

# Shared Airspace, Shared Liability?

## Challenges to liability allocation in a converging public-private ATM domain

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**Abstract**—New and emerging digital and increasingly autonomous technologies have challenged some of the fundamental legal and institutional principles of civil aviation. New technologies come with new entrants of a fundamentally different safety and operational mindset compared to the traditional manned aviation stakeholders. Against this background, the progressive deployment of solutions such as U-Space will lead, in the long run, to a convergence of the ATM and UTM functions enabling all kinds of airspace users to benefit from the full set of services. However, the smooth adoption and public acceptance of these new technologies and the successful attainment of the targets set out in the ATM Master Plan depend, to a large extent, on clarifying the responsibilities and liabilities of the involved State and non-State actors in this complex cyber-physical environment. This paper aims to shed light on the current challenges to the distribution of responsibility and allocation of liability in the ATM domain at international and EU level.

**Keywords**—ATM, UTM, U-Space, liability, State responsibility, international air law

### I. INTRODUCTION

The proliferation of digital and increasingly autonomous technologies has been gradually transforming the aviation industry for more than a few decades already. The introduction of new technologies is accompanied by the emergence of new actors of a fundamentally different safety and operational mindset compared to the traditional manned aviation stakeholders [1]. The future of aviation is increasingly defined by information exchange and growing dependence on such technologies, which are becoming a fundamental pillar of civil aviation's "safe and orderly"<sup>1</sup> development.

By way of example, unmanned aircraft systems are expected to have a profound impact on civil aviation. They present both opportunities and challenges for all aviation stakeholders. With the entry into force of Regulation (EU) 2018/1139<sup>2</sup> (hereinafter referred to as the "new Basic

Regulation"), the competence of EASA<sup>3</sup> has been extended to all unmanned aircraft operations, regardless of their take-off mass. While the implementing and delegated regulations are yet to be adopted by the European Commission, it could be said that the EU already has a modern risk-based, progressive, proportionate and operation-centric safety framework for unmanned aircraft operations. However, little progress has been made at both international and regional level to address the legal and regulatory challenges related to the integration of unmanned aircraft into the current air traffic management (ATM) environment. In the EU, the U-Space Blueprint and the follow-up update of the ATM Master Plan outline a vision of a highly automated, digital ecosystem of services interfacing with traditional ATM/ANS<sup>4</sup> functions to ensure the smooth integration of unmanned aircraft in non-segregated airspace. In the long run, the progressive deployment of U-Space will lead to a convergence of the ATM and UTM<sup>5</sup> functions enabling all kinds of airspace users to benefit from the full set of services [2], [3]. In this complex environment multiple stakeholders with different goals, requirements and experience will have to collaborate with each other in order to deliver these targets. Furthermore, the smooth adoption and public acceptance of these new technologies and the successful attainment of the goals set largely depend on clarifying the responsibilities and liabilities of the involved stakeholders in this cyber-physical environment.

This new setting calls for a re-evaluation of the legal and regulatory approach towards the allocation of liabilities and responsibilities in a shared airspace, specifically in cross-border scenarios. It is the aim of this paper to discuss these challenges in the context of international and EU air law and to restate the need of an international legal instrument to deal with liability challenges in cross-border ANS and UTM provision. The paper is structured, as follows:

- Section II analyses the role of ATM and UTM in light of their intrinsic link with State sovereignty and the

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This research has received funding from the SBO OmniDrone project: <https://www.omnidrone720.com>

<sup>1</sup> See the preamble of the 1944 Chicago Convention.

<sup>2</sup> Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008,

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(EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91.

<sup>3</sup> European Aviation Safety Agency.

<sup>4</sup> Air Navigation Services.

<sup>5</sup> Unmanned Aircraft Systems Traffic Management.

evolution of the relationship between State and non-State actors in international civil aviation;

- Section III presents some of the imminent challenges before air navigation service providers (ANSP) and U-Space service providers in the Single European Sky (SES);
- Section IV focuses on the liability issues of future collaborative and cooperative approaches to ATM and UTM in a public-private setting and the State's role;
- Section V discusses the available redress mechanisms to injured parties in light of the sovereign nature of ATM activities and the exclusivity established by the international liability conventions, such as the 1929 Warsaw Convention and the 1999 Montreal Convention.

