Director, Airspace and Emerging Technologies
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Submission to National Emerging Aviation Technologies Discussion Paper

The Australian Strategic Air Traffic Management Group (ASTRA) has been established as a collaboration of aviation organisations to coordinate industry advice to Government on matters relating to Air Traffic Management (ATM) planning and decision making, assisting the government to deliver strategic ATM policy directions and objectives.

In response to the evolution of Unmanned Aircraft Systems (UAS) and Urban Air Mobility (UAM) vehicles, ASTRA established the UAS and UAM Integration Working Group (UUI WG) to undertake activities to further the safe and efficient integration of these new airspace users.

Since its inception earlier this year, the UUI WG has developed the *Objectives and Guiding Principles for the Operationalisation of Australian Low Level Airspace* paper to inform and support ongoing Government policy and rulemaking in this emerging sector of the aviation industry.

As such, ASTRA is formally submitting this paper to the *National Emerging Aviation Technologies Discussion Paper* consultation. While this paper has not received formal ratification by the ASTRA Council, the UUI WG has a broad membership of expertise in this area and I do not expect any reluctance to submit this paper from the Council.

I trust that this paper is useful in the evolution of emerging aviation technologies.

Sincerely,

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THE AUSTRALIAN STRATEGIC AIR TRAFFIC MANAGEMENT GROUP

UAS and UAM Integration WG

Objectives and Guiding Principles for the Operationalisation of Australian Low Level Airspace

13th- OCT-2020

V1.7

1 Introduction

1.1 Background

The aviation industry is undergoing a period of significant innovation, the likes of which have not been seen since the beginning of the jet age. Remotely Piloted Aircraft Systems (RPAS), also known as drones, and Advanced Air Mobility[1] (AAM) vehicles (e.g. air taxi concepts), are rapidly emerging. They will be used for a wide range of applications, from last-mile transportation of passengers and freight, delivery of telecommunication services to regional areas, to helping fight bushfires. The potential social, economic, and environmental benefits are vast particularly for a relatively small but geographically large nation like Australia.

The introduction of these new users poses new challenges to the Australian airspace and air traffic management (ATM) system. These nascent airspace users will utilise airspace in fundamentally new ways, at a scale and complexity the existing system was never designed to handle. The safe and efficient integration of these new airspace users serves as a catalyst for innovation in the way airspace and ATM is currently provided – innovation that can deliver advantages to all airspace users, new and existing.

Worldwide, there is growing recognition of this opportunity, with some countries already exploring new operational models and the demonstration and evaluation of new technologies and procedures that exploit recent advances in automation, communication networks and digitisation. The initial

[1] The broader term of AAM is used throughout this document. AAM encompasses Urban Air Mobility (UAM) concepts.

focus has been on very low-level (VLL)[2] airspace but there is an appreciation that the concepts explored today will provide a potential foundation for the modernisation of all airspace, for all users, into the future.

Australia has been a pioneer in the uptake of RPAS / drones. The number of RPAS operations is expected to grow as RPAS capability and the enabling regulatory framework continues to mature, and the business case for RPAS use in many new and existing applications strengthens. Already there are more commercial RPAS in operation in Australian skies than conventionally piloted aircraft, and the number of licenced remote pilots and approved commercial RPAS operators continue to grow. It is clear that RPAS are here to stay and will be a significant presence in Australian skies into the future. Although not as advanced, there has been much interest in AAM concepts and their potential early use in Australia through initiatives like the Uber Air Pilot City Program in Melbourne.

Australia's vision for airspace needs to be updated to reflect not only the emergence of these new airspace users but also to take into account the vast opportunities recent advances in digitisation and automation present for all airspace users.

1.2 Purpose

This paper is intended to inform and support ongoing Government policy and rulemaking towards ensuring a safe, efficient, sustainable and cost-effective airspace and ATM system for the future.

