

CONSIDERATIONS FOR MANAGING SPACE OPERATIONS

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1. Introduction

1.1 Background

Traditionally, space operations were conducted by the military or a state space agency, e.g., the National Aeronautics and Space Administration (NASA) in the U.S.A. or the Japan Aerospace Exploration Agency (JAXA) in Japan. Recent advancements in technology and private sector investment along with the rising demand for space research, products, and services are creating significant growth in the commercial space sector. Commercial companies are now launching operations with payloads that include low-earth orbit satellites, parts or supplies to support space stations, and space tourists. There were 291 space launches globally in 2025, representing a 12.4% increase over the 259 launches in 2024¹. This growth is expected to continue for the foreseeable future.

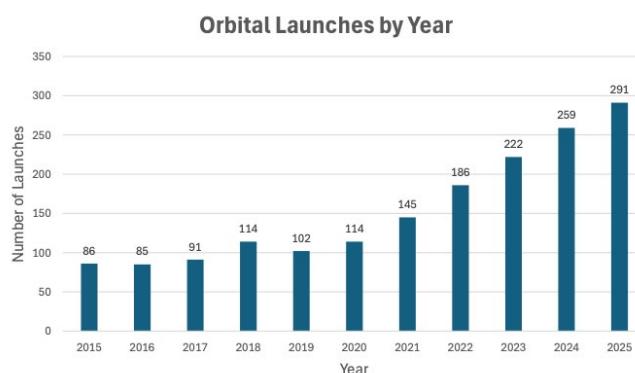


Figure 1 – Orbital launches by year.

Space operations, whether on launch or re-entry, must pass through airspace systems managed by an air navigation service provider (ANSP). Throughout this document, we refer to space operations as Space Transport Operations (STOs) and refer to operators as Launch or Re-entry Operators (LROs).

Most space launches today are concentrated at spaceports in relatively few States, but those launches, and subsequent re-entries may affect multiple states and ANSPs and their airspace systems. LROs should consider the potential effects their operations may have on airspace users and airspace structures worldwide. This could include measures such as optimising launch windows and trajectories to reduce airspace closures and traffic flow impacts, when able. Well-defined danger areas are used to integrate such operations.

This paper provides considerations for both the ANSP that manages daily air traffic operations and the LRO. This paper is consistent with recent industry efforts, including the [International Air Transport Association's \(IATA's\) Space Debris Safety Risk Assessment – Lite²](#), which highlights the increasing risks from debris generated during STOs. While IATA's paper serves as a call for global action, this CANSO guidance provides practical considerations and frameworks for ANSPs and LROs to address many of the identified operational needs. This document also makes frequent references to two other entities: the Space State Regulator (SSR), that regulates commercial space operations and spaceports, and Civil Aviation Authorities (CAAs), that regulate civil aviation. These roles may be performed by the same office as the ANSP (in the case of smaller States), or by separate offices within one organisation (e.g., the FAA in the U.S.A.), or by separate organisations.

Other stakeholders in STOs include ATS units, regional air traffic flow management (ATFM) systems, regulatory authorities, industry associations, and possibly military or local public safety offices.

¹ [BryceTech, Global Space Launch Activity in 2024. Alexandria, VA](#)

² [IATA, Space Debris Safety Risk Assessment – Lite. Geneva, Le Grand-Saconnex. May, 2025](#)

1. Introduction

1.2 Scope

Due to the rising number of space operations around the world, CANSO understands many countries are grappling with the complexity of the coordination required to manage such activities' effects on their airspace system's safety and efficiency. This document provides guidance to ANSPs and LROs to help ensure the safe integration of STOs into civil airspace. The regulatory activities related to SSRs and CAAs are outside the scope of this document.

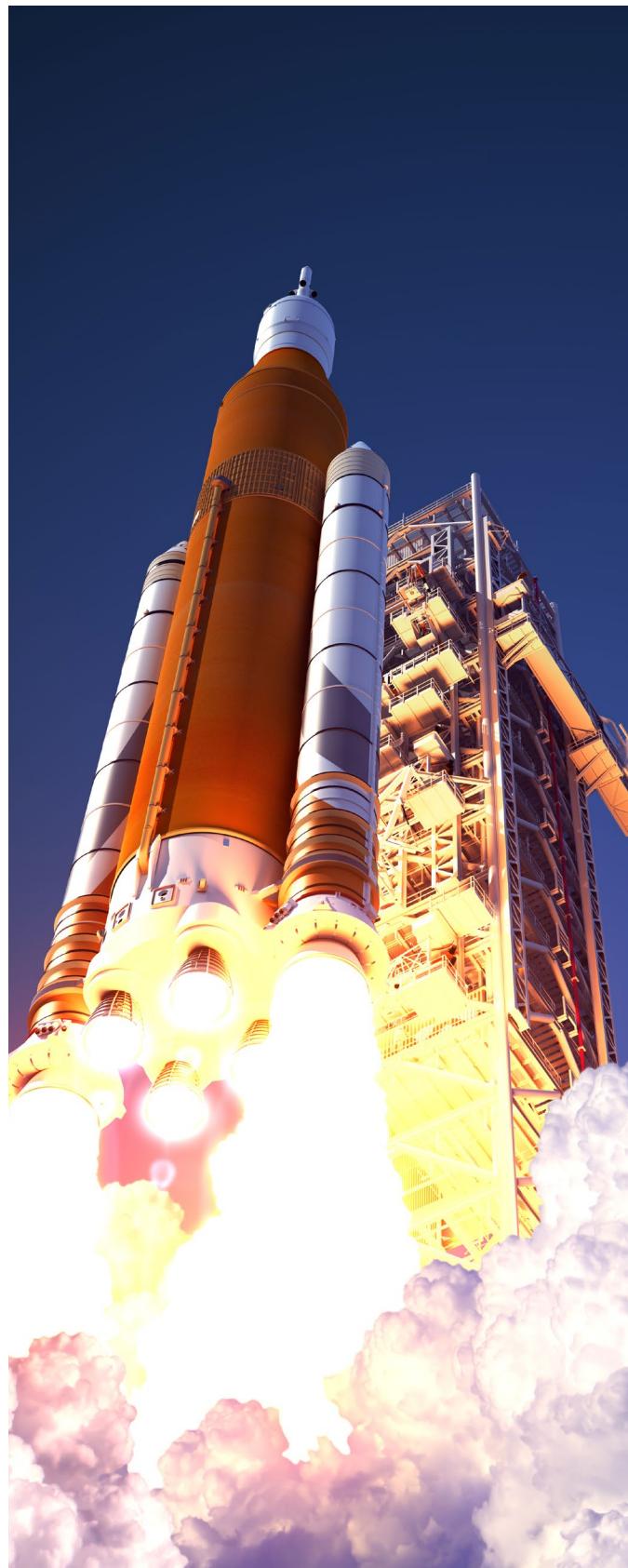
This paper addresses two separate and distinct functions of ANSPs involved in STOs:

1. the coordinating ANSP, controlling airspace in which a launch or re-entry takes place, and
2. the integrating ANSP(s) whose airspace may be affected.

Section 5 of this document presents a table summarising the key considerations for both types of ANSPs and the LRO.



Figure 2 – Polaris Dawn mission commander Jared Isaacman is seen anchored to a ladder dubbed the “skywalker” by SpaceX during his spacewalk.



1. Introduction

1.3 Overview of STOs in an Airspace System

ANSPs integrating STOs typically publish NOTAMs defining danger areas associated with the STO or other special use airspace to protect non-participating aircraft. The shape, duration, and location of the danger area is specific to each launch and is approved in accordance with local regulations. A launch may occur from a spaceport, government range, mobile launcher, or platform on water. Some launch vehicles are launched, meaning carried by another aircraft to a certain altitude before being launched.

Launch vehicles are not categorised as aircraft since they do not currently require ambient air for propulsion or navigation. Therefore, launch and re-entry vehicles are not currently within the remit of the International Civil Aviation Organization (ICAO). These vehicles must pass through airspace that is regulated or controlled by ANSPs or CAAs. Therefore, airspace management of these vehicles is within the remit of ICAO.

Although this passage through lower altitudes of airspace represents only a small fraction of the overall space mission, it is helpful to maintain an overview of all the phases of space operations. Figure 3 shows typical phases of a vertical lift launch designed to deliver a payload. Key phases of a space transport operation from the perspective of aviation safety are phases where risk to aircraft exists. This includes any phases of flight where the vehicle or any of its components are not on the surface or orbital. Many factors affect the geometry and duration of the danger area such as component material, size, altitude of the jettison, and reliability of the vehicle. Additionally, depending on the mission and size of the launch vehicle, the trajectory (and associated danger areas) may impact multiple flight information regions (FIRs).

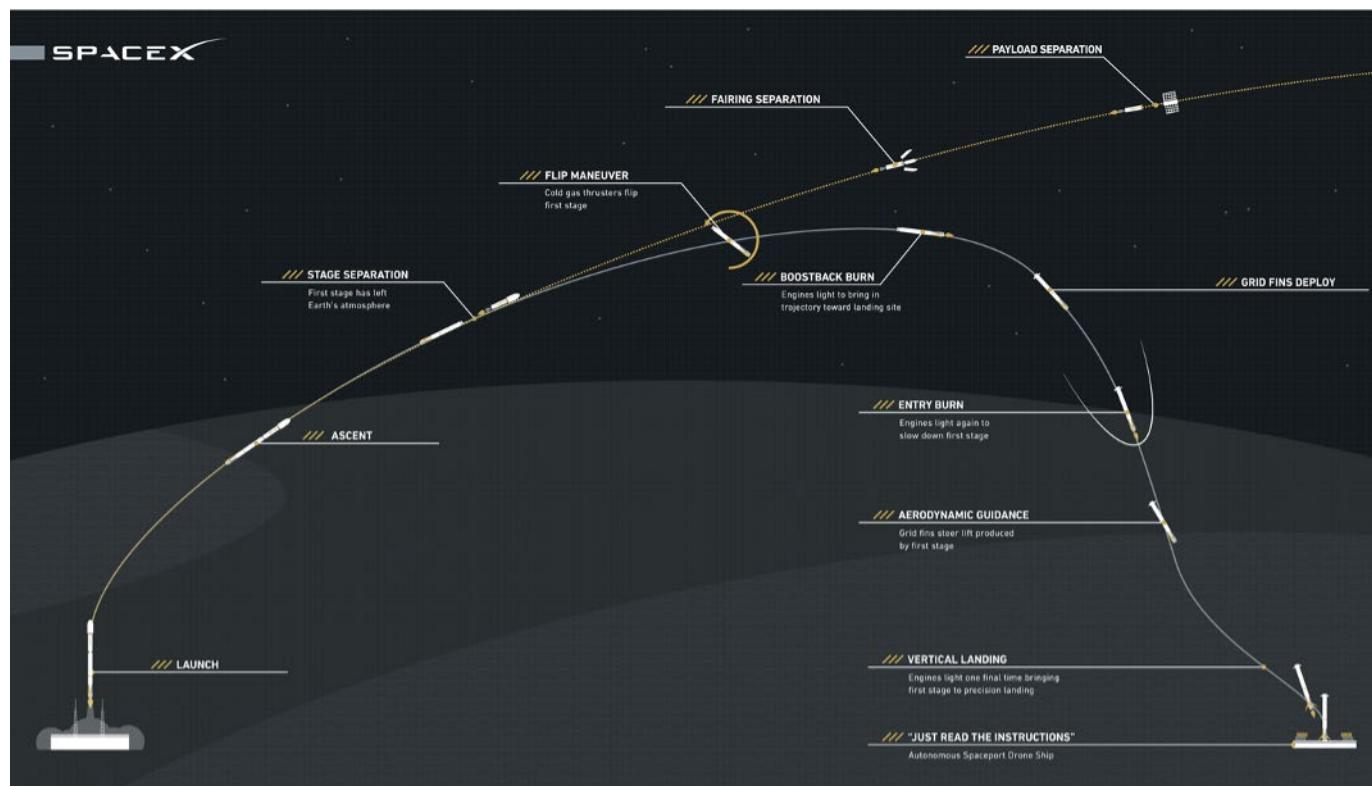


Figure 3 – Phases of a typical space operation. Credit: SpaceX.