## II. ATM AND UTM: AT THE CROSSROADS OF SOVEREIGNTY

### A. ATM: the role of the State

It is an established position in public international air law that the provision of air navigation facilities is an international responsibility of States. Therefore, the Chicago Convention establishes that the contracting States assume the responsibility to provide, in their territory, airports, radio services, meteorological services and other air navigation facilities to facilitate international air navigation.<sup>6</sup> The provision of air navigation services and facilities is intrinsically linked with the principles of complete and exclusive sovereignty of States over the airspace above their territory.<sup>7</sup> Since the provision of air navigation services and facilities in the airspace above a State's territory concerns the exercising of the sovereign functions of that State, these activities have traditionally been regarded as a combination of a natural and legal monopoly [4, p. 325]. The majority of ANSPs in the EU are State-owned or State-controlled, the sole exception being the UK and its partly privatised NATS.<sup>8</sup> While their internal organisation may vary from one country to the other, they remain under the State's sovereign control.<sup>9</sup> Consequently, the State's role in ANS

<sup>6</sup> See Article 28, item "a" and Annex 11 of the Chicago Convention on the responsibilities of States in ensuring a safe, performant and reliable provision of air navigation services. In EU law, see recital 5 of Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky (the Service Provision Regulation) and recital 5 of Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky (the Airspace Regulation).

<sup>7</sup> See Article 1 Chicago Convention which also reflects an established position in customary international law.

<sup>8</sup> The main air navigation service provider in the UK.

<sup>9</sup> For example, ANSPs may be structured as autonomous organisations, such as state-owned/controlled public or private companies, or as governmental bodies, such as departments within a Ministry of Transport etc. Recital 10 of Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the Framework Regulation) provides that air

provision is one of critical importance in the ATM domain, not least because it triggers a discussion regarding the extent of this responsibility as far as UTM in a shared airspace is concerned, as to which see section IV.

While ATM comprises a bundle of services, some of which have a purely commercial nature<sup>10</sup>, at the core of this package lie the sovereign functions of ensuring the safe and orderly provision of air navigation services [4, p. 333]. It is notorious that these activities' sovereign nature and, consequently, the fact that they are not open to competition have for more than a decade constituted a major barrier to the effective implementation of Functional Airspace Blocks (FABs) and of the Single European Sky for that matter [5]. It is worth highlighting that the rationale behind FABs was not to obviate State borders or limit the sovereign powers of States. FABs were intended as bottom-up State-led initiatives aimed at "enhanced cooperation between the air navigation service providers (ANSPs) and the national supervisory authorities (NSAs) to obtain *operational efficiency gains* through such strategies as common procurement, training and *optimisation* of air traffic controllers (ATCs) resources" (emphasis added). Thus, the main goal of FABs is to improve the traffic flow and the performance of the European ATM system without prejudice to Member States' sovereignty over their airspace and to the requirements of the Member States relating to public order, public security and defence matters. This position is also explicitly confirmed by Article 1, para. 2 of the Framework Regulation and Article 4 of the FABEC Treaty.<sup>11</sup> States remain, therefore, legally responsible for the oversight and control of the airspace above their territory. Hence, their sovereignty over the portions of the airspace forming part of a FAB is not affected anyhow. Furthermore, it has been highlighted in both scholarship and the practice of ICAO's General Assembly that States remain the solely responsible entities for meeting their commitments regarding air navigation services under the Chicago Convention [6], [7].

The preceding analysis shows that ATM's sovereign nature means the State plays a central role in the oversight and control over the airspace above its territory. While States are free to delegate the functional responsibility for the provision of these services to either a public or a private company, it is the State that is ultimately responsible and liable. While this has caused few practical issues so far, the reality of new entrants alongside the opening up of certain air traffic services to competition and the growing demand for cross-border provision of such services in the Single European Sky raise significant challenges. These challenges trigger legal questions as to

navigation services, in particular air traffic services which are comparable to public authorities, require functional or structural separation and are organised according to very different legal forms in the various Member States.

<sup>10</sup> Such as provision of training and consultation services, transfer of radar data etc.

<sup>11</sup> Treaty relating to the establishment of the Functional Airspace Block "Europe Central" between the Federal Republic of Germany, the Kingdom of Belgium, the French Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands and the Swiss Confederation.

whether States are allowed to designate more than one provider in the same airspace or FAB, how the State and non-State actors' responsibility and liability should be allocated in such cases, and what the international responsibilities of States would be in the context of the emerging (mostly commercial) UTM initiatives, technologies and systems such as U-Space.