An immediate area of priority lies in the operationalisation of Low Level Airspace (LLA). This need arises due to expected near term proliferation of new users such as RPAS and AAM. A new airspace operational concept that accounts for these new users is required to ensure the continued safe, efficient, fair, and sustainable use of airspace into the future. It is recognised that the objectives and guiding principles established in this document may have broader applicability outside of LLA operations; potentially providing relevant guidance to ongoing innovation in aviation technologies, operational models, and enabling regulatory frameworks for airspace and ATM more broadly.

The objective and principles presented in this paper are only intended to guide future work to identify and assess suitable operational models, technical, regulatory or governance architectures for LLA. No specific solution in relation to these aspects is implied.

1.3 ASTRA

The Australian Strategic Air Traffic Management Group, ASTRA, is an aviation industry body dedicated to developing an optimum air traffic management system for Australia. As such, it is the Federal Government's primary source of industry advice on air traffic management directions.

ASTRA brings together all of the industry stakeholders including aircraft operators, airports and service providers to develop and continuously review the ASTRA Strategic Air Traffic Management Plan and develop a recommended Target Operational Concept.

[2] There is no international consensus on the definition of VLL. The initial scope of this document is on the operationalisation of Low Level Airspace (LLA), which is defined in Section §3 of this document.

ASTRA also provides an industry-wide representative forum for developing the industry position on ATM matters as the basis for strategic advice to Government, and to coordinate agreed integrated ATM planning, development and implementation effort by all relevant ATM stakeholders.

1.4 UAS and UAM Integration Working Group

The principal role of the ASTRA Unmanned Aircraft System and Urban Air Mobility Integration (UUI) Working Group is to undertake activities within the scope of the ASTRA Charter to further the safe and efficient integration of new airspace users into the Australian airspace system.

The UUI working group is challenged with the development of the operating concept, supporting rules and operating procedures, and the air traffic management, communications, navigation, and surveillance technologies necessary for safe and efficient UAS and AAM operations in Australian airspace.

The working group includes representation from a broad cross section of Australian airspace stakeholders including representation from high capacity regular public transport operators, general aviation and helicopter operations, pilot associations, and the emergent UAS/AAM industry.

1.5 Outline of Paper

The following section, Section §2, presents a high level vision for the future of Australian airspace and context for the paper. The section summarises the benefits, opportunities, and challenges associated with emerging airspace users.

Section §3 describes the high level objectives and governing principles for the operationalisation of low level airspace in line with the strategic vision presented. The final section, Section §4, presents next steps and recommendations.

2 Vision for the Future

The aviation industry is undergoing a period of significant innovation and restructure, the likes of which have not been seen since the beginning of the jet age.

New users such as Remotely Piloted Aircraft Systems (RPAS), also known as drones, and Advanced Air Mobility (AAM) vehicles (e.g. air taxi concepts), are emerging. Already, increasing numbers of predominantly small commercial and recreational RPAS are taking to Australian skies. As the scale and capability of these systems grows, so too does the scope of their potential applications. Applications which include the transportation of small freight, farming and agriculture, the management of critical road, rail, water, power, communications and other distributed infrastructure, management of our parks and wildlife, to applications in civil services like firefighting, rapid medical response, and law enforcement. While the vast majority of RPAS today are small, they will increase in size and capability, progressively expanding into applications like point-to-point cargo delivery (van and truck replacement), "air crane" services, mobile cell towers in the sky, and potentially through to remotely piloted aircraft capable of regional, domestic and international transportation of freight.

The technology innovations brought on by the RPAS sector have also served as an enabler to new aviation passenger transportation concepts – or AAM. While this sector is operationally less advanced than RPAS, innovation is accelerating. AAM describe a diverse array of aircraft types – with common characteristics being the capability to perform short or vertical take-off and landing and a reliance on electric or hybrid propulsion systems. Most designs are limited in payload (passenger) capacity, range and endurance making them initially suited to shorter urban "commuter" transportation use cases, however, a number of higher performance AAM platforms are targeting regional / urban connector use cases. Performance, and in turn the range of potential transportation use cases, are expected to improve with advancements in energy storage technology. Initially, AAM will potentially operate from a small number of vertiports on nominated routes (e.g., city centre to airport or connector routes between satellite centres). This will expand to large scale commercial fleet operations that utilise a network of vertiports situated across cities and surrounding population centres. A substantially smaller number of AAM are expected to be operated by civil services (e.g., law enforcement and ambulance) and an even smaller proportion are expected to be privately owned or operated by specialist charter services or tourism providers. Initially, AAM are expected to have a human pilot on board. However, the level of aircraft automation will increase quickly in order to have a viable long term business model. Ultimately, fleets of automated UAM will be remotely monitored by human crews situated on the ground. It is expected that early AAM/UAM platforms will also be used in automated (remotely piloted) freight operations.

