExtendedProjectedProfile ::= SEQUENCE
        {
        computation-time        [0]     DateTimeGroup,
        way-point-sequence      [1]     SEQUENCE SIZE (1..128) OF SEQUENCE
                {
                latitude                [0]     Latitude,
                longitude               [1]     Longitude,
                level                   [2]     EPPLevel                OPTIONAL,
                name                    [3]     WaypointName            OPTIONAL,
                estimated-time          [4]     ETA                     OPTIONAL,
                estimated-speed         [5]     SpeedIASMach            OPTIONAL,
                vertical-type           [6]     VerticalType            OPTIONAL,
                lateral-type            [7]     LateralType             OPTIONAL,
                level-constraint        [8]     LevelConstraint         OPTIONAL,
                speed-contraint         [9]     SpeedConstraint         OPTIONAL,
                time-constraint         [10]    RTA                     OPTIONAL,
                ...
                },
        current-gross-mass      [2]     GrossMass               OPTIONAL,
        trajectory-intent-status [3]    TrajectoryIntentStatus  OPTIONAL,
        ...
        }
```

Figure 1 - EPP Structure

The above EPP description is just one report type in the ADS-C application. If required to support the full ADS-C application, the avionics will be required to support the assembly of other complex reports such as:

- Ground vector reports
- Air vector reports
- Observed metrology reports
- Speed schedule profile reports
- Emergency reports
- Time of arrival range reports
- Required time of arrival status reports
- RNP profile reports
- Planned approach speed reports
- Hold data reports
- Runway occupancy reports

Each of these additional report types are going to require development to aggregate various data types to build the report including but not limited to:

- Winds data
- Temperature data
- Turbulence data
- Humidity data
- Ground track
- Ground speed
- Vertical speed
- Speed schedules
- Time of arrival data

Implementing the remainder of of ATS B2 will require other considerable effort. For those equipment manufacturers which support ATN B1, there is commonality and potential for some reuse when implementing the CM and CPDLC applications.

A list of ATS B2 services from RTCA/DO-350A (EUROCAE/ED-228A) section 2.4.5 is shown in Figure 2. The implementation of ATN B1 in use in Europe includes the DLIC, ACM, CRD, and AMC. The remaining services are new to ATS B2. Effort will be required to build the new CPDLC messages and data types to support these new services.

ATS Services	Data Link Applications			ATM Operations Supported by Data Link										
	CM	CPCLC	ADS-C	Departure Clearance	Taxi Clearance	ATC Comm	Separation Assurance 1	Separation Assurance 2	Climb Decent Procedure	ITP	IM-AACD	4DTBO	DRNP	IM-PTM
DLIC	√													
ACM		√				√								
CRD		√				√	√	√	√					
AMC		√				√								
DCL		√		√										
D-TAXI		√			√									
IER		√	√			√	√	√						
PR			√				√	√	√					
4DTRAD		√	√									√		
ITP		√								√				
IM		√	√								√			√
OCL		√				√								
DRNP		√	√										√	

Figure 2- ATS B2 Services

The above discussion has focused on the burden to the equipment manufacturers to build an ATS B2 system. This burden will be extended to airframe manufacturers which produce aircraft subject to the EPP mandate.

Certifying only the EPP report is a very different scope of effort versus certifying the entire ATS B2 suite of capabilities. The absence of ground implementation adds to these challenges. The ground systems may support EPP in the next couple of years but full support for all ATS B2 is expected to be a process that extends into the 2030s. Test tools can serve as a remediation to support certification testing but does not replace the reassurance gained by testing against a live deployment. This would require mature test tools to be available to industry.

Forward/Backwards Compatibility

Without a homogenous ground deployment, the airborne system will be responsible for managing forward and backwards compatibility. Managing both the forward and backwards compatibility is

considered a more 'complex' and expensive implementation to the airborne side. Based on the current structure of mandates, new aircraft delivered in 2028 and after must support the CPDLC capabilities defined by ATN B1 and the EPP capability in ATS B2. For the avionics to support the CPDLC requirements they can either support both ATN B1 and ATS B2 or can support ATS B2 with ATN B1 backwards compatibility as defined in RTCA/DO-353A (EUROCAE/ED-231A).

An alternative to the aircraft supporting backwards compatibility could be achieved by the ground systems providing ATS B2 to ATN B1 compatibility. Since existing aircraft (those not required to support ATS B2/EPP) will still be required to support ATN B1, ground systems must also support ATN B1. The ground systems could be updated to support ATS B2 CPDLC with backwards compatibility for ATN B1. This would allow for a 'simpler' avionics' implementation where only ATS B2 would have to be supported on the airborne side and the ground side would be able to both natively support ATS B2 and translate to ATN B1.