### B. UTM: the role of the industry

The concept of UTM emerged in response to the commercial demand for low-altitude unmanned aircraft operations and the need to safely integrate these operations into the airspace. In the US, it was NASA that developed the first conceptual framework for UTM as a "community-based traffic management systems where the operators are responsible for the coordination, execution and management of operations, with rules of the road established by FAA" [8, p. 4]. Unlike the US, the European counterpart to the UTM envisaged by SESAR is far more ambitious as it proposes a phased approach for the safe integration of drones in all classes of airspace, not only low-altitude operations. The initial U-Space blueprint prepared by SESAR in 2017 was followed by a proposed update to the ATM Master Plan [2], [3]. At the same time, multiple initiatives are taking place worldwide to develop and test a basic set of first-generation UTM services. Examples include solutions developed by commercial enterprises such as Unifly, AirMap and others. The dynamics of this industry are further challenged by the activities of commercial actors non-traditional to the aviation industry exploring new ventures. This is clearly illustrated by the recent, rather unusual move of Google and Facebook to join CANSO.<sup>12</sup> Therefore, it could be said that, unlike the historical development of ATM, it is the industry that has taken the driver's seat when it comes to UTM.

While a leading role of the industry is crucial for the successful development, testing and implementation of UTM solutions, it comes at the price of exacerbating the challenges outlined in the preceding paragraphs. The following analysis attempts to provide an answer to the questions: what the legal nature of these services would be in international and EU air law, how the role of these private actors could be reconciled with the sovereign nature of the functions related to ATM, and whether such private service providers could rely on the jurisdictional immunities which have been traditionally available to ANSPs.

Public international air law does not distinguish between different types of ANSPs. To the extent pilotless aircraft fall within the scope of the Chicago Convention [9, p. 3], it is safe to assume that the provision of Article 28 applies to the provision of air navigation services to both manned and unmanned aircraft. Thus, international law does not seem to treat differently the nature of the air navigation services rendered to manned and unmanned aircraft. Consequently, the type of airspace users to whom these services are rendered has no bearing on the international responsibilities of States.

In the EU, the SES legal framework provides further guidance on the matter. Thus, Article 8, para. 1 of the Service Provision Regulation stipulates that Member States are obliged

<sup>12</sup> Civil Air Navigation Services Organisation.

to "ensure the provision of air traffic services *on an exclusive basis* within specific airspace blocks in respect of the airspace under their responsibility" (emphasis added). This position implies that Member States have discretion to designate one air traffic service provider either for their entire jurisdiction or for a specific airspace block. The reference to "exclusive basis" simply means that two (or more) providers should not operate in the same airspace block at the same time for safety reasons (e.g., to prevent conflicting instructions etc.) [10, p. 640]. Therefore, there is nothing in current EU air law that prevents Member States from designating multiple air traffic service providers for different blocks of airspace within their jurisdiction. In order to determine the extent to which this situation applies to an environment where providers of both manned and unmanned traffic services operate, it is first necessary to establish the scope of the concept of "air navigation service provider".

The provision of Article 2, para. 5 of the Framework Regulation defines an air navigation service provider as "any public or private entity providing air navigation services for general air traffic". Pursuant to Art. 2, para. 26 of the Framework Regulation, general air traffic includes movements of civil aircraft, as well as all movements of State aircraft when these movements are carried out in conformity with the procedures of the ICAO. Provided unmanned aircraft are a subset of aircraft pursuant to the provisions of Art. 3(30) in connection with Art. 3(28) of the new Basic Regulation, their operation should be considered to form part of the general air traffic. Consequently, to the extent unmanned air navigation service providers, be they public or private entities, meet the certification requirements laid out in Art. 6 and 7 of the Service Provision Regulation, there is nothing that prevents them from operating in specific airspace blocks alongside other ANSPs in other airspace blocks.

The Service Provision Regulation mandates that Member States shall designate an air traffic service provider holding a valid certificate in the EU.<sup>13</sup> The regulation therefore distinguishes between the legal act of certification and the legal act of designation [10, p. 640]. In line with Art. 1, para. 2 of the Framework Regulation, it is within the sovereign powers of a State to designate one among many certified air navigation service providers to provide air traffic services within its territory or in a specific airspace block.

ANSPs could avail themselves of the services of other service providers that have been certified in the EU.<sup>14</sup> These services may include, for example, aeronautical information services, but they may also involve provision of air traffic services. In any case, the working relationships between the providers must be formalised by means of written agreements or equivalent legal arrangements that define the responsibilities, functions etc. However, in the case of provision of air traffic services by a foreign ANSP as well as a formal agreement, the approval of the Member States concerned shall be required too.<sup>15</sup>

<sup>13</sup> Article 8, para. 1, sent. 2 Service Provision Regulation.