COVID-19 has had a significant impact on the global aviation industry, including emerging sectors. In the near term, COVID-19 is expected to cause a degree of consolidation across the UAS and AAM sector, however, investment and sector growth is expected to continue. While plans for initial operations may experience delays, the broader need to address airspace integration challenges remains. This position is consistent with an industry paper presented at the recent ICAO Air Navigation Council (ANC) meeting[3], which highlighted the importance and need for continued innovation towards addressing critical airspace integration issues.

While there is uncertainty as to the timeline for this future – two things are certain. Firstly, the potential social, economic, and environmental benefits from these new aviation sectors are vast

[3] https://www.airbusutm.com/a-new-digital-era

particularly for a relatively small but geographically large nation like Australia. Secondly, the introduction of these new airspace users will pose significant challenges to the Australian airspace and Air Traffic Management (ATM) system, in the respect that:

1. They will need to operate safely and efficiently alongside existing airspace users
2. They will operate at scale, with the expected number of operations orders of magnitude greater than that of conventional airspace user operations today
3. There is potential for significant concentrations in their activity
4. They will fly complex and dynamic flight profiles
5. They will be diverse in performance
6. They will have varying degrees of automation
7. They will regularly operate from very low to extremely high altitudes
8. They will operate in and around existing controlled airspace

The concept of operation and supporting framework of operational rules, airspace structure, procedures and air traffic management system in place today was not designed to account for operations of this nature. A new airspace operational concept to ensure the safe and efficient utilisation of low level airspace needs to be developed.

3 Low Level Airspace

3.1 Scope

The initial focus is on the operationalisation of Low Level Airspace (LLA) in Australia. The integration of new users, in particular RPAS and AAM, and their likely near term proliferation at low altitudes presents a here and now challenge, and the immediate focus of this paper. It is recognised that the objectives and principles put forward may have broader applicability beyond the scope of operationalising LLA.

Low Level Airspace (LLA) is not defined in relation to a specific location, altitude, or time. For the purposes of this paper, LLA broadly refers to the airspace within which 'new airspace' users such as RPAS and UAM are expected to initially operate[4]. This airspace is typified as:

- Low altitude[5]
- Concentrations of activity over built up areas, between satellite centres or at specific sites (e.g., freight distribution hubs, mine sites, ports, etc.)
- Predominantly uncontrolled (Class G) but some use cases requiring entry into control zones

A new airspace operational concept and supporting air traffic management concept will be required to ensure the continued safe, efficient, secure, and sustainable operation of aircraft in the above mentioned environment.

It should be noted that this definition is likely to be refined as the operational concept for LLA is matured. It is also likely that initial operational concepts and technologies for LLA will be first proven/implemented for specific users and airspace environments (e.g., small drones operating below 400ft) but the concept is not restricted to these users or airspace environments.

The objective and principles do not imply a specific operational model, technical, regulatory or governance architecture for LLA.

3.2 Key Assumptions

- LLA is not restricted to RPAS/drones/AAM or other new user types.
- The operationalisation of LLA is broader than just the safe and efficient integration of RPAS – it is about recognising the changing demand and nature of use of this airspace by all users, existing and new.
- LLA is not restricted to operations occurring below 400ft.
- The operationalisation of LLA will require consideration of aspects of airspace design, operating rules, as well as new air traffic services.
- The established Air Traffic Management system will continue to evolve but is unlikely to evolve in a manner sufficient to accommodate the unique demands of operations taking place in LLA. A new automated traffic management system or technologies that support user-

[4] It acknowledged the UAS/AAM operations are not limited to LLA.
[5] For context only, low altitude is assumed to mean operations taking place below ~5,000ft AGL.

based self-separation will be required to accommodate the scale and complexity of operations envisioned.