For this 'simpler' avionics method to work, all ANSPs would have to support both ATS B2 and ATN B1 backwards compatibility at the time that ATS B2 aircraft begin to be fielded. Without such an assurance of homogenous ground support, avionics suppliers must plan their design to support ATS B2 CPDLC with ATN B1 backwards compatibility. Aircraft manufacturers must make their plans to certify a system which supports ATS B2 CPDLC with ATN B1 backwards compatibility. As of February 2023, no such plan is known to exist with ANSPs. Therefore, the more 'complex' implementation is the way for the airborne equipment to mitigate the risk of not being fully interoperable with all ANSPs.

Integrated Systems

As discussed above, ATS B2 will support additional services beyond those supported in ATN B1. Included with these are:

1. **DCL** – Departure Clearance
2. **D-TAXI** – Digital Taxi
3. **IER** – Information Exchange and Reporting
4. **PR** – Position Reporting
5. **4DTRAD** – 4-Dimensional Trajectory
6. **ITP** – In Trail Procedure
7. **IM** – Interval Management
8. **OCL** – Oceanic Clearance
9. **DRNP** – Dynamic Required Navigation Performance

There are some new services such as DCL and OCL, but their associated CPDLC messages will largely be similar and/or a reuse of those used for the CRD service.

For other new services, such as D-TAXI, IER, and PR, new uplink and downlink CPDLC messages must be developed but the exchanges are fairly straight forward.

The 4DTRAD, ITP, IM, and DRNP services introduce much more complexity to their CPDLC messages, and they require coordination with other parts of the flight deck.

4DTRAD

The EPP report is being introduced to allow for initial 4D trajectory (i4D) based operations. Full 4D operations require the EPP and additional ADS-C reports for conformance monitoring along with CPDLC messages. The 4DTRAD operating method from RTCA/DO-350A (EUROCAE/ED-228A) section 3.9.3 is shown in Figure 3.

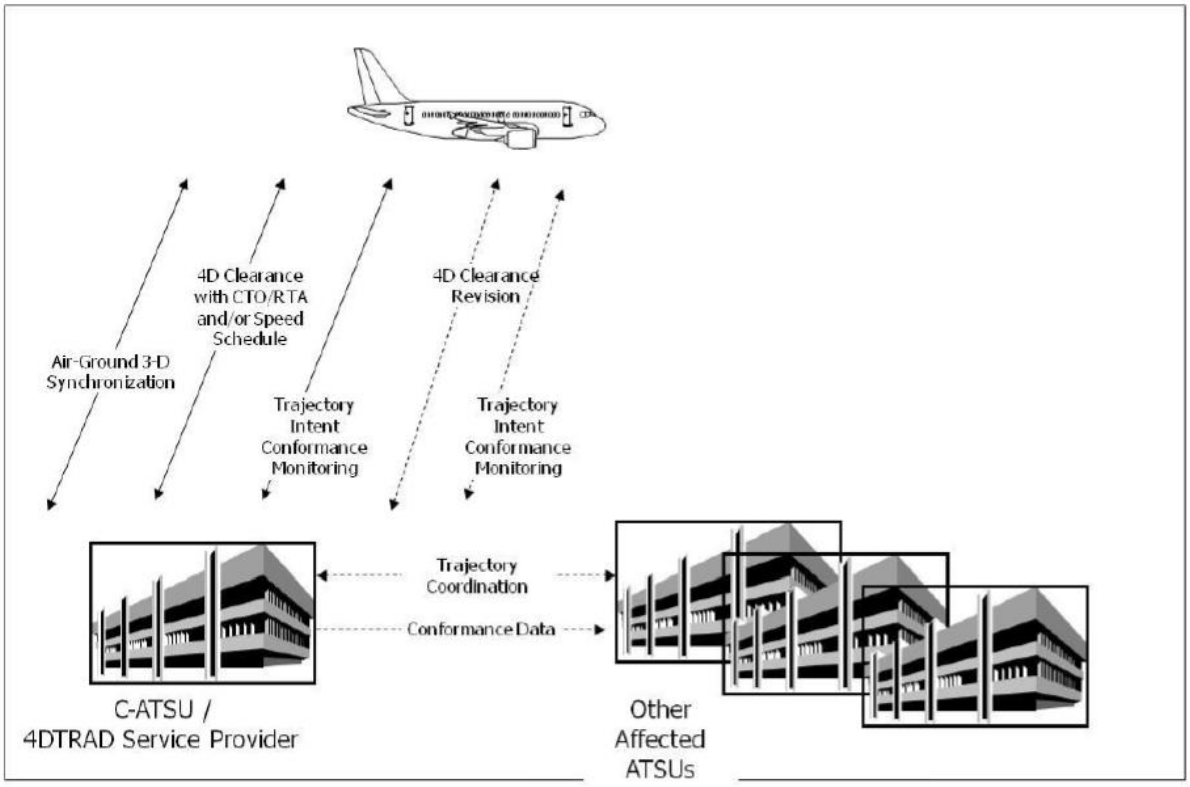

Figure 3- 4DTRAD Operating Method

The 4D CPDLC messages can include instructions for Controlled Time Over (CTO), Speed Schedules, and/or Required Time of Arrival (RTA).