<sup>14</sup> Article 10, para. 1 Service Provision Regulation.

<sup>15</sup> Article 10, para. 3 Service Provision Regulation.

The scenario of an ANSP from one Member State cooperating with an ANSP from another Member State should be distinguished from the relations arising between ANSPs in the context of FABs [10, p. 642]. As previously mentioned, FABs are defined regardless of State borders for operational and performance-driven optimisation of air traffic by encouraging enhanced cooperation among ANSPs or the introduction of an integrated provider.<sup>16</sup> While it is clear that multiple ANSPs may operate within a FAB, the legal framework is silent on whether there is a limit to the number of ANSPs which could provide air traffic services within a FAB. In the absence of any rules to the contrary, it is reasonable to assume that a scenario where different ANSPs dealing with either manned or unmanned traffic is very likely and possible under the current framework.

The preceding analysis draws a relatively clear picture of the position of ANSPs in current EU air law. However, this is certainly not the case when it comes to reconciling the vision of a highly automated and digital U-Space with the traditional understanding of air navigation services. Thus, for example, the U-Space blueprint makes it clear that U-Space is not a defined volume of airspace, nor does it aim at replicating the function of ATC [2, p. 6]. To the contrary, one of the long-term ambitions of the project is to create a “clear and effective interface to manned aviation, ATM/ANS” [2, p. 4]. U-Space aspires to contribute to the evolution of ATM with the integration of large unmanned aircraft relying on the same infrastructure as manned aviation. From an architectural point of view, U-Space will be organised as a “federation of U-space service providers that can cooperatively manage drone traffic in the same or/and adjacent geographical region, under a regulatory framework ensuring the overall performance level and in particular its safety” [3, p. 10]. These service providers are expected to continuously exchange information among themselves and coordinate standards enabling automated UTM. In this vision, U-Space and ATM will evolve together to overcome the current fragmentation of the ATM sector, still dominated by diverging national approaches leading to low incentives to invest in new technologies and resulting lack of interoperability between legacy systems.

In order to support this evolution, the legal framework will have to define the position, function and responsibilities of these U-Space service providers. If these providers are considered ANSPs, the full spectrum of requirements should be applicable to them. This implies they will need to go through the said certification and designation procedures. However, to what extent is such a vision aligned with the explicit goal of U-Space to serve as a complementary means to ATM and not to replicate its functions?

From a legal perspective, the U-Space services related to UTM would undoubtedly qualify as air navigation services within the scope of the Framework Regulation.<sup>17</sup> In light of the sovereign functions that are delegated upon ANSPs, in the majority of European countries, with the notable exception of the UK’s NATS, these providers act as governmental

<sup>16</sup> Article 2, para. 25 Framework Regulation.

<sup>17</sup> Article 2, para. 4 Framework Regulation.

authorities whose acts, clearances etc. could be qualified as administrative acts from a legal standpoint [10, p. 649]. In this context, any U-Space service provider, at least to the extent they qualify as an ANSP upon which the exercising of governmental authority has been delegated, would be subject to strict certification and designation requirements. The difficulty here is that many of these providers will be companies, new entrants lacking both the experience and the safety culture of traditional aviation stakeholders.

The proposed update to the ATM Master Plan outlining a roadmap for the safe integration of drones in all classes of airspace hints at the fact that the regulatory framework for U-Space will not simply mirror the one that is already in place for manned aviation [3, p. 13]. In line with the proportionate, progressive and risk-based approach of the new Basic Regulation, it is expected that there will be rules deviating from the legal framework currently applicable to ATM. However, any efforts in this direction should hold account of at least the following challenges.

First, if new entrants would benefit from a set of alleviated rules, it is of the essence to clarify their status under public international air law. There is nothing in the Chicago Convention that prevents States from delegating the provision of air navigation services to private bodies, be they national or even foreign. It is widely acknowledged that such delegation does not deprive States of their sovereignty over the airspace above their territory [11]. In any case, the responsibility of the State remains one of oversight over the activity of the respective service provider. As a matter of principle, this position should be equally valid in both ATM and UTM scenarios as long as the provision of air navigation services is concerned. The situation is much less clear in case U-Space service providers are not considered ANSPs operating under a delegation from the State. It is reasonable to ask whether their function would still be considered public and who would bear the responsibility for the oversight of their activities. In other words, if the activity performed by the U-Space service provider is not provision of air navigation services, one could reasonably ask what it is and against which (legal) standards its conduct should be assessed.