1. Introduction

1.4 Levels of ANSP Involvement

The ANSP responsible for managing the airspace through which the launch originates is the coordinating ANSP. They coordinate management of the danger area(s) with other ANSPs whose airspace may be affected, called the integrating ANSPs. Depending on the coordinating ANSP's procedures, the danger area request may come from the LRO or the ANSP. In some States, the State or LRO will conduct some of the activities identified as the role of the coordinating ANSP. For example, there are instances in which the LRO can promulgate an international NOTAM from ANSPs without prior intergovernmental coordination.

Once a launch date and time is collaborated between the coordinating ANSP or LRO and the integrating ANSP(s), the integrating ANSP should publish associated NOTAMs defining danger areas.

The combination of coordinating ANSPs, integrating ANSPs, and LROs must ensure safety of the airspace system and non-participating airspace users. Figure 4 shows FIRs around the world that were affected by launches from the United States of America during 2023 through the third quarter of 2024. In these instances, the United States' FAA was the coordinating ANSP, while the others were integrating ANSPs.

Coordinating and integrating ANSPs should determine the level of engagement needed with their CAs and SSRs in collaborative decision-making (CDM) efforts. Each ANSP or CAA is responsible to inform ATS units of the expected impact on their airspace and coordinate integration into their airspace. This might include, for instance, airspace closures or reroutes into their systems.

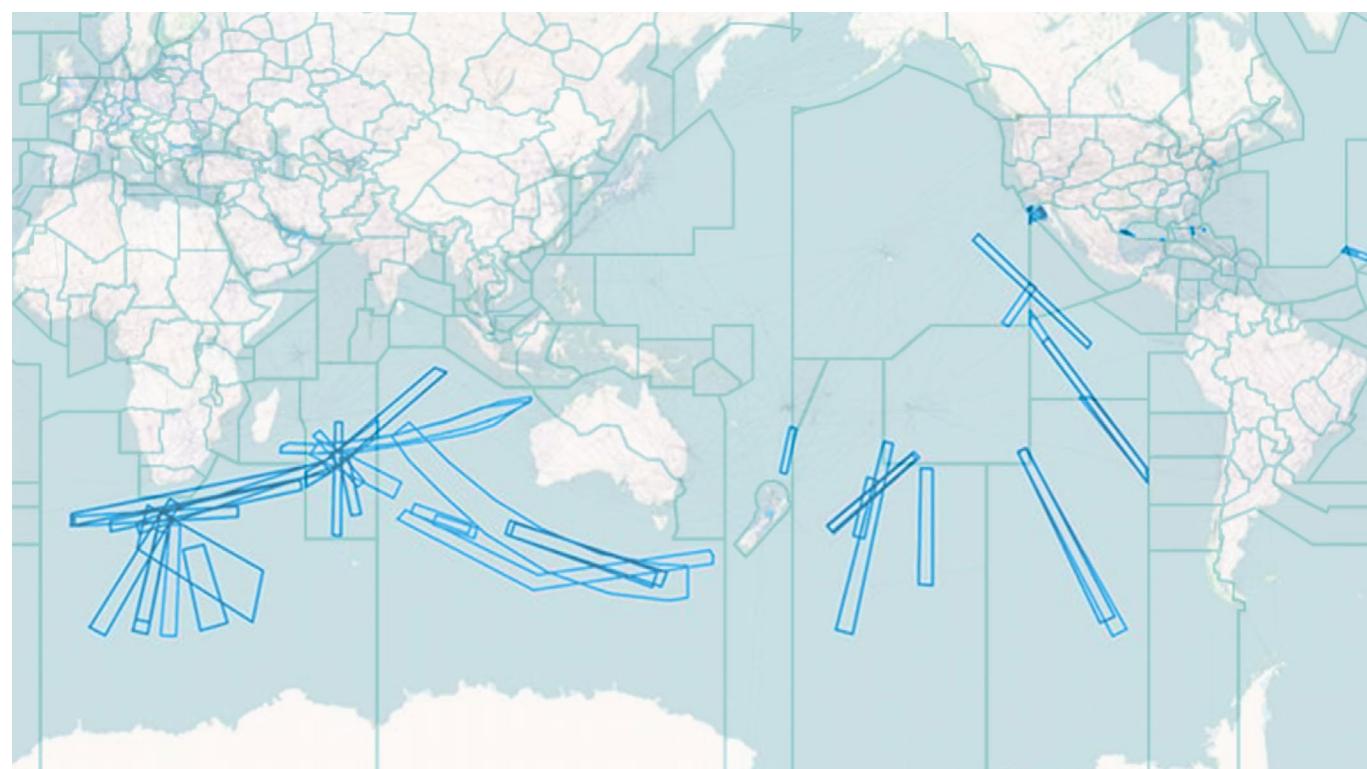


Figure 4 – This figure shows global FIRs impacted at various times by space transportation operations originating from the United States in 2023 and part of 2024.

2. Terms and Acronyms

Airspace Management Plan (AMP)	A plan that lays out how the ANSP will manage the airspace.
Aircraft Hazard Area	Airspace that is preemptively calculated and used by ATC to segregate air traffic from space transport operations. An AHA is designated via NOTAM as either a TFR or stationary altitude reservation [ALTRV]. Unless otherwise specified, the vertical limits of an AHA are from the surface to unlimited.
Air Navigation Service Provider (ANSP)	A public or a private legal entity providing air navigation services within a specified region.
Air Traffic Control (ATC)	Set of procedures, practices, and personnel who provide air traffic separation services.
Air Traffic Control Officer (ATCO)	An individual employed by the air navigation service provider who directly provides air traffic control services.
Air Traffic Management (ATM)	The collection of air traffic control services and airspace management services to maintain safe and efficient movement of aircraft.
Air Traffic Flow Management (ATFM)	A set of services that contribute to safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilised to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.
Air Traffic Services (ATS)	A generic term meaning, variously, flight information service, alerting service, air traffic advisory service, or air traffic control service (area control service, approach control service, or aerodrome control service).
Air Traffic Service Unit (ATSU)	A subset of the ANSP responsible for providing air traffic control services, communication, and navigation assistance to aircraft in their assigned airspace.
CANSO ATFM Data Exchange Network for the Americas (CADENA)	Processes and procedures in the Latin America and Caribbean region used to facilitate data sharing and common situational awareness in air traffic management.
Civil Aviation Authority (CAA)	The agency of a sovereign State given responsibility, by agreement or statute, to determine and administer regulations to ensure that aircraft are operated safely.
Collaborative Decision Making (CDM)	The set of processes and practices to foster collaborative air traffic management decisions and data exchange among members of the air traffic management community.
Coordinating ANSP	An ANSP taking a primary role in coordinating STOs and airspace management activities with other ANSPs who may be affected.
Danger Area	A region of Special Use Airspace around a launch or re-entry operation to protect non-participating aircraft.
Debris Response Area (DRA)	Contingency airspace that is preemptively calculated to account for possible falling debris in response to the malfunction of a space transport operation.

2. Terms and Acronyms

Flight Information Region (FIR)	A specified region of airspace in which a flight information service and an alerting service are provided and delegated to a State responsible for the operational control.
Flow Constrained Area (FCA)	An artifact used in air traffic flow management that defines a region of airspace, flight filters, and time interval to identify flights subject to a constraint.
Integrating ANSP	An ANSP affected by space operations addressed by a coordinating ANSP.
Launch Vehicle	A vehicle built to operate in, or place a payload in, outer space or a suborbital rocket.
Letter of Agreement (LOA)	A formal written document stating how air traffic facilities will interact in a specific situation.
Malfunction	An unexpected or abnormal occurrence during a space transportation operation that generates debris and may necessitate the protection of airspace from potential hazards.
Notice of Intent (NOI)	A formal written or electronic request to conduct a space transport operation.
Space Transport Operation (STO)	The launch and reentry of vehicles and payloads to, from, or within outer space or suborbital trajectory, including all related preparation and ground operations.
Space Transport Vehicle (STV)	A launch or re-entry vehicle involved in a STO.
Launch or Re-entry Operator (LRO)	The entity conducting the launch or re-entry operation.
NOTAM	A notice distributed by means of telecommunication containing information concerning the establishment, condition, or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
Pre-Flight Information Bulletin (PIB)	A summary of critical aeronautical information, including relevant NOTAMs, which pilots access before a flight to gain awareness of any significant changes or hazards along their planned route.
Re-entry Vehicle	A vehicle designed to return from Earth orbit or outer space to Earth, or a reusable launch vehicle designed to return from Earth orbit or outer space to Earth, substantially intact.
SARPs	ICAO Standards and Recommended Practices.
State Space Regulator (SSR)	A state agency that regulates space launches, space re-entries, and spaceport operations.
Safety Management System (SMS)	A systematic approach to managing safety, including the necessary organisational structures, accountabilities, policies, and procedures.
Scrub	The cancellation of a STO for a specific day within 24 hours of the intended launch time, with the plan to attempt a launch again on a different date.

3. Airspace Authority and Management

3.1 Airspace Authority and Regulation

According to international law, each state has the legal authority to apply its regulations to its sovereign airspace in accordance with laws and practices created by its legislative body. This authority can be delegated. In the case of international civil aviation, these international laws are governed by two international treaties known as the Chicago Convention and the United Nations Convention on the Law of the Sea (UNCLOS). Civil aviation is further regulated by the Civil Aviation Authority (CAA) in that State. See Appendix A for further information on authority.

3.2 Flight Information Regions (FIRs)

For operational purposes, global airspace is partitioned into FIRs (see Figure 5). In each FIR, an authority provides flight information service and Alerting Services (ALRS). In busy regions, ANSPs also provide flight separation services. ICAO is the United Nations agency that helps 193 countries cooperate and share their skies to their mutual benefit. ICAO member States decide which States are responsible for the management of each FIR.