- The degree of automation of aircraft (unmanned and existing conventionally piloted) will continue to increase.

3.3 High Level Objective

The overarching objective is to ensure a future low level airspace environment can support the safe, efficient, and sustainable use of airspace.

The nature of LLA use is changing with an increasing number and diversity of airspace users with varying operational requirements. Accounting for these changes and leveraging ongoing innovation and technology, LLA will need to reflect the same characteristics of the airspace environment today, including being safe, secure, accessible, reliable, resilient, efficient and environmentally sustainable.

3.4 Guiding Principles for the Operationalisation of Low Level Airspace

A set of high level principles guiding the operationalisation of LLA are presented below. It should be noted that some of these principles are inherently competing. Moving forward, the challenge lies in finding a balance between these competing tensions.

High Level Principle 1 - Safety is Critical

A. Safety is Paramount – Safety performance shall have precedence over all other requirements (i.e., efficiency, sustainability, flexibility, etc.).

B. High Safety Standard – The operationalisation of LLA must ensure that there is no reduction to the high standard of safety of aviation operations today.

C. Risk-based – A proportionate, risk-based approach should be adopted, whereby design decisions (i.e., technologies and procedures) should have a traceable and defendable basis in safety risk.

D. Safety of All – Safety must be considered in relation to the risks to first and second parties associated with aircraft operations (e.g., passengers and crew on-board aircraft, ground personnel, etc.) and in relation to risks posed to third parties not directly associated with aviation activity (e.g., general public and property overflown).

E. Safety for the Future – Ensure safety performance is consistent with the changing risk profile of LLA and the foreseeable longer term operational concept.

F. Integrated Part of Aviation Safety – The LLA concept should be consistent with the overarching state safety program, national aviation safety and air navigation plan(s).

G. Governance – The level of assurance and subsequent oversight required of LLA stakeholder organisations, people, processes, and products must be proportionate to the associated safety risks.

High Level Principle 2 - Airspace is a National Resource for All

A. Fair and Equitable Access – Airspace is a public asset and all users (existing and emerging) have a right to access provided minimum safety requirements can be met. However, it must be recognised that airspace and infrastructure (e.g., vertiports, airports) are constrained resources and operational prioritisation will be required. Operational priorities should be based on safety, and secondarily the nature of the application, and not the type of airspace user. For example, an unmanned aircraft performing search and rescue should be afforded the same prioritisation that would be given to a conventionally piloted aircraft performing the same mission. All users, new and existing, should recognise that the bar for entry is changing, and what is accepted today may not meet the minimum safety and efficiency requirements for the airspace environment of tomorrow. All airspace users will need to evolve in line with the changing requirements of the airspace ecosystem.

B. Address All User Needs – must address the changing needs of all LLA users, both existing and emerging.

C. Nationally Consistent – the operationalisation of LLA should provide a consistent level of safety and efficiency of airspace operations across the country. Specifically, any requirements relating to the management of noise, environment, security, or privacy concerns (or others etc.) that impact on LLA operations should be consistent between States and Territories.

D. Efficient Management of Airspace – LLA must be treated as a limited resource and increasing demand requires the management of LLA at temporal and spatial resolutions far higher than what occurs today.

E. Globally Aligned but Fit for Purpose – We cannot expect internationally-developed solutions to meet the unique needs of the Australian LLA environment. With that said, Australia cannot have an "orphan" system. While we pursue an operational concept suitable for the Australian context we must make sure, to the maximum extent possible, that regulations, standards, designs, operating rules and procedures are globally-aligned, compatible and interoperable.

F. Interoperable and Seamless – LLA is an integrated part of the Australian airspace system. It cannot be treated in isolation and must interface with existing ATM systems and airspace. LLA should, over time, support seamless operations of users between airspace and service area boundaries, provided that those users are able to comply with applicable requirements of each system.