Second, in the case of cross-border provision of services by a U-Space service provider, either in a FAB, or upon cooperation between service providers, States would still have to rely on mutual agreement since the provider would still need access to the airspace. However, in the lack of legal certainty as to the status of the U-Space service provider and, therefore, the degree of oversight due on the part of the State regarding its activities, negotiation of such agreements could be all the more difficult. Furthermore, as far as currently established FABs are concerned, the parameters of these agreements would also have to be amended to allow for the operation of U-Space service providers.

Third, the liability of the U-Space service providers would need to be clearly defined. Depending on whether the functions of the U-Space service providers will be considered of public (sovereign) or private nature, the liability regime and the available remedies could vary significantly. While in the

former case typically the liability of the State would be triggered, in the latter the provider would be subject to the liability rules applicable to conduct of any other legal person. The difficulties in allocating liabilities in such cases are discussed in the following section.

### III. LIABILITY ALLOCATION: ONE AIRSPACE, MULTIPLE GUARDIANS?

It was already mentioned that, as a rule, the liability of the State in the ATM context is linked to the fact of delegation of its duties to provide air navigation services to autonomous entities, be they public or private corporations, national or foreign [10, p. 654]. There is no, however, a harmonised framework of rules concerning the liability of ANSPs neither in private international air law, nor in EU air law.

Broadly speaking, there are two ways to approach the liability of States [12, p. 53]. The starting point of the first approach, also known as the primary State liability doctrine, is the sovereign nature of air navigation services. The States which have adopted this approach consider the State to be primarily liable for damages caused by the service provider.<sup>18</sup> Unlike the first approach, the second approach, also known as the effective service provider doctrine, takes a functional perspective on air navigation provision. The States which have adopted this approach would hold the service provider primarily liable alongside the subsidiary liability of the State.<sup>19</sup>

While the challenges of liability allocation in cross-border provision of air navigation services have been studied at length in legal scholarship, these studies have focused mostly on the allocation of liability among traditional ANSPs. The architecture suggested by the U-Space blueprint and the proposed update to the ATM Master Plan raise some additional questions in cross-border scenarios where one or more U-Space service providers are either operating in a FAB, alongside traditional ANSPs, or rendering sub-contracted services to an ANSP in another Member State.

In the scenario where one or more U-Space service providers are operating in a FAB, alongside ANSPs, the main difficulty would come from the nature of the function performed by the U-Space service provider. For example, one possibility is that the function of such a provider is considered to be a public service of provision of air navigation whose origin could be traced back to a legal delegation on the part of the State. In this case, it is likely that for any damages caused by that provider the State would be held either primarily or subsidiarily liable. In line with the sovereign nature of air navigation service provision, cases where the U-Space service provider(s) and/or the ANSP are operating in the airspace over the territory of their national State would not be considered cross-border cases, even if occurring within a FAB. This is also the approach taken by the FABEC Treaty which provides for a compensation mechanism with a rather high threshold [12, pp. 58-60]. A typical cross-border scenario would be the case where, within a FAB, a U-Space service provider from State A has been designated by State B as a service provider in (part of)

the airspace of State B alongside the ANSP of State B. Depending on the nature of the services rendered by the U-Space service provider and the approach taken by the respective State, for damages occurring as a result of the activity of the U-Space service provider, either the U-Space service provider or State B could be held liable. Thus, if the activity of the U-Space service provider is regarded as exercising of delegated duties on the part of State B, the latter could be held primarily liable on the basis of a functional criterion, i.e. with a view to the function performed and not of the entity performing it [13], [10, p. 654].<sup>20</sup> However, if the activity of the U-Space service provider is considered as a service of purely private, commercial nature, it is likely that claims could be brought directly against the provider under general tort law.

Due to space limitations, the above example is a rudimentary one and clearly fails to account for the complications of the interaction between legally and technically distinct service providers in shared airspace. Since it is not (yet) clear who the manager or the operator of the U-Space system would be, whether the governance model would be centralised or decentralised and what its legal and institutional relations with the legacy ATM system would be, one could only speculate as to the different challenges that lie ahead. Among the institutional challenges, it is worth mentioning that the U-Space system and the U-Space service providers would rely on highly automated digital technologies. For example, the rollout of the advanced (U3) and the full (U4) U-Space services would require coordination on the part of the traditional ANSP not only with the U-Space service providers, but also with a whole new category of digital, increasingly autonomous systems that are not under their control or oversight. These institutional challenges could open the door to new potential sources of liability.