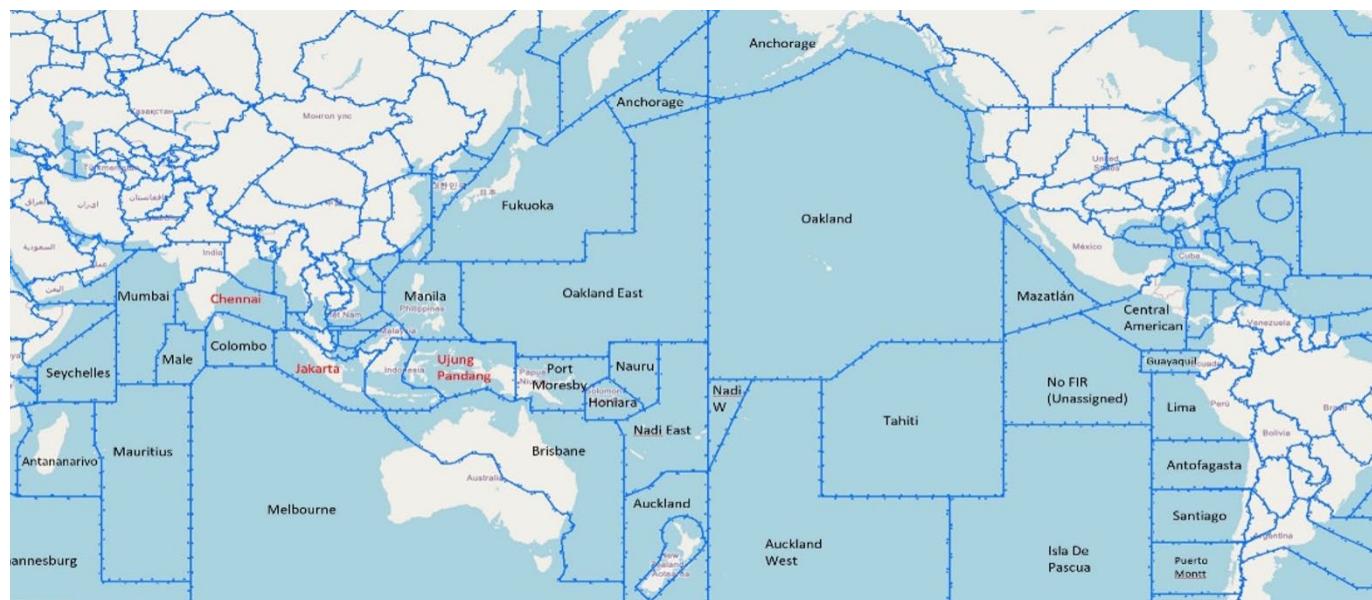


Figure 5 – FIRs around the world.

3.3 Space State Regulator

A Space State Regulator (SSR) regulates commercial space operations and spaceports in each State. This authority is not necessarily the same as the Civil Aviation Authority (CAA), as some States designate separate agencies to oversee space operations. In most States, the LRO would first notify the SSR of their intent to conduct a STO. The LRO should work closely with the SSR to obtain the necessary approvals. Once the SSR approves the operation, management of the operation is usually transferred to the coordinating ANSP. If not the ANSP, then the State, military, or LRO may conduct some coordinating ANSP activities.

3. Airspace Authority and Management

3.4 Airspace Management

Daily operation of the airspace is managed by the ANSP. In some countries, air navigation services are provided by another department within the CAA. While space transportation operations themselves fall outside the scope of ICAO's authority, as they are not civil aviation, they do impact civil aviation operations. STOs result in the need for airspace restrictions (e.g., Danger Areas) and timely dissemination of information through NOTAMs. The management and publication of these airspace restrictions fall within the remit of ICAO through its SARPs and PANS and are implemented by ANSPs in accordance with Article 12 of the Chicago Convention.

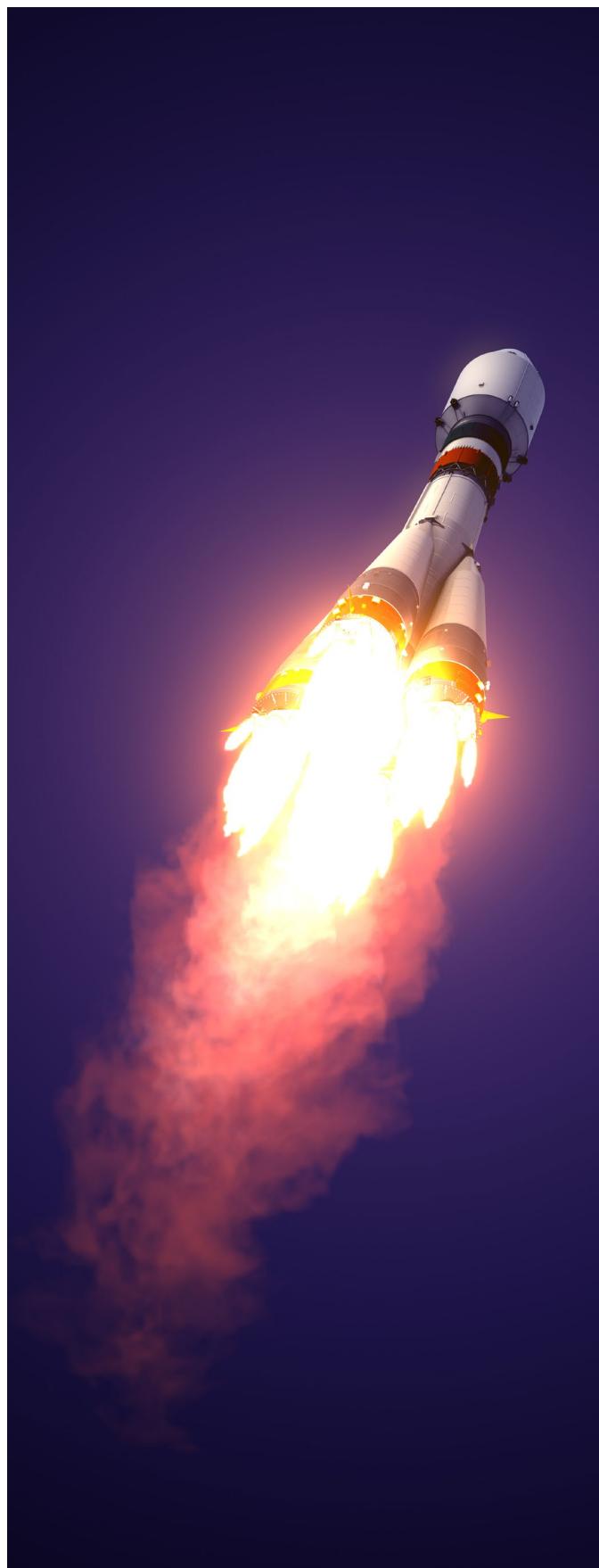
Space operations can affect multiple FIRs globally, though not necessarily simultaneously. These FIRs may include both sovereign and delegated (international) airspace, including areas over the high seas. Further legal and regulatory details regarding sovereignty and FIR responsibilities can be found in Appendix A.

Prior to a STO, the LRO must work closely with the ANSP(s) to plan for safe and efficient integration of the operation into the airspace system. This includes identifying impacted FIRs, coordinating Danger Area designations, and ensuring appropriate notifications to stakeholders in accordance with ICAO Doc 10066 (PANS-AIM).

3.5 LRO Awareness

LROs should be aware of the various authorities governing airspace and space activities. Key contacts for LROs include the SSR, ANSP, and CAA in the region(s) where launch and re-entry activities occur or will be affected.

It is particularly important for LROs to understand the distinction between sovereign airspace and ICAO-delegated international airspace, especially over the high seas where sovereignty does not apply. ICAO SARPs, including those related to airspace management and the publication of Danger Areas, remain applicable without exception in these areas. Appendix A outlines these legal principles and the related treaty obligations in greater detail.



4. Integration Considerations

This chapter summarises the considerations for integrating STOs into airspace systems for both ANSPs and LROs. The considerations are broken down into four key phases for an STO: Request for Airspace, Airspace Planning, Day-of Activities, and Post Operations Analysis as shown in Figure 6.

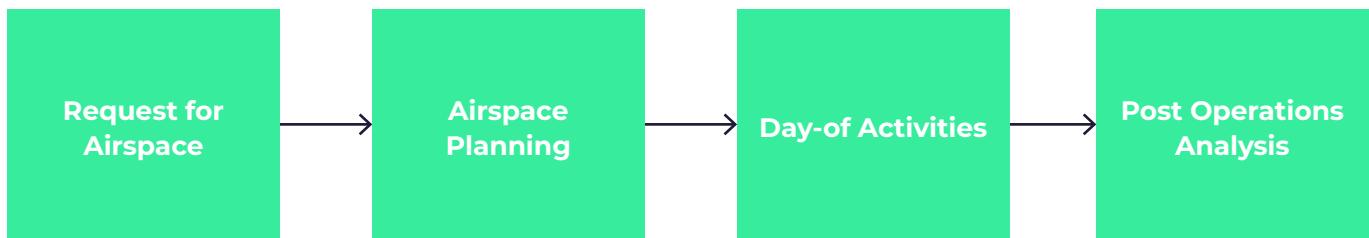


Figure 6 – Key Phases for Integration of a STO.

4.1 Request for Airspace

In this section, we recommend activities for the coordinating ANSP and the LRO to process a request for airspace. These are shown in Figure 7. Blue-filled boxes are activities the coordinating ANSP should perform. The figures in this section point to an LRO supporting some of the activities, but a government range or spaceport may perform some of the activities on behalf of an LRO. The request for airspace should be submitted with sufficient lead time to allow for effective coordination of each request. In most cases, this can be done weeks or even days before the launch.

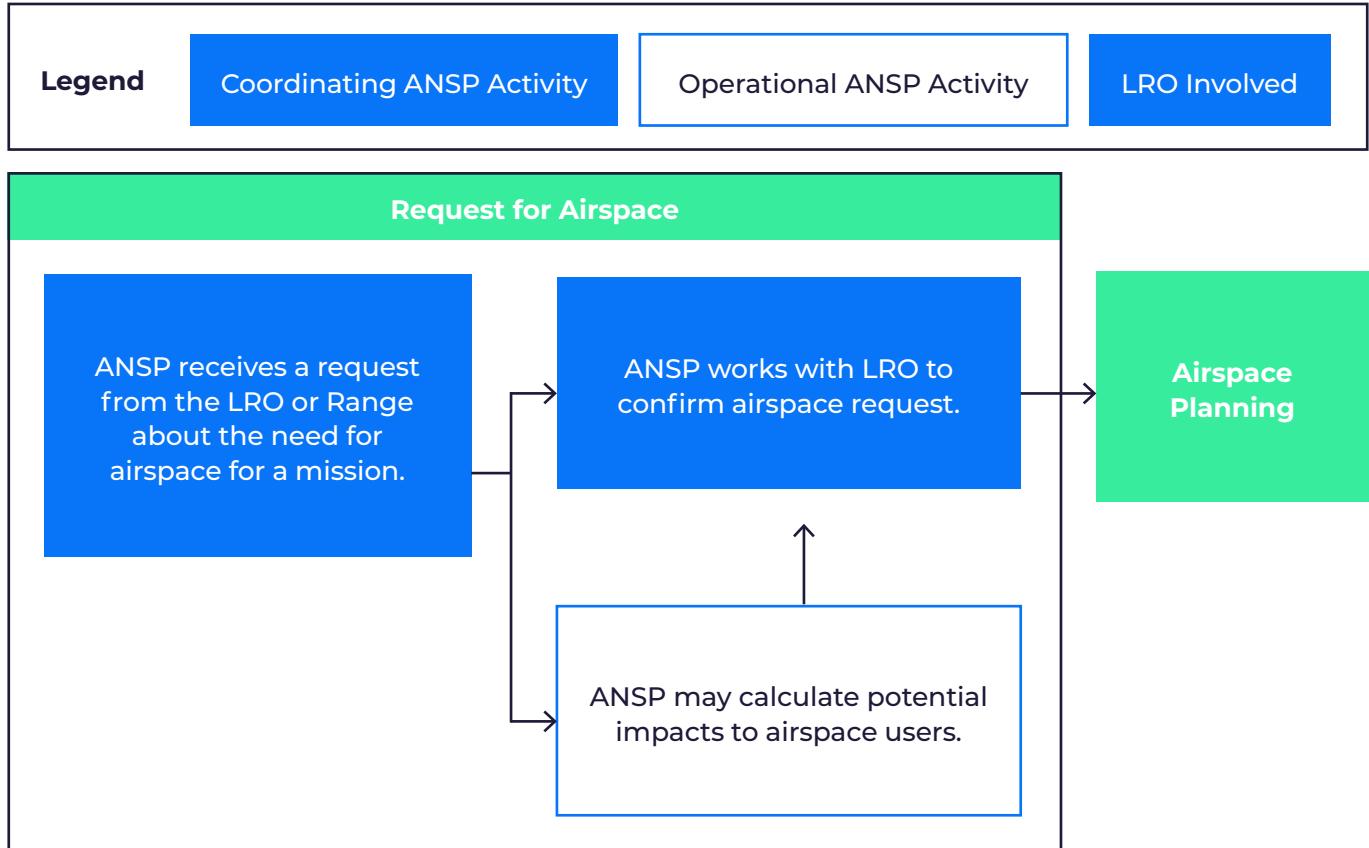


Figure 7 – Activities within Request of Airspace Phase.