High Level Principle 3 - Future Proof

A. **Industry-led** – Industry brings knowledge and expertise that can help ensure a LLA operational concept that keeps pace with innovation. Government should assess how industry can play a greater role with the aim to accelerate outcomes aligned with broader stakeholder needs.

B. **Unified Operational Concept** – Recognition that the concepts being explored today are establishing the foundations for the future of all airspace users in all classes of airspace.

C. **Support Evolving User Needs** – The LLA ecosystem must have the flexibility to support an increasingly diverse range of aircraft types, performance, and concepts of operation — including those still emerging (e.g., AAM). Performance/Outcome Based approach should be adopted to ensure LLA airspace, associated technologies and regulatory frameworks provide the flexibility needed to support ongoing innovation. The pace of technology innovation is not expected to slow and is expected to deliver advances in the safety and efficiency of airspace operations for all airspace users.

D. **Scalable -** The LLA operational concept must be able to support higher numbers of operations of increasingly complexity.

E. **Foster Innovation** – Should provide for, and encourage continual innovation in, technology and operational procedures that can enhance safety and system performance.

High Level Principle 4 – Support Fair Commercial Participation and Competition

A. **Affordable** – Must ensure affordable and accessible levels of service for all airspace uses.

B. **Fosters Commercial Competition** – Provided safety performance can be maintained, operational models should allow for fair commercial competition between airspace users and prospective LLA ATM service providers.

C. **User Pays –** A user pays model for services should be adopted. Costs should be competitively driven but should not inhibit the viability of an emerging industry.

High Level Principle 5 – Socially Responsible

A. **Recognition and Engagement** – The broader community need to be acknowledged as an increasingly important stakeholder in the aviation system particularly as new aviation sectors begin to operate over and, in some cases, in our communities;

B. **Responds to Community Concerns** – The LLA operational concept needs to be designed and managed to help address broadening societal concerns – in particular noise, privacy, environment, and security – associated with LLA operations. Opportunities where new technologies can be used to support the holistic and objective management of these concerns should be explored.

C. **Privacy of Airspace Users** – All airspace users have a right to privacy and this right should be protected. Any organisation collecting data on airspace users should adhere to national privacy principles.

High Level Principle 6 – Conflict Risk Management for LLA

A. **A Single Plan** – New means for managing conflict risk and the efficient flow of air traffic flow in LLA will be required to support the scale and complexity of operations envisaged. The solution may take the form of a new automated LLA Air Traffic Management System[6] [7] or means of user-based self-separation assurance. Irrespective of its implementation, this new means must be incorporated into, and aligned with, a single roadmap for the modernisation of Australian airspace and ATM and consistent with the Australian Airspace Policy Statement. Existing airspace strategic plan(s) must be updated to consider the phased introduction of a new LLA ATM system, new user-based separation concepts, and the needs and associated challenges of the introduction of new users such as UAS and AAM;

B. **Interoperability** – The concepts for managing airspace conflict and efficiency in LLA must be compatible with the existing ATM System and not disrupt or detriment the provision of existing and future air traffic services.

C. **Phased** – Development and evolution of the technologies and procedures for managing airspace conflict and efficiency in LLA should be phased. These phases should account for the safety risk profile that needs to be managed, the maturity and readiness of concepts and technologies, international development plans/concepts, and end-user demand.

D. **Service Requirement** – Any requirement mandating the need for airspace users to subscribe to a LLA ATM service or equip with a particular technology should be determined on the basis of risk, and secondarily, efficiency of operations (e.g., at a vertiport). A user should retain the freedom to voluntarily subscribe to LLA ATM services where such services are available but not a mandatory requirement.

E. **Consistency** – The service performance of any prospective LLA ATM service or user-based self-separation assurance technology should be consistent no matter where you fly (locally, regionally, or globally). Users should be able to transition any service regions and or service providers smoothly and without the need for changes to equipment or procedures.

F. **Service for All** – The technologies and procedures for managing airspace conflict and efficiency in LLA (including any prospective LLA ATM services) should be available to any airspace user who meets the necessary requirements, manned or unmanned.