In an evolving ecosystem where legacy ATM systems, air traffic controllers and other stakeholders would have to cooperate and evolve in line with highly automated U-Space system, the potential for misunderstanding, lack of reliance and trust on the part of the air traffic controllers naturally increases the potential for accidents. For what it's worth, an air traffic controller would have to trust the reliability of information originating from partially or even fully autonomous systems. Furthermore, the rollout of the SWIM<sup>21</sup> framework would give rise to new challenges as it will obviate the traditional distinction between a producer and user of information [14, p. 204]. In a decentralized system where everyone is a data user and a data producer at the same time, the allocation of liabilities across different entities of public and private nature and subject to different national laws would become an extremely cumbersome task [14, p. 206]. Serving as a kind of a doppelganger of ATM, U-Space would be based on highly automated data-driven systems which would learn and adapt in real-time in order to serve the needs of airspace users operating equally real-time learning and adaptive unmanned aircraft. This amalgamation of increasingly autonomous cooperative

<sup>18</sup> This approach is followed by the Federal Republic of Germany.

<sup>19</sup> This approach is followed by the Swiss Confederation.

<sup>20</sup> This was the stance adopted by the Regional Court of Konstanz in the case LG Konstanz 27 July 2006, Az 4 O 234/05 H.

<sup>21</sup> System Wide Information Management.

technologies would likely lead to situations of ‘outsourcing’ and dynamic ‘handoff’ of certain ground-based functions to airborne elements and vice versa.

Against this background, airspace users, service providers and manufacturers could face significant liability risks. As well as the classical catalogue of ground and air risks, the ATM stakeholders would have to consider a new category of risks stemming from their (over)reliance on data. For example, manufacturers and service providers alike would face the challenge of untangling a complex network of heterogeneous data sources in order to determine the source of an issue. In legal terms, this means it would become increasingly difficult to establish the actor responsible for the occurring damages. As many of the U-Space services would rely on autonomous technologies based on machine learning techniques, the producers of these systems would need to be aware of their product liability exposure, especially in cases of adversarial attacks and malicious or unintentional data poisoning [15], [16], [17], [18].<sup>22</sup> This would prove to be a tremendous undertaking in the cases where a system has been manufactured based on training and testing data originating from multiple dataset producers, data curators and machine learning model developers acting across borders. Finding the (ultimately) liable party in this complex chain of legal and institutional relations will prove to be a significant barrier to the injured party seeking redress and at the same time will give rise to growing legal uncertainty.

One distinct challenge relevant to the allocation of liabilities in cross-border provision of air navigation services is related to the vertical and horizontal blurring of the boundaries between the functions, responsibilities, and tasks of States [19, p. 244]. More specifically, this is a matter of how the interaction between State and non-State actors in collaborative public-private settings, such as U-Space, impacts the liability of the involved stakeholders.

#### IV. THE STATE’S ROLE IN A COLLABORATIVE PUBLIC-PRIVATE ATM ENVIRONMENT

The previous sections clearly demonstrated the tensions between the public, sovereign nature of air navigation service provision and the proliferation of industry-driven initiatives. Many of these tensions are induced by the inevitable conflicts between technological innovation and conservative safety culture. The exponentially growing number of stakeholders with their different views and goals, the increasing technological complexity and unpredictability coupled with the truly global nature of aviation have considerable impact on the allocation of liability in case of accidents.

The liability risks in the ATM system are not confined to national borders. However, the sovereign nature of these activities induces strong reluctance in States to indulge in risk- and liability sharing. While there have been calls in scholarship for enhanced international cooperation and restructuring of the

<sup>22</sup> For example, by inserting changes to images so as to create artificial obstacles or by changing the prediction of classifiers of computer vision models so as to make mistakes when classifying objects.

concept of State liability in the three distinct categories of organisational, supervisory or design liability [19, p. 246], the matter remains a thorny area of public (international) law because of the political sensitivity over matters of sovereignty.

Both policymakers and academics agree that public-private collaboration is the future of air navigation service provision. In such a collaborative setting, the State’s role is evolving from that of an ultimate and non-disputed authority to an actor with a growingly organisational, supervisory and design responsibilities.