Messages such as "UM51 CROSS [position] AT TIME [RTA]" will assign a Required Time of Arrival to a waypoint contained within the [position] variable. If the RTA value was assigned to a waypoint in the FMS, then that RTA value would be included as a time constraint for the applicable waypoint in the EPP report.

The challenge with complying with RTA assignments is that the FMS must be capable of producing a Time of Arrival Control (TOAC) solution. Most general/business aviation FMSs do not have TOAC capability. TOAC solutions require complex computations and interactions with aircraft systems including performance management functions, speed management, auto-throttle, etc. There are GA/BA aircraft which operate above FL285 which do not have the performance management functions and/or other capabilities necessary to support RTA/TOAC. Therefore, it should not be assumed that all aircraft

subject to the EPP mandate will have the ability to support RTA assignments/TOAC solutions, at least not at the time the mandate comes into effect.

ITP and IM

The ITP and IM services further require multiple aircraft systems to work in concert with each other to execute the instruction.

The In Trail Procedure service described in RTCA/DO-350A (EUROCAE/ED-228A) section 3.10.3.1 is shown in Figure 4.

The ITP service will integrate the usage of CPDLC to request/issue climb and descent clearances relative to reference aircraft identified via ADS-B. In this operating method, even if the CPDLC messages can be exchanged with ITP requests or clearances, unless the surveillance system also supports the ITP capability the CPDLC messages alone will not allow this service to work.

ITP is intended for use in oceanic/remote airspace where ground-based surveillance isn't available. Many of the GA/BA aircraft which will be required to comply with the EPP mandate (i.e., those which fly above FL285) do not have the capability to fly oceanic/remote routes. These GA/BA aircraft which must comply with the EPP mandate may not have the surveillance option available on them to support the ITP. Therefore, if full ATS B2 is required, attempting to certify the CPDLC aspect of ITP without the necessary surveillance support may create a difficult situation for the certification applicant.

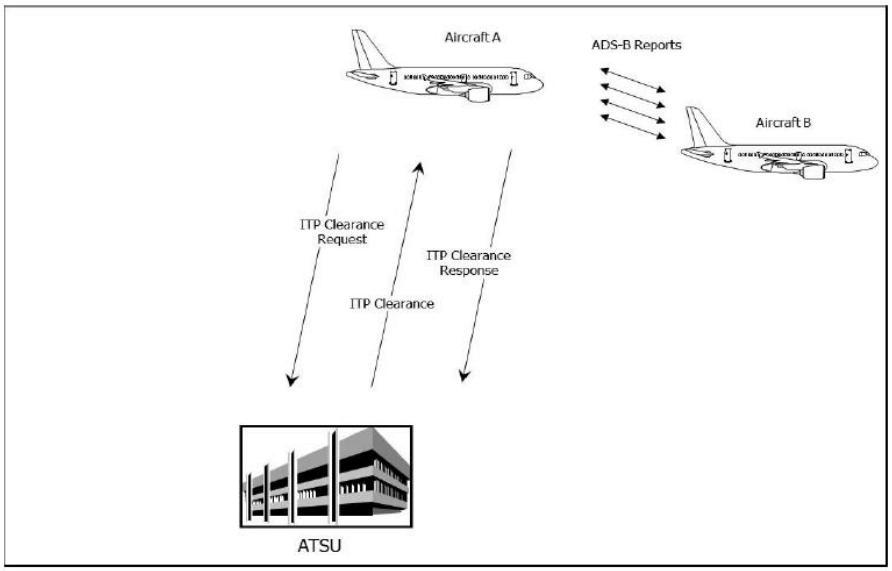

Figure 4 - ITP Operating Method

The Interval Management service described in RTCA/DO-350A (EUROCAE/ED-228A) section 3.11.4.1 is shown in Figure 5.