4. Integration Considerations

4.1.1 ANSP Receives LRO's Request for Airspace

Airspace requests must be made by the LRO prior to a planned operation sufficiently far enough in advance to allow for adequate coordination. In some States, the request goes to the coordinating ANSP, while in other states, it goes to the SSR. There are cases in which timing of the operation is unknown well in advance, as can happen with some military operations.

Ideally, this airspace request would take the form of a notice of intent, containing the following information:

- Launch information: Mission name, site, times and dates for primary launch and backup launch;
- Type of vehicle (e.g., Falcon 9, Atlas V);
- Mission type (launch, re-entry, airborne launch);
- Geographical and temporal extent of danger area(s) defined by coordinates (latitude and longitude, in compliance with ISO 6709 standards);
- Any relevant supplemental information, e.g., contingency areas which are activated in the event of a launch malfunction;
- Payload priority considerations, e.g. payloads sponsored by the military or government.

The notice of intent may be formed solely by the LRO, or it may be formed in collaboration with the SSR or CAA before the coordinating ANSP receives it. Timing of the operation and size/shape of the danger area may lead to subsequent negotiations involving the LRO. The ANSP may then provide feedback on the notice of intent. The ANSP (possibly in conjunction with the SSR and CAA) should consider establishing a process for the generation, transmission, negotiation, and acceptance of the notice of intent. (Refer to Appendix C).

After accepting a final notice of intent, the coordinating ANSP should then request danger areas to be published via NOTAM(s) by the integrating ANSPs, with a minimum of seven days (as recommended by ICAO Document 10066, 'Aeronautical Information Management'). However, given complexities of these operations, submitting earlier would be beneficial.



4. Integration Considerations

4.1.2 Coordinating ANSP May Perform Airspace Impact Assessment

The coordinating ANSP who receives the notice of intent from the LRO or the SSR should review the information from the perspective of safety and impact to air traffic management services and airspace. Assessment considerations for the coordinating ANSP may include the following:

- What effect will the proposed operation have on ATC and other airspace users?
- Are other activities of a similar type taking place or requested?
- Can the STO be moved to a less impactful time of day, or is this a time-sensitive operation with a narrower launch window?
- Does the operation require support from an air traffic flow management (ATFM) measure (e.g., rerouting programme)?
- What other FIRs will be affected by the proposed danger area(s) and potential ATFM measures?

The coordinating ANSP may work with the LRO to adjust the STO window time or duration based on airspace impact and efficiency considerations. Information should be shared with integrating ANSPs as early as possible in the airspace analysis phase to inform the impact assessment and support timely and effective planning.

The coordinating ANSP may work with the LRO to adjust the STO window time or duration based on airspace impact and efficiency considerations. Early engagement between the LRO and both coordinating and integrating ANSPs, via phone calls, emails, or electronic data exchange, increases the likelihood of acceptance and effective integration. Sharing information early in the airspace analysis phase allows integrating ANSPs to identify potential conflicts (e.g., military exercises, special events), reducing the risk of last-minute disruptions. Providing advanced tools such as forecast calendars of upcoming launches and events further supports proactive planning and improved airspace management across FIRs.

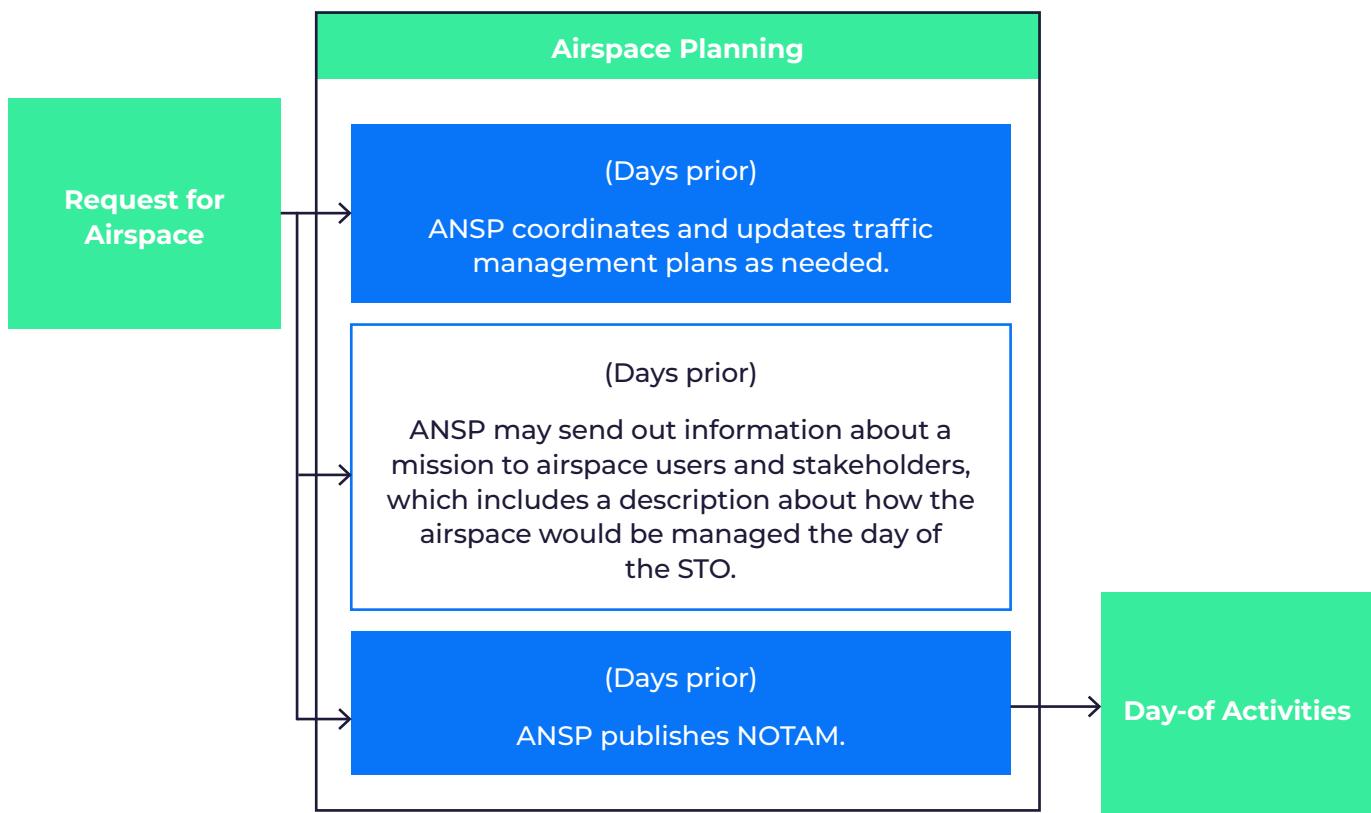


Figure 8 – Activities within Airspace Planning Phase.

4. Integration Considerations

4.1.3 Risk Hazard Analysis

The SSR (or its equivalent) should oversee a risk hazard analysis for each STO during the licensing and permitting process to ensure they meet applicable safety criteria. ANSPs/SSR/CAA should use the results of the risk hazard analysis to determine the appropriate geographical dimensions and time periods for defining danger area(s) suitable to ensure the safety of their ATM operations. These geographical and temporal definitions of the danger area(s) should be included in the NOTAM and PIB.

Risk hazard analysis should also incorporate the technical maturity and reliability of STVs and the ANSP's level of operational experience when determining the size and duration of danger area(s).

4.2 Airspace Planning and Collaboration

In this section, we provide recommendations to the ANSP for how to plan airspace management activities that have been approved prior to the day of operation (see Figure 8). This would apply mainly to the coordinating ANSP, but the integrating ANSP may need to plan airspace management activities for their own airspace.

Successful implementation of STOs into airspace systems requires collaboration from all stakeholders. ANSPs should establish collaborative partnerships and coordination mechanisms with spaceports, LROs, ATS units, CAAs, and other relevant stakeholders (e.g., militaries and local public safety stakeholders) involved in STOs. Regular communication and coordination are crucial for information sharing. ANSPs should consider engaging in relevant forums and collaborative initiatives to share best practices and harmonise standards for integrating STOs into airspace systems.

In coordination with the appropriate SSR(s), ANSPs should review information provided by LROs to:

- Establish formal agreements with stakeholders involved on how to notify, plan, coordinate, and execute these operations and necessary stakeholders within an LOA between all pertinent stakeholders (i.e. ANSPs and operators);
- Communicate with LRO on upcoming STOs;
- Participate in opportunities such as licensing reviews, operator announcements, conferences, site visits, etc.;
- Determine ANSP and ATSU support needs for each mission as soon as practicable;
- ANSP or ATSU management may direct assignments earlier based on mission requirements and pre-mission coordination needs.

The ANSP should consider establishing an official communication mechanism. For instance, some ANSPs have established a 'space mailbox'. The space mailbox is an email address that can be used as a recognised contact point for pre-launch coordination issues. However, to be effective, its existence needs to be known in advance by relevant stakeholders, including potentially affected ANSPs and ATSUs. A key benefit of the group mailbox model is to avoid connecting pre-launch coordination communications to a specific individual (e.g., by using a personal email address), who might leave the organisation or move to another role. The idea is that the space mailbox should be checked daily by all identified ANSP team members. Also, messages can be appropriately labelled and archived.

Before establishing such mechanisms, the ANSP should consider existing mechanisms that can be used to accomplish their goals. When information arrives by individual emails, phone calls, or other sources, it should be appropriately documented and shared with appropriate stakeholders.

4. Integration Considerations

4.2.1 NOTAMs Formation and Dissemination

The LRO is responsible for ensuring timely coordination and providing necessary information, as established in LOAs, for a NOTAM to be issued by the responsible NOTAM issuing office, which may or may not be the ANSP. This information should be provided in the LRO's notice of intent to launch or reenter.

The LRO should update their notice when there are changes to the planned mission, which may require the ANSP to issue an updated NOTAM.