The State’s organisational role is manifested in the State’s duty to ensure clear allocation of responsibilities and liability through exercising its prescriptive jurisdiction in adopting laws and regulations [19, p. 253]. Such legislative and regulatory actions would likely be influenced by increasingly data-driven processes of standard- and norm-setting, otherwise known as “personalisation of the law” [20]. The shift towards collaborative governance, risk-sharing and federation hinted at in the U-Space vision coupled with the performance-driven, progressive and risk-based framework laid down with the new Basic Regulation create opportunities for a more tailored approach towards the obligations related to the provision of air navigation services. The increasing availability of safety and operational data now also allows for the more precise allocation of liabilities. However, this personalisation and granularization of the obligations could also propagate certain negative externalities throughout the system. For example, the wide availability of safety data across multiple stakeholders could have a markedly negative impact on the foundational pillar of “just culture”, namely the promotion of disclosure without apportioning blame. As the process of personalisation of the norms would rely on the supply of (reliable) data, certain stakeholders may attempt to circumvent such tailoring of their obligations by adducing reasons of trade secrets, property-like rights of ownership on data etc. Furthermore, the availability of data enhancing (automated) decision-making could also have the “adverse” effect of raising the standards of care against which the conduct of a certain party is assessed, thereby leading to a potentially increased liability exposure.

The State’s supervisory role reflects the trend of delegation of responsibilities towards private entities while retaining supervisory powers. The ATM domain is a typical example of this trend. The effective performance of this task in present-day conditions depends on the sufficiency of (high-quality) information which enables the State to exercise its supervisory powers [19, p. 253]. The difficulty here is how to create sufficient incentives for private entities to share information with the State without fear of being held accountable for (not) taking certain decisions. While the aviation domain has operationalised the concept of “just culture” to incentivise stakeholders to share more information for several decades already, the said negative externalities of the widespread availability of safety data threaten the very essence of this concept. It is therefore important for States to strike a balance between the need to promote safety culture and incentivise responsible disclosure so as to facilitate its supervisory role and the commercial interests of private actors. This is especially so in the case of new entrants in the ATM domain, such as the

alleged U-Space service providers, which would benefit from a light-touch regulatory approach.

The State's design responsibility is manifested in its ability to organise its relationships with other stakeholders. This is particularly important in the ATM domain which would become growingly dependent on other stakeholders with the decoupling of the roles of data user and producer in the SWIM framework and the rollout of the U-Space. The design responsibilities of the State have both vertical, through the collection of data from stakeholders, and horizontal dimension, through organising these stakeholders in networks, incl. cross-border [19, p. 253]. The horizontal design responsibility of States in the ATM domain ties back to the need to organise ANSPs, hitherto fragmented and confined within national borders, in strong collaborative networks not only among each other but also with other stakeholders. While any such effort should hold account of potential anti-competitive effects (especially when it comes to services which are not part of the sovereign functions of air traffic control), evolution and mutual learning through collaboration is seen as the ultimate way of achieving the co-existing of ATM and U-Space. Furthermore, this is one of the goals of the SES2+ legislative package which is still blocked in the Council pending a resolution of the dispute over the status of Gibraltar [21].

The preceding paragraphs demonstrated that the trends of federation, decentralisation and increasing technological autonomy lead to the emergence of federated data pools, services, and computations with ensuing complex interactions between State and non-State actors that challenge the understanding of how responsibility, control and liability are distributed. Furthermore, the introduction of certain novel technologies, such as distributed ledgers (blockchain) in safety-critical environments could lead to new risks jeopardising systems' operation. These are related, for example, to the fact that such technologies could embed and further propagate along the value chain certain unsafe, malicious or corrupt entries exposing the systems to (often) unforeseeable safety risks.

The complex legal and institutional relations between the actors in the ATM value chain make seeking redress in case of an accident even harder. The technical complexity of accidents involving air navigation service provision is exacerbated by the availability of certain jurisdictional immunities to ANSPs exercising sovereign functions and the exclusivity of the international air law conventions dealing with liability in case of an accident. The following section provides an overview of these challenges.

#### V. REDRESS MECHANISMS: BETWEEN SOVEREIGN IMMUNITIES AND EXCLUSIVITY

The sovereign nature of the functions of air navigation service provision determine certain special characteristics of the liability regime applicable to these providers. The approach of the international air law conventions to channel the liability through the air carrier and provide for exclusivity might render actions against providers problematic. This sections briefly explores these two issues, also in light of the potentially

different legal nature of the activities carried out by U-Space service providers.

In cases where the State is involved in the provision of the air navigation services<sup>23</sup>, the provider could benefit from a jurisdictional immunity. The rationale behind jurisdictional immunities in international law is to enable States to perform their public functions by shielding them from prosecution in foreign courts [22, p. 487]. While the modalities of granting immunities are beyond the scope of this paper, suffice it to say that according to the restrictive theory of immunity, immunity is granted only concerning acts involving the exercising of governmental authority<sup>24</sup> and not commercial or other transactions<sup>25</sup> which are not inherent in the State [22, p. 488]. In any case, the sovereign character of air navigation services has been widely acknowledged and as such providers operating under governmental delegation could benefit from jurisdictional immunities.