The IM service is intended to provide a means for more efficient management of traffic flows and spacing by integrating CPDLC messaging, ADS-C reporting, and ADS-B reporting. The CPDLC messaging will be used by ATC to assign lateral traffic spacing requirements relative to other target aircraft. The

management of positioning relative to those target aircraft will require input from those target aircraft's ADS-B reports.

Additionally, ATC will monitor various parameters of the separated aircraft via ADS-C reports. The input data from the CPDLC IM clearance and the incoming ADS-B position data must be calculated by an FMS or other FIM (Flight Interval Management) LRU which will be responsible for maintaining the separation from the target aircraft. Note that some of the IM separation assignments can contain 4D instructions which can contain RTA constraints. As discussed in the 4DTRAD section above, this requires the ability to arrive at TOAC solutions. Following the similar theme from the above discussions, even if the ATS B2 CPDLC and ADS-C components are in place, the FMS or FIM equipment must be developed to enable the IM service.

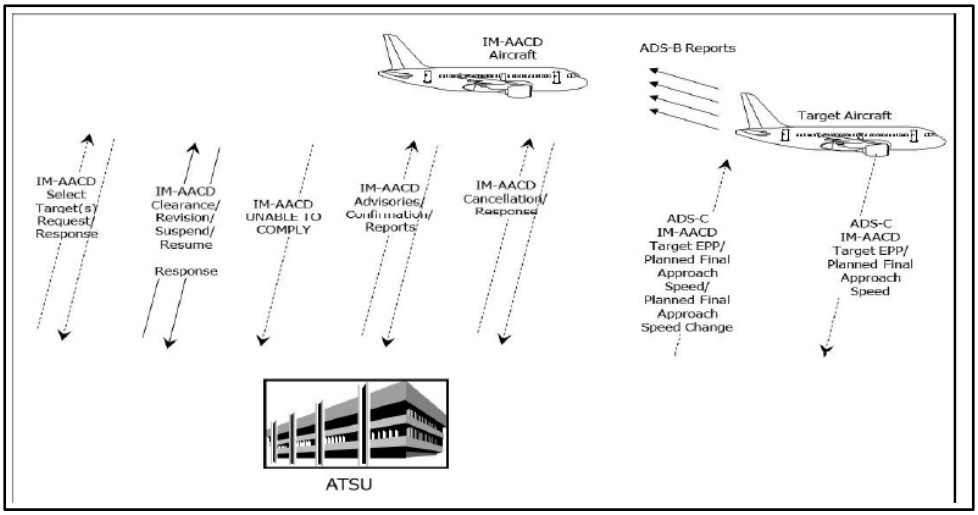

Figure 5 - Interval Management Operating Method

DRNP

The operating method of the DRNP (Dynamic Required Navigation Performance) service described in RTCA/DO-350A (EUROCAE/ED-228A) section 3.13.3.1 is shown in Figure 6.

DRNP will allow ATC to dynamically define legs on a route and to assign an RNP values on specific legs of a route via CPDLC uplink messages. ADS-C reports will allow ATC to monitor if the aircraft is conforming to the route assignment.

This is another case where the CPDLC messages and ADS-C reports could be supported but the aircraft's FMS will need new functionality to apply RNP constraints on a leg-by-leg basis and to import the unpublished RF (Radius to Fix) and FRT (Fixed Radius Transitions) legs from the uplinked CPDLC messages.

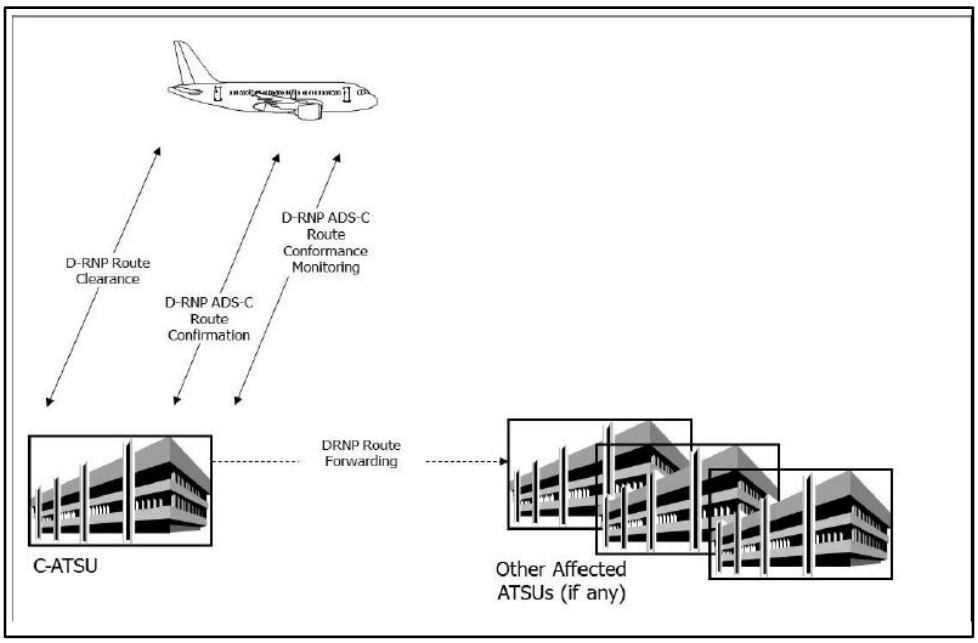

Figure 6 - DRNP Operating Method

Summary/Way Forward

The takeaway from this paper should be the recognition that there is an exceptional gap between the EPP mandate and the much larger scope of developing and certifying an entire ATS B2 system.