G. **Automated** – Automation will play a key part in the operationalisation of LLA in order to meet the scale and complexity of operations envisioned.

[6] Air Traffic Management (ATM) is defined by the International Civil Aviation Organization (ICAO) as the "dynamic, integrated management of air traffic and airspace — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions."

[7] To avoid implied associations with any existing architecture or LLA operational concept (i.e., U-Space, UTM, RTM, etc.), the ASTRA UUI WG uses the term LLA ATM to broadly describe a "highly automated air traffic management capability". Such a capability may be required, alongside other potential solutions for conflict and efficiency management of LLA operations into the future.

H. Support Safety Proactive Management – The technologies and procedures for managing airspace conflict and efficiency in LLA should support opportunities to actively monitor, assess, manage and report safety performance.

I. Resilience – Any prospective LLA ATM system, technology or procedure must be designed to accommodate and mitigate failures.

J. Secure – Any technology or procedure for managing airspace conflict and efficiency in LLA must be sufficiently secure for safe operation. Security requirements should have an objective and traceable basis to the security risks being managed.

High Level Principle 7 – Broader System of System Approach

A. Integrated System – The advancement of LLA must be accompanied by parallel advancements in the broader system it resides in. Specifically, in ground facilities, vertiports, supporting navigation, communication, and surveillance systems, power/services, and landside interfaces (e.g., intermodal ground transportation hubs).

4 Steps Towards Realising this Vision

4.1 How Will Low Level Airspace Evolve?

LLA airspace is expected to evolve in a phased/staged manner. These phases should be proactively defined accounting for:

- changes in the safety risk profile
- the maturity and readiness of concepts and technologies
- international development plans/concepts
- changes in airspace user requirements (e.g., performance, demand, and use cases)
- phases of existing airspace and ANSP modernisation plans

4.2 Role of Industry

Industry collaboration will be essential to ensuring a future LLA ecosystem that can keep pace with innovation. Early engagement with end-users, ANSPs, LLA ATM providers and broader industry stakeholders will be essential to understanding and meeting user needs now and into the future, and to leverage the full potential of rapidly evolving technologies. The expertise and resources of industry can be strategically used to accelerate outcomes for the broader benefit of all stakeholders.

This proactive engagement approach is consistent with international efforts – with EASA and FAA both actively engaging with industry in the development and evaluation of policy, principles, operational concepts and architectures.

This engagement must extend beyond tradition aviation stakeholders. Stakeholders that should be involved in the operationalisation of LLA include, but not limited to:

- Regulatory authorities (e.g., Civil Aviation Safety Authority, Australia Communication and Media Authority, etc.)
- Air Navigation Service Providers (i.e., Airservices Australia, Defence)
- Government Departments and Agencies (e.g., Civil Aviation Safety Authority, ACMA, Defence, BOM, etc.)
- Airports
- Local Governments, Agencies and Land Authorities (e.g., State law enforcement, State Parks, etc.)
- Infrastructure providers (e.g., mobile data networks, navigation, etc.)
- Data providers (e.g., spatial, weather, etc.)
- Community groups
- Other stakeholders who may utilise or draw substantial value from LLA operations

4.3 Next Steps

The ASTRA UUI working group recommends the following next steps to the ASTRA Council:

1. That the ASTRA Council accept and approve for public release the UUI Working Group paper
2. That the ASTRA Council submit the paper in response to the National Emerging Aviation Technology Policy Issues Paper
3. That the ASTRA Council table the paper with the Government's Aviation Policy Group (APG) chaired by the Department of Infrastructure, Transport, Communications and Regional Development (DITCRD) and request feedback from the APG on:
    a. The revision of the strategic plan for Australian airspace and ATM accounting for the needs of emerging sector and recent innovations in enabling technology;
    b. The need for broader Department, agency and community engagement on matters concerning the operationalisation of low level airspace;
4. That the ASTRA UUI WG continue to advance industry position on the operationalisation of LLA by developing a:
    a. Low Level Airspace Operational Concept
    b. Strategic Flight Plan for Low Level Airspace
    c. Technical position papers on key low level airspace concepts – including the assessment of architectures and operating models