For ANSPs, depending on State requirements, coordination of NOTAMs involving multiple States should be affected, whenever possible, a minimum of seven days in advance. This is in accordance with guidance contained in ICAO Procedures for Air Navigation Services – Aeronautical Information Management (PANS-AIM, Doc. 10066), the ICAO Aeronautical Information Services Manual (Doc. 8126) and the PANS – ICAO Abbreviations and Codes (PANS - ABC, Doc. 8400). However, the length of time should reflect each integrating ANSP's unique constraints such as available staffing to handle these requests (not all are 24/7), coordination/ approval processes, experience for the type of mission, volume of requests being handled, and ability of the ANSP's automation systems to handle such requests and missions.

NOTAMs issued for STOs should be generated and processed in accordance with current ICAO Provisions and SSR approved procedures. In accordance with The NOTAM Code section of ICAO Doc. 8400 (the PANS-ABC), the following NOTAM code should be used:

- QRDCA/IV/BO/W – Where 'Q' indicates it is a code abbreviation for use in the composition of NOTAM; where "RD" stands for "Danger Area" and 'CA' stands for 'Activated'; and where the 'I and 'V' indicate the danger area is applicable to IFR traffic and VFR traffic, respectively; and where the 'BO' indicates the NOTAM is of operational significance for Pre-flight Information Bulletin (PIB) entry and concerning flight operations; and where 'W' indicates the scope is considered 'air display'.
- QRTCA/IV/BO/W – Where 'RT' stands for 'Temporary Restricted Area' and 'CA' stands for 'Activated'.

Airspace managers may choose to activate different types of airspace in support of STOs, including warning areas, danger areas, or other forms of altitude reservations (ALTRVs). The size and geometry of danger areas should have already been determined by the appropriate ANSP/SSR/CAA.



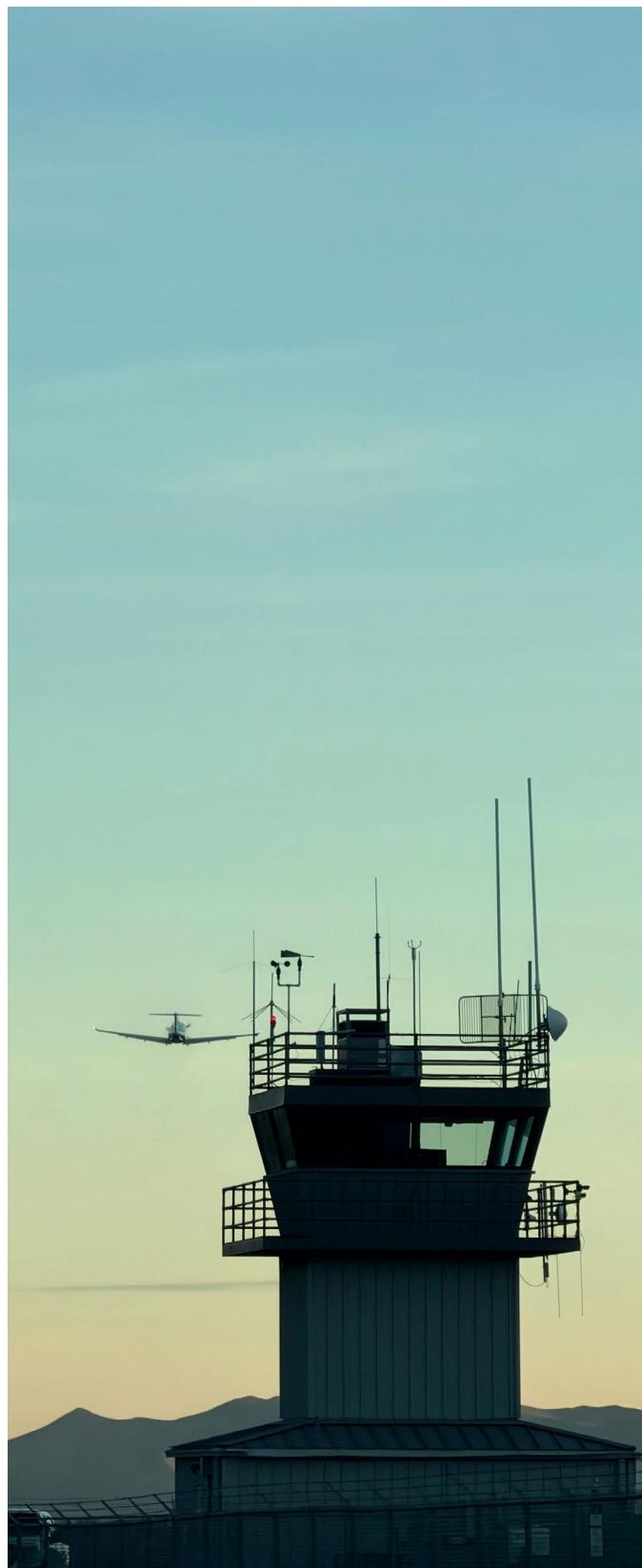
4. Integration Considerations

4.2.2 Development and Dissemination of an Airspace Management Plan (AMP)

The coordinating ANSP should consider the need for an airspace management plan for each mission, which is a planning document that lays out how the ANSP will manage the airspace. In some cases, the ANSP may determine that standard airspace procedures will sufficiently address the situation. When an airspace management plan is warranted, it can be a very simple document, or more extensive, depending on the complexity of the STO and the impacted airspace. A fully-developed AMP would ideally include the following:

- Background describing the type of activity, and pertinent information;
- Primary and back-up launch or re-entry dates;
- Written description of the danger area(s) that includes its general location, size, and effective times;
- General operational impact describing the effect on the affected airspace and airspace users;
- Images or screenshots including the danger area(s) and other areas, as appropriate;
- ATFM plan, which may include ATFM measures³ to manage operations within ANSPs on the day of the event;
- Route availabilities for non-participating aircraft operators;
- Expected tactical ATFM measures, e.g. miles-in-trail, that are pre-coordinated between affected ANSPs to implement while supporting operations;
- Contingency plans in the event of a failed operation (e.g. activation of mitigation procedures).

Ideally, an AMP template would be developed for future re-use. The AMP should be distributed to affected offices within the coordinating ANSP and other affected airspace user groups. Where FIRs managed by other ANSPs are impacted by the STO, the coordinating ANSP should consider sharing the AMP with them or developing a joint AMP as appropriate.



³ Also known as air traffic flow management initiatives, these measures include ground delay programmes and rerouting programmes.

4. Integration Considerations

4.3 Day-of Activities

In this section, we provide recommendations to the ANSP and LROs for managing airspace on the day of the space operation. All regulatorily required LOA / Notice of Intent (NOI) within an ANSP, LROs, spaceports, ranges, and with other ANSPs are assumed to be in place. Day-of activities are shown in Figure 9.

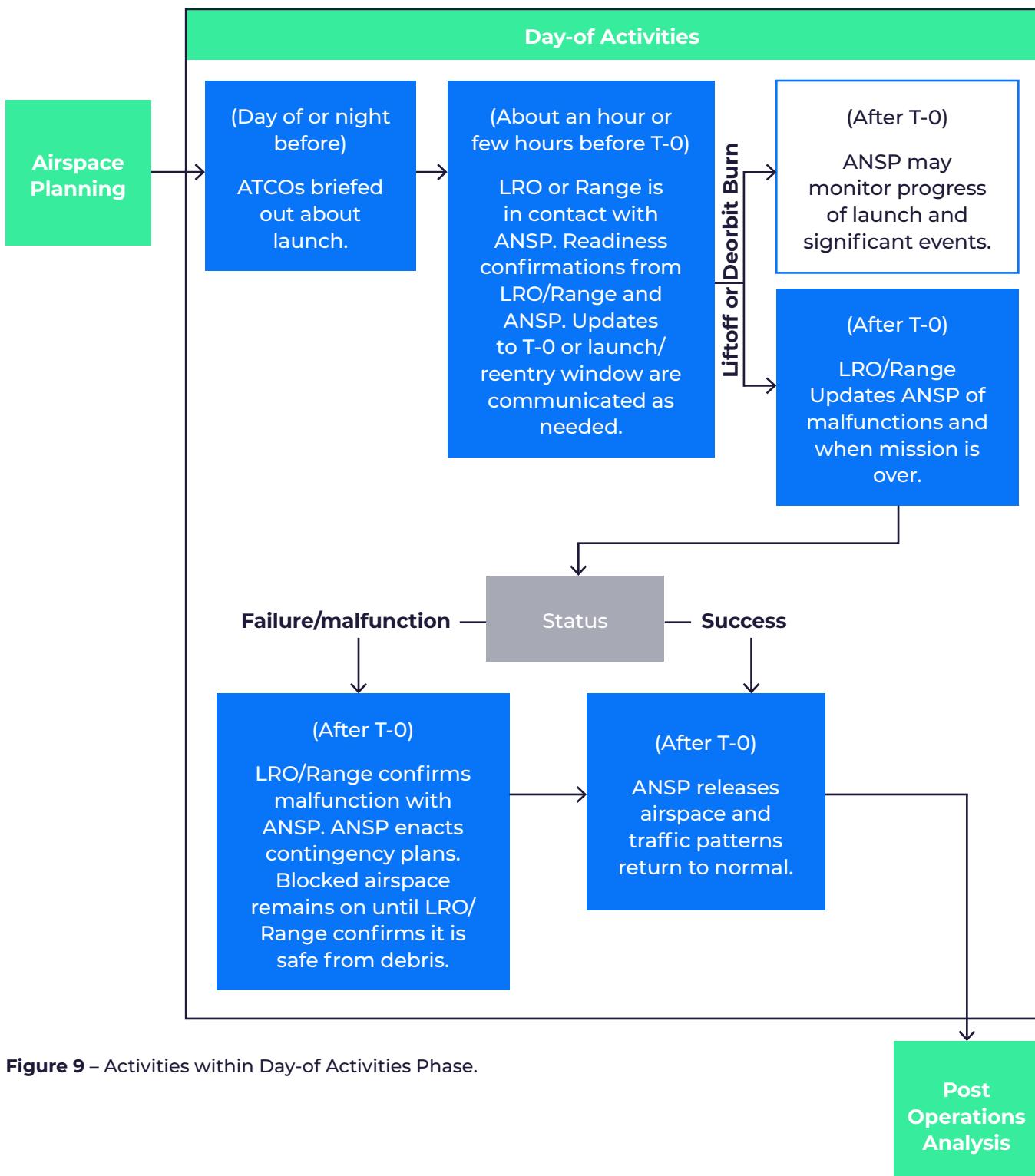


Figure 9 – Activities within Day-of Activities Phase.

4. Integration Considerations

4.3.1 Technology and Systems Readiness

The coordinating and integrating ANSPs will have made a technological status and systems readiness assessment prior to the day of operations. This assessment typically includes a review of the following:

- Ability to update NOTAMs;
- Ability to draw or depict danger areas on ATM and ATFM automation displays to ensure safety and increase situational awareness;
- Communication mechanisms;
 - Teleconference call capabilities;
 - List of stakeholder individuals, organisations, or relevant bodies who may need updates on the day of operations;
- Systems and infrastructure involved in the planning, coordination, and management of the STO.