When the EPP mandate goes into effect it is highly probable that none of the CPDLC messages new to ATS B2 will be used.

While it may be ideal to the system implementor (e.g., SESAR) to have the avionics ready to digest any ATS B2 traffic when the ANSPs are ready, it is an expensive expectation to develop, certify, and deploy these complex capabilities just for them to fly around for years without being used. Furthermore, as discussed with ITP, many BA/GA aircraft may never be able to use the full suite of services provided by ATS B2.

The necessity to maintain backwards compatibility with ATN B1 CPDLC messages and the expanded FMS/surveillance requirements to utilize several of the services means that fielding all of ATS B2's capability will likely end up being a multi phased approach.

As ANSPs evolve over time from legacy ATN B1 to native ATS B2 capability, it is expected that interoperability issues will arise and will require updates. The ATN B1 system began deployment in the early 2010s, if not earlier for some early adopters, and there continue to be interoperability problems found, often due to lacking or ambiguous standards.

Furthermore, it is unreasonable to expect the FMS and Surveillance systems will support many of the earlier discussed services at the time the EPP mandate goes into effect. Those more advanced services such as RTA/TOAC, IM, DRNP will require new development for many, if not all equipment

manufacturers. Artificially forcing the data link system to claim full ATS B2 capability without having the supporting systems in place does not appear to add value to the operator.

Until ground validation trials and standards updates are completed, these services will not truly be ready for deployment. Many of these services are not expected to be ready by the air or ground systems until the 2030s.

Regulators should strongly consider making their certification requirements align with what is available for use in the real world. If EPP is what is mandated, that should be allowed to be certified on its own. If manufacturers want to certify beyond that capability, and the standards are mature, a regulatory path forward should certainly be available but an all or nothing approach is going to cause undue burden.

ICAO flight plans allow for equipage codes to communicate the aircraft's capabilities. These could be expanded for ATS B2 services to allow declaration of what is currently available on any specific flight/aircraft to allow for subsets of the standard to be certified and used.

The current Rev. A of the ATS B2 standards divides the CPDLC application into 3 message sets and ADS-C into 2 sets of reports. The draft of Rev. B standards further divides CPDLC into 5 message sets and ADS-C into 4 report sets. Upon publication of these standards, using these groupings may also help to define easily traceable subsets of capabilities.

While the tone of this discussion has focused largely on European implementation and certification due to the EU mandates, US based airframers will perform their certification through the FAA. The FAA's AC 20-140C currently has instructions on how to certify an ATS B2 system. It requires full equipage including the most complex capabilities, IM and DRNP, neither of which the FAA is anywhere near being ready to support. This further enforces the concern that the regulators are forcing capabilities on avionics when they have not even started investing on the ground side.

> This AC adds airworthiness approval guidance for a Baseline 2 (B2) data communications system. Operators will need to equip their aircraft with B2, as defined in this AC, to conduct future NextGen operations in the U.S. National Airspace System (NAS) including Interval Management (IM) and Dynamic Required Navigation Performance (DRNP).

Figure 7 - FAA AC 20-140C Excerpt

With the EPP mandate going into effect at the end of 2027, avionics manufacturers and airframers must begin to make serious commitments towards what they are going to develop and certify, respectively.

The desire presented in this paper is to allow for a tailored certification approach with follow on additions as needed. If the regulators do not agree and force a larger scope of equipage, this will require a longer development cycle. The lack of published updated standards, a formalized industrialization plan, and regulatory requirements means that implementors will be squeezed into a smaller timeline for an incredibly complex system. This is incongruent with a successful deployment.