While it is true that to date none of the European States has ever claimed either sovereign or jurisdictional immunity [12, p. 53], it nevertheless remains an avenue for escaping foreign jurisdiction in certain cases. Interestingly, especially through the lens of the restrictive theory of immunity, the unbundling of core air traffic services from support services<sup>26</sup> suggested by the SES2+ proposal [21] is likely to have impact on the available immunities depending on the nature of the transaction. Furthermore, in light of the allegedly commercial nature of (at least some of) the U-Space services, it would be interesting to see whether and to what extent certain immunities from jurisdiction could be available to U-Space service providers operating on the basis of governmental delegation.

As previously mentioned, the liability of ANSPs is not harmonised and is subject to the rules of national law. It is very often set out as unlimited fault-based liability [12, p. 53].

Despite the possibility of recourse to jurisdictional immunities, most of the States have implemented succinct, yet allegedly efficient mechanisms for seeking redress from States in case of accidents. However, for accidents in manned aviation, the international air law conventions harmonising certain liability aspects provide for a pre-emptive effect through introduction of exclusivity of actions. Thus, Article 24 of the 1929 Warsaw Convention and Article 29 of the 1999 Montreal Convention provide that actions for damages, however founded, ("whether under this Convention or in contract or in tort or otherwise" – relevant only for the Montreal Convention), must be brought under the conditions and limits set out in the respective convention. While a *prima facie* literal interpretation of these provisions would incline one to think that as long as an action can be brought under one of

<sup>23</sup> For example, through an autonomous organisation of the public law where the State is a majority shareholder

<sup>24</sup> Also known in public international law as "*acta iure imperii*".

<sup>25</sup> Also known in public international law as "*acta iure gestionis*".

<sup>26</sup> Defined in Art. 2 (37) of the SES2+ proposal as "air navigation services other than air traffic services as well as other services and activities, which are linked to, and support the provision of air navigation services".

conventions, it *ipso facto* precludes actions against other defendants, such a finding has no support in judicial practice. Furthermore, such an interpretation would be inconsistent with Articles 31-33 of the 1969 Vienna Convention on the Law of Treaties which prescribes that provisions should be interpreted in light of the ordinary meaning of the terms used and the object and purpose of the treaty. This is evident from the title of the conventions indicating the aim of *unification of certain rules* relating to *international carriage by air* (emphasis added). Thus, it is reasonable to conclude that these instruments would not preclude actions against ANSPs, or U-Space service providers for that matter.

The debate within ICAO about the need to harmonise the ANSP liability rules was never materialised in an international treaty. Some authors have argued that at this stage there is no need for unification [12]. However, the emergence of global providers of air navigation services, the decoupling of the air traffic control function from the physical location of the control tower in remote tower operation scenarios, and the cross-border nature of the related liability risks will force the issue of whether there is a need for an international convention on ANSP liability back on to the global air law agenda.

## VI. CONCLUSION

The evolution of ATM is defined by trends of increasing collaboration between public and private actors and proliferation of increasingly autonomous data-driven technologies. As ATM becomes a more collaborative, cooperative and technologically complex environment, the distribution of responsibilities and liability also becomes increasingly difficult. On the one hand, global aviation relies heavily on legal certainty in the way airspace, as a scarce resource, is managed by States within and across borders. On the other hand, the interweaving of public and private actors in UTM make it increasingly challenging for States to discharge their international obligations to ensure the safety of air navigation. The emergence of new, global providers of air navigation services and facilities, such as Google's Project Wing and the future U-Space service providers, represents a shift away from the understanding that air navigation service provision, being a sovereign function, is a domain exclusively reserved for States. This results in a *de facto*, but not necessarily *de iure*, sharing of their responsibility with (global) non-State actors upon which no single State can exert adequate oversight. Accordingly, the limitations of the current fragmentation of liability regimes, deeply rooted in national laws, and their inaptness to deal with the new risks to the ATM/UTM system will become all the more obvious. While past initiatives to reach a universal agreement on the matter of liability in ATM have failed, it may be that this time it will not be the States that will take the lead, but rather the new players, as "norm entrepreneurs" [23] claiming "their" share of the global airspace alongside the responsibility for using it.

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