4.3.2 Prior to Liftoff or Deorbit Burn

Approximately 72 hours before the scheduled launch, ATCOs from the coordinating and integrating ANSPs should be briefed about the upcoming STO. The briefing should include information about danger areas, the relevant vehicle and LRO details, affected/closed ATS routes, ATFM measures, applicable meteorological conditions and forecasts and other airspace management methods that will be implemented to reroute traffic around the danger areas. The ANSPs should determine whether controller workstations affected by the STO should display activation and deactivation times.

As the scheduled STO gets within hours, the coordinating ANSP, integrating ANSP(s), LRO, and appropriate state entity involved, e.g., Federal Range, should establish contact with each other to confirm each other's readiness. The coordinating ANSP should use their knowledge of key mission events, such as loading fuel into a launch vehicle, to refine the window of time the airspace is restricted.

The LRO should notify the coordinating ANSP of any updates to the T-0 time (liftoff or de-orbit burn) or their launch/re-entry window as soon as they are known. The coordinating ANSP will then notify

any integrating ANSPs. The sooner ANSPs become aware of a potential delay or scrub, the less impact the mission will have on other airspace users. For example, notifying the coordinating ANSP of a scrub or delay at least two hours prior to the scheduled launch should allow some domestic or short-haul flights to avoid reroutes and delays. However, if that notification were to come less than 30 minutes prior to the scheduled launch time, then many domestic flights would already have been rerouted or delayed. Long-haul routes, especially trans-oceanic routes, are generally planned many hours in advance and short notice scrub or delay notifications may not provide a tactical benefit to flights that are already airborne and flying around published NOTAM areas. However, maximising the notice provided may allow ATCOs to tactically re-route subsequent long-haul departures to more efficient routes sooner, reducing the impact of the restricted areas to the extent possible.

4.3.3 After Liftoff or Deorbit Burn

After the STV achieves liftoff or has successfully completed its deorbit burn, the LRO should continue keeping their lines of communication active with the ANSPs until the mission is successfully completed. After the LRO notifies the coordinating ANSP of mission completion, the coordinating ANSP should notify the integrating ANSPs that the airspace can be released, which allows traffic patterns to return to normal.

ANSPs may benefit from monitoring the progress of the mission including the vehicle's conformance to the planned trajectory, and successful execution of key mission events. There are tools available to support this today, and ANSPs and operators will need to continue working together to obtain and effectively use this information. Early information and better situational awareness about the vehicle's trajectory conformance and health status could lead to faster ATC responses to mitigate effects from vehicle malfunction events or to reclaim airspace during nominal missions.

4. Integration Considerations

4.3.4 Failure or Malfunction

The LRO must immediately notify appropriate ANSP personnel (as specified in their LOA/NOI) if the STV experiences any malfunction that could result in a debris generation, deviation from the planned trajectory, or changes to danger areas. The LRO is required to announce essential mission milestones announced via the mission hotline. Timely receipt of these status updates is necessary to efficiently and effectively manage airspace activation and deactivation during launch activities. The coordinating ANSP should alert and maintain communications with integrating ANSPs if they may be affected. If such a malfunction occurs, active danger areas remain active until the LRO (or state entity acting on behalf of the LRO) notifies the coordinating ANSP that the danger area is safe from hazards.

In the event of a malfunction, the LRO (or state entity acting on behalf of the LRO) should also calculate an updated danger area based on the latest known information and determine if the updated danger area is encapsulated within an existing danger area. Each affected ANSP should follow their contingency plans as appropriate to respond to mishap situations.

4.3.5 Maintain Situational Awareness

4.3.5.1 Plan Awareness

All stakeholders should be aware of the information in the airspace management plan prior to the operation. Coordination is often point-to-point and contact between affected parties should be in accordance with existing LOAs. The LRO will likely be engaged through some combination of these mechanisms:

- Planning teleconferences;
- Telephone hotline or chat tool for ad-hoc questions and issues;
- Operational information displays via official web pages.

4.3.5.2 Mission Awareness

Throughout the launch day, the LRO should assist ANSPs, and other stakeholders to maintain situational awareness of the STO mission status. This should include:

- Launch readiness (countdown) status and re-entry readiness;
- Delay or cancellation notifications (if any);
- Notification of irregular, unexpected or unplanned events, such as contingency events.

The LRO/ANSP LOA should define the processes that ensure the ANSP receives current information, in a timely manner, from the LRO. The ANSP can also provide situational awareness about the airspace and nearby aircraft for the LRO.

4.3.5.3 Weather Awareness

Weather conditions and forecasts should be tracked throughout the day. The mission could be jeopardised by excessive temperatures, high winds, convective activity, cloud cover, or solar flares. For instance, Figure 10 shows the tropical storm that delayed launch of Crew-9 to the International Space Station. These are primarily concerns for the LRO, and they affect the ANSP because they could change mission plans (e.g., delayed or postponed launch).



Figure 10 – September of 2024: Tropical storm Helene delayed NASA and SpaceX launch of Crew-9 to the International Space Station.

4.3.6 Managing Airspace

4.3.6.1 NOTAM Management

The LRO should immediately notify the ANSP if airspace is no longer in use and can be released before the NOTAM's published end time. If airspace is returned early, the NOTAM should be cancelled for its remaining time. If the beginning of the launch window is delayed, then the ANSP should coordinate tactical use of the danger area airspace through real-time communication with all stakeholders who receive operational information.

4. Integration Considerations

4.3.6.2 Time-based Airspace Management

To minimise disruptions to international civil aviation while ensuring safety, ANSPs can consider implementing time-based airspace management procedures. These procedures aim to restrict access to only the minimum necessary airspace during a defined time window, rather than closing large areas of airspace for extended periods.

Time-based procedures are typically communicated in advance and coordinated with stakeholders, including air traffic facilities and operators. For long-haul or trans-oceanic flights, this allows aircraft to plan routes and fuel loads with consideration of the anticipated launch or re-entry window. Where possible, aircraft are not rerouted unless their predicted crossing time overlaps with the activation window of the restricted airspace.

In cases of dynamic launch windows (i.e. a range of possible launch times), ANSPs should coordinate with the LRO to define protective measures that account for potential variations in T-0. While tactical use of airspace is possible, especially in cases of delay, its feasibility depends on the timing of the activation relative to

the position and phase of flight of affected aircraft. Therefore, advanced coordination and clearly defined parameters in LOAs are critical to balancing operational flexibility with safety.

4.3.6.3 ATFM Support

To maintain orderly flow in or around the affected airspace, the ANSP should consider applying ATFM measures if capable⁴. For some ANSPs, this will be limited to simple demand monitoring. This allows the ANSP to identify exactly which aircraft might be affected by the STO danger area(s). Other ANSPs who can reroute, or delay aircraft bound for the affected airspace might consider implementing ATFM measures which include ground stops, ground delay and airspace flow programmes, and reroutes.

If the ANSP has the capability, they can construct and implement a flow constrained area (FCA) around the danger area(s) to keep aircraft out of the FCA in specific time periods, as shown in Figure 11. This provides a precise and efficient way to identify and manage affected aircraft. Notifications should be issued to all stakeholders when ATFM measures are cancelled or extended.

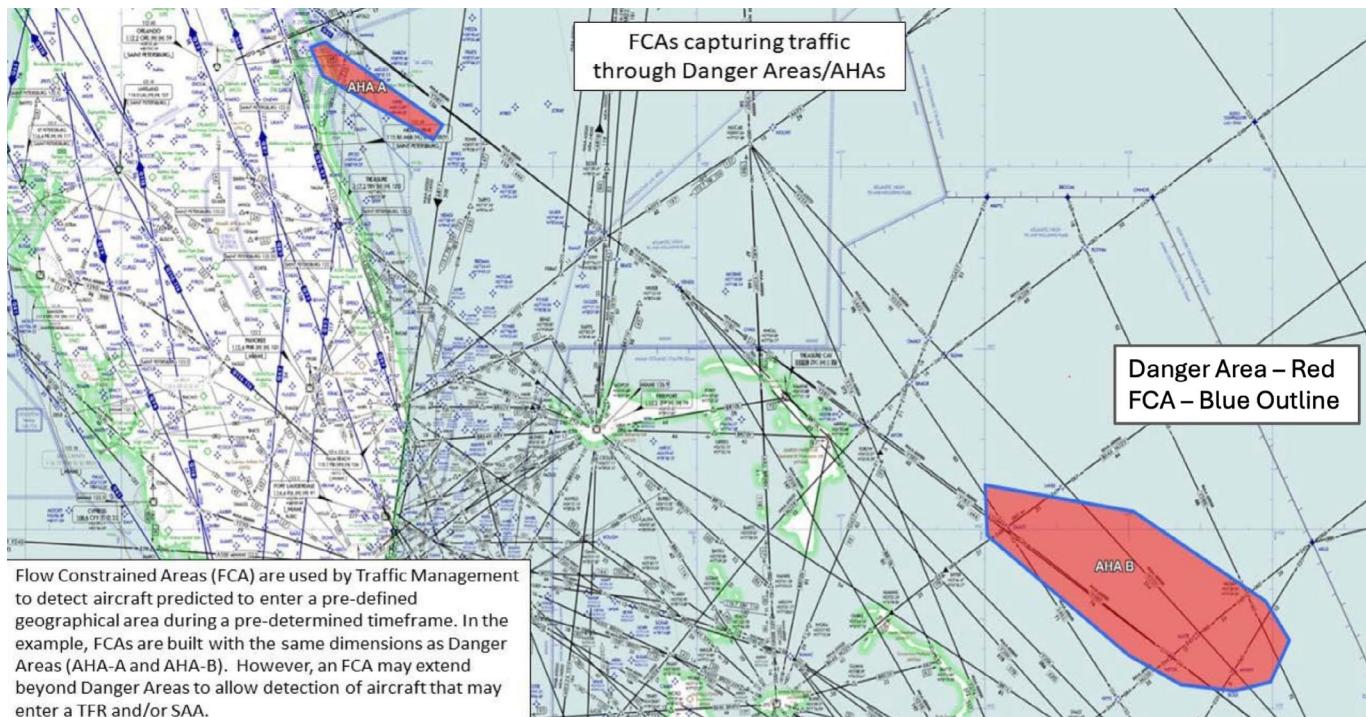


Figure 11 – Traffic managers create a FCA outlining the Danger Areas (blue border).

⁴ ICAO Document 9971, "Manual on Collaborative Air Traffic Flow Management".

4. Integration Considerations

4.3.6.4 Contingency Plan Enactment

ANSPs should develop contingency plans for off-nominal or malfunction events, then disseminate them (usually in the LOAs) with appropriate stakeholders in advance of the operations. For instance, this may include description of a region that could be subject to falling debris. The LRO should provide input as to possible triggers for contingency plans. After the completion of the STO, the SSR should investigate incidents or accidents related to a space operation as necessary. Incidents involving aircraft should also be investigated pursuant to the requirements of ICAO Annex 13 (Aircraft Accident and Incident Investigation) and Annex 19 (Safety Management).

At this time, there are no internationally recognised standards specifying unique details of STO contingency plans; ANSPs can implement their own versions of contingency plans. The LRO may be required to engage with ANSPs to provide information relevant to the creation of contingency plans.

As an example, the FAA in the U.S. employs their Acceptable Level of Risk model, using Debris Response Areas (DRA) to help manage airspace contingency responses. A DRA is a volume of airspace, in addition to the typical Danger Areas active during a STO, that are identified by the FAA prior to a mission. DRAs do not account for all possible failures – only probable failures to a certain threshold (1×10^{-7}). The difference between the Danger Area (which the FAA calls an Aircraft Hazard Area or AHA) and the DRA is that aircraft can operate within the DRA volume

during a normal STO. If a contingency event occurs and debris is predicted to fall outside of active Danger Areas, then the FAA activates the relevant DRA, with the confirmation of the LRO, and would notify affected controllers. The DRAs are pre-drawn and loaded into the ATM systems but only displayed on the controller's workstation when a contingency event occurs and is officially activated.

Controllers then take appropriate action to ensure the safety of aircraft affected by an active DRA, such as rerouting aircraft around the active DRA and helping aircraft in the newly activated DRA to expeditiously exit the area. The DRA stays active until notification from experts on risk analysis it is clear of debris. Currently, the FAA limits the use of DRAs to only the portion of their domestic airspace that is under radar surveillance and adequate communications coverage.

4.4 Post Operations Analysis

Events and lessons learned should be documented by the ANSP and the LRO on the day of operations, or shortly thereafter (Figure 12). Ideally, an examination with internal stakeholders would be held to review how well the operations went and how processes or procedures might be improved.

For STO that involves integrating ANSPs, a Post Operations Analysis between ANSPs to review ANSP specific comments and coordination is recommended.

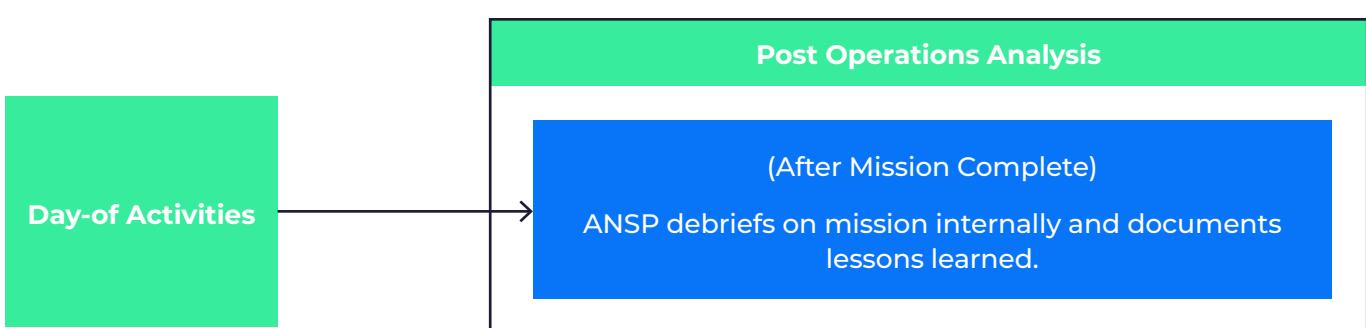


Figure 8 – Activities within Post Operations Analysis Phase.

4. Integration Considerations

4.5 Overall Workflow

Figure 13 summarises the overall activities for the ANSP and LRO already discussed in this chapter. The activities were broken down into four key phases for a STO: Request for Airspace, Airspace Planning, Day-of Activities, and Post Operations Analysis.

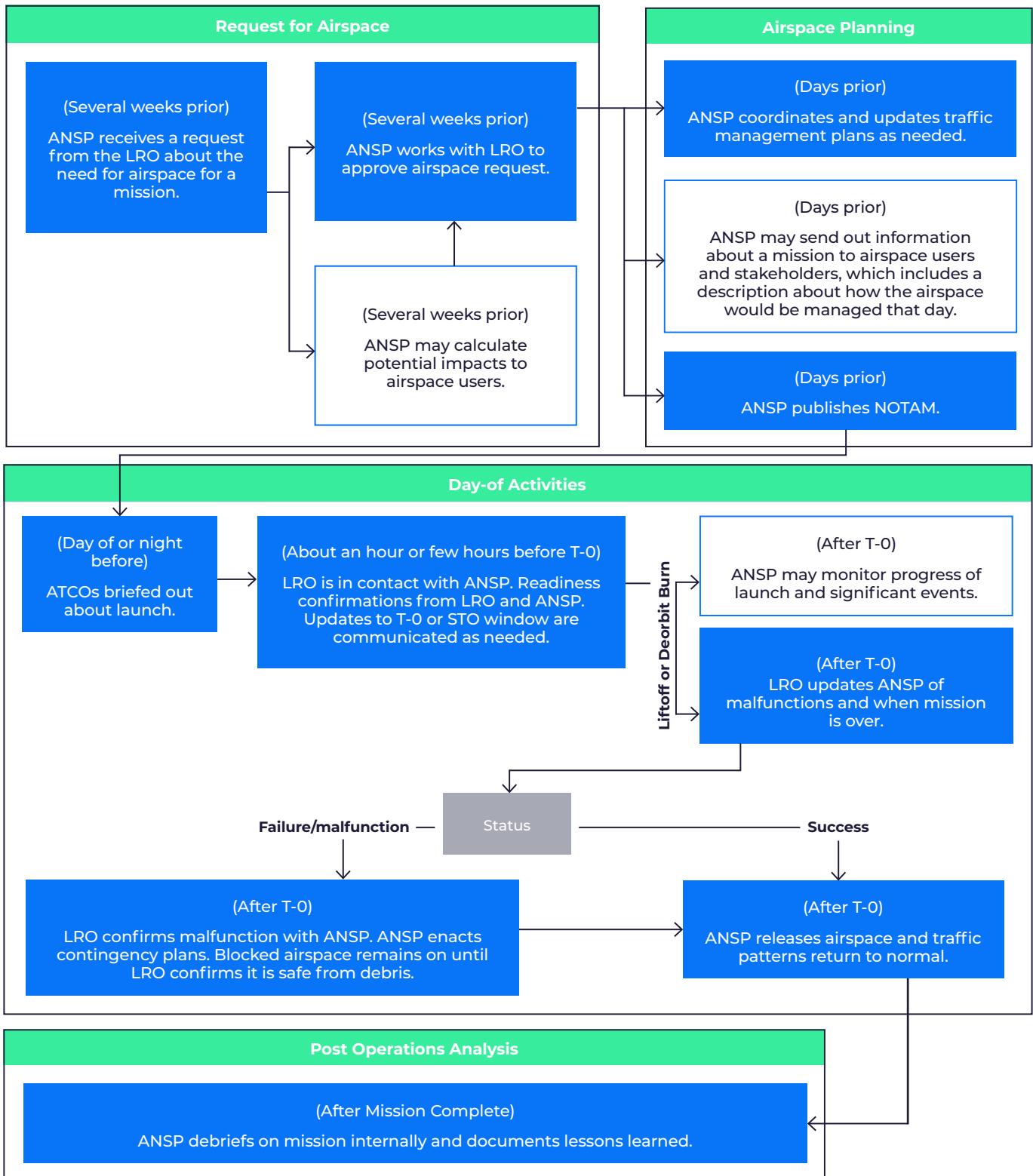


Figure 13 – Overall Workflow with Activities. White Boxes indicate Optional Activities.

5. Summary of Considerations

In this chapter, we summarise the considerations for ANSPs and LROs. These are captured in four tables as follows:

- **Table 1** - Considerations for request for airspace;
- **Table 2** – Considerations for airspace planning and coordination;
- **Table 3** – Considerations for the day of operations;
- **Table 4** – Considerations for post operations analysis.

In each table, considerations are broken down by the coordinating ANSP and integrating ANSP, and LRO.

Table 1: Notification Considerations

Subject	Coordinating ANSP	Integrating ANSP	LRO
Regulation and Policy	ANSP should consider division of roles and responsibilities between the SSR and the ANSP. For instance, regulations and policies for STOs are usually set by a state regulator outside the ANSP.	Same.	LRO should be aware of regulations and policies.
LRO Request for Airspace	Consider what the process will be for the LRO to submit a request for airspace use (e.g., ANSP, CAA, or SSR).	Receive and implement requests, in accordance with ICAO Document 10066, Annexes 11 and 15.	LRO requests airspace use from appropriate authorities (ANSP, CAA, or SSR).
Airspace Impact Assessment	ANSP may conduct an airspace impact assessment for the STO based on the initial request. Prompt may come from the SSR.	None.	LRO may be asked for additional information to support impact assessment.
Collaboration	ANSPs should consider how they will coordinate with spaceports, LROs, air traffic facilities, regulatory authorities, and other relevant stakeholders (e.g., military and local public safety) involved in STOs.	Consider best practices for coordinating NOTAMs for STOs.	LRO should agree with the ANSP on frequency, timing, and method of coordination with the ANSP or other stakeholders.

5. Summary of Considerations

Table 2: Airspace Planning Considerations

Subject	Coordinating ANSP	Integrating ANSP	LRO
Airspace Management	Form a plan for how the airspace is to be managed.	Consider which aspects of the plan depend on or affect their operations.	LRO should be aware of how they impact airspace management and their role in it.
NOTAM Formation	Form a NOTAM for dissemination in accordance with ICAO guidance based on information provided by LRO.	Ingest or process NOTAM information as received, in accordance with ICAO Doc 10066, 8126, 8400 and Annexes 11 and 15.	Responsible for ensuring timely coordination and providing necessary information for a NOTAM to be issued by the responsible NOTAM issuing office. Provide updates to their notice when there are changes to the planned mission.
Disseminate Information to stakeholders	Prior to day of operations, ANSP should disseminate relevant information to stakeholders via a NOTAM (at a minimum). The NOTAM, however, can be accompanied by an AMP or other relevant information about the STO.	Inform airspace stakeholders of potentially hazardous activities, in accordance with ICAO Doc 10066, 8126, 8400 and Annexes 11 and 15.	LRO receives NOTAM and other relevant information from the ANSP. The LRO is also responsible for ensuring that the NOTAM is published prior to initiating their operation and that the content of the NOTAM is correct (e.g., dates, times, coordinates).

5. Summary of Considerations

Table 3: Day of Operations Considerations

Subject	Coordinating ANSP	Integrating ANSP	LRO
Technology and Systems Readiness	Consider forming a technology and systems readiness checklist for the day of operations.	Receive necessary information and disseminate appropriately.	LRO may be asked by the ANSP for systems readiness checks.
Situational Awareness	Consider how awareness will be maintained for (1) airspace management plan execution, (2) STO mission awareness (e.g., status, go/no-go), (3) weather effects that could impact non-participating aircraft (e.g., planned reroutes).	Same.	Have plans and mechanisms established for maintaining situational awareness with the ANSPs, especially with respect to their go/no-go status, execution of key mission events, and local weather conditions affecting their operation.
NOTAMs Management	Consider how/if airspace can be released early.	Consider real-time communication mechanisms with coordinating ANSPs to ensure the safe use of airspace after an operation.	Communicate to the ANSP if/when airspace can be released early.
Time-based Airspace Management	Consider the benefits of implementing dynamic launch windows.	None.	As appropriate, coordinate with the ANSP on time-based airspace management approaches.
Contingency Plan Enactment	Consider what type of contingency plans may need to be executed or created during an operation.	Same.	Notify ANSP if the STV experiences any mishap (failure or malfunction) that could result in a debris generating event, deviation from the planned trajectory, or change in danger areas. Calculate an updated danger area based on the latest known information and determine if the updated danger area is encapsulated within an existing danger area. Notify the coordinating ANSP when the danger area is safe from hazards.
ATFM Support	Consider how air traffic flow management activities (if in place) can provide support.	Same.	None.

5. Summary of Considerations

Table 4: Post-Operations Analysis Considerations

Subject	Coordinating ANSP	Integrating ANSP	LRO
Post Operations Analysis	Consider conducting post-operations reviews internally or with stakeholders to gather lessons learned.	Same.	Participate in post-operations analysis as requested by the ANSP.
Documentation	Consider capturing lessons learned or proposed future improvements in documents.	Same.	Same.
Future Improvements	Consider modifications to practices and procedures for future improvement.	Same.	Same.

Appendix A. International Considerations and ICAO Context

A.1 International Standards and Recommended Practices (SARPs)

ANSPs should be aware of some key differences in SARPs for civil aviation versus STOs. In 1944, the Convention on International Civil Aviation, also known as the Chicago Convention, created the ICAO to harmonise civil aviation around the world. Since that time, ICAO has played an active role in issuing standards and recommended practices for its 193 member states. ICAO's authority is limited to only civil aircraft⁵. Since STOs are not civil aviation operations and space vehicles are not aircraft, ICAO authority does not address STOs. However, ICAO's purview does extend to management of civil operations potentially impacted by STOs, and ICAO standards are binding upon ANSPs from its member states⁶.

Currently, there is no body or authority to regulate or develop standards or practices for STOs. Instead, STOs are governed by several international treaties. The Committee on the Peaceful Uses of Outer Space (COPUOS) was established by the United Nations in 1959 to govern the exploration and use of space for the benefit of humanity. COPUOS has formed five treaties including the Outer Space Treaty, the Liability Convention, and the Registration Convention⁷. The Inter-Agency Space Debris Coordination Committee (IADC) is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space. IADC promotes international cooperation in the peaceful use of outer space and facilitates multilateral treaties. For example, IADC develops technical recommendations for all STOs. These forums provide recommendations recognised by most state space oversight bodies as starting points for national legal and regulatory frameworks to govern space activities.

Issues regarding the regulation of space operations should be deferred to the SSR. SSRs are charged with oversight of public safety for commercial space operations and the operation of spaceports. ANSPs correspondingly play a fundamental role in ensuring

⁵ See ICAO Doc 7300.

⁶ Though binding, all States file differences to the SARPs for their airspace volumes.

⁷ See UN web page.

the safety and security of the airspace system. Therefore, the implementation of danger areas is an essential role of an ANSP during STOs.

A.2 ICAO Context and Treaty

A.2.1 Chicago Convention

The Convention on International Civil Aviation (Chicago Convention - 1944) created ICAO to harmonise Standards and Recommend Practices related to civil aviation.

ICAO plays a crucial role in safe integration of commercial space STOs into the airspace by developing international standards. These standards apply to publication of danger area (DANGER AREA) NOTAMs and ensuring aircraft do not enter the danger areas.



Appendix A. International Considerations and ICAO Context

A.2.2 Sovereign vs Delegated

For the purposes of this document, Sovereignty refers to the legal right (according to international law) to exercise the power of a State over an airspace volume in accordance with laws and practices created by the legislative body of that State. This contrasts with Delegated Authority which, for the purposes of this document, means the transfer of responsibility for the management of an airspace volume to a specific State, in accordance the rules established under international law. In the case of international civil aviation, the Chicago Convention (and its Annexes) is the international Treaty that defines the conditions under which international or “delegated” airspace shall be managed.

The International Convention on Civil Aviation (Chicago Convention) recognises in Articles 1 and 2, that States have complete and exclusive sovereignty over the airspace above their sovereign territory, i.e., the airspace above its land areas and adjacent territorial waters. Conversely, for airspace over the “high seas,” as referred to in Article 12 of the Convention, State sovereignty does not apply, and “... the rules in force shall be those established under this Convention” (Annex 2 – Rules of the Air refers). This means that all waters beyond territorial waters (12 NM) are considered high seas and that the airspace over the high seas is considered international (delegated) airspace from an aviation viewpoint.

Article 12 of the Chicago Convention states, “Over the high seas, the rules in force shall be established under this convention.” Article 28 prescribes that where States elect to provide facilities and services to support international air navigation, these facilities and services should comply with ICAO Standards and Recommended Practices, as far as practicable.

Chicago Convention

Article 1 - Sovereignty is the contracting States recognise that every state has complete and exclusive sovereignty over the airspace above its territory.

Article 2 - Territory - for the purposes of this Convention, the territory of a State shall be deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State.

Article 12 - Rules of the contracting State undertakes to adopt measures to ensure that every aircraft flying over or maneuvering within its territory and that every aircraft carrying its nationality mark, wherever such aircraft may be, shall comply with the rules and regulations relating to the flight and maneuver of aircraft there in force. Each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention. Over the high seas, the rules in force shall be those established under this Convention. Each contracting State - undertakes to insure the prosecution of all.

Appendix A. International Considerations and ICAO Context

The Air Traffic Services Annex 11 states that “the Standards and Recommended Practices in Annex 11 apply in those parts of the airspace under the jurisdiction of a Contracting State wherein air traffic services are provided and also wherever a Contracting State accepts the responsibility of providing air traffic services over the high seas or in airspace of undetermined sovereignty. A Contracting State accepting such responsibility may apply the Standards and Recommended Practices in a manner consistent with that adopted for airspace under its jurisdiction.”

The exception to how a State's Sovereign Territory is normally defined is when considering the case of an Archipelagic State and therefore, Sovereignty over Archipelagic Waters. In a general sense, an archipelago is an island group or island chain where adjacent landmasses are no more than 100 NM apart⁸. In such circumstances, the water between landmasses and the water contained within any lagoon surrounded by landmasses no more than 100 NMs apart are considered Archipelagic Waters. Archipelagic Waters and the airspace above them are sovereign and part of the territory of the State concerned as is the water and airspace extending out 12 NM from the landmasses and archipelagic waters.

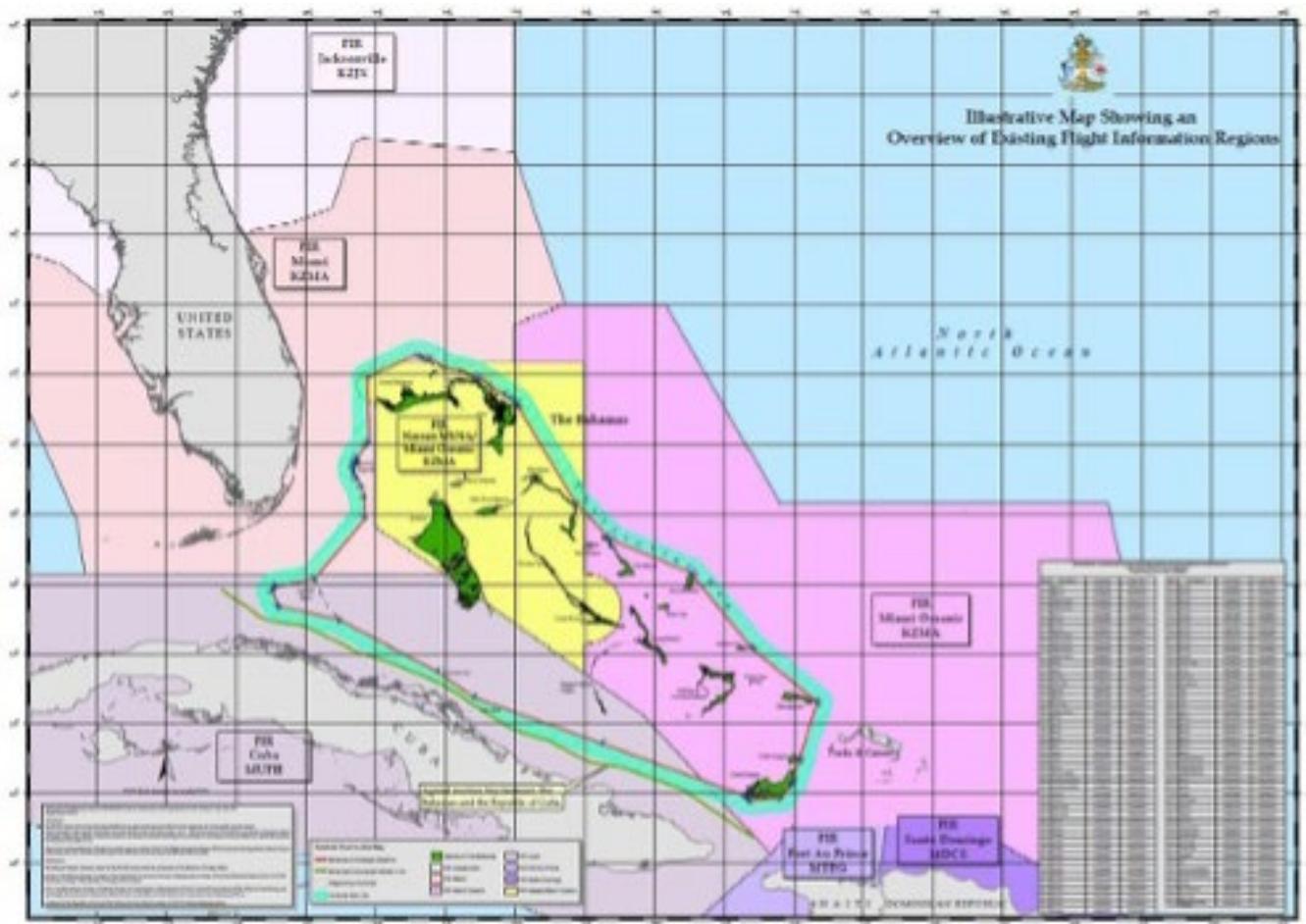


Figure 14 – The Bahamas are considered an Archipelago. When attempting to access The Bahamian Sovereign Airspace, rules surrounding sovereignty are enforced reference the lateral lines shown.

⁸ Except for 3%, which can be 125 NM apart.

Appendix A. International Considerations and ICAO Context

A.2.3 Sovereignty over Exclusive Economic Zones (EEZ)

While the United States is not a party to the United Nations Convention on the Law of the Sea (UNCLOS), U.S. case law adopts and acquiesces to the provisions of UNCLOS and treats them as customary international law. EEZs only influence maritime resources and do not have any legal consequences for aviation. The airspace above EEZs is considered "high seas airspace" and not subject to any sovereignty by States.

Article 87 of the UNCLOS sets forth the freedoms that all States enjoy over the high seas, which include freedom of overflight for aircraft. The very limited set of rights coastal states enjoy in their EEZs, described in Article 56 of the UNCLOS, are not full sovereign rights and are of limited significance for aviation activities. Article 87 of the UNCLOS sets forth the freedoms

that all States enjoy over the high seas, which include freedom of overflight for aircraft. The very limited set of rights coastal states enjoy in their EEZs, described in Article 56 of the UNCLOS, are not full sovereign rights and are of limited significance for aviation activities.

Article 58 of the UNCLOS provides: "In the exclusive economic zone, all States, whether coastal or land-locked, enjoy, subject to the relevant provisions of this Convention, the freedoms referred to in article 87 of navigation and overflight..."

Article 2 of the UNCLOS states that "sovereignty extends to the airspace over the territorial sea." In addition, "the sovereignty over the territorial sea is exercised subject to the UNCLOS and to other rules of international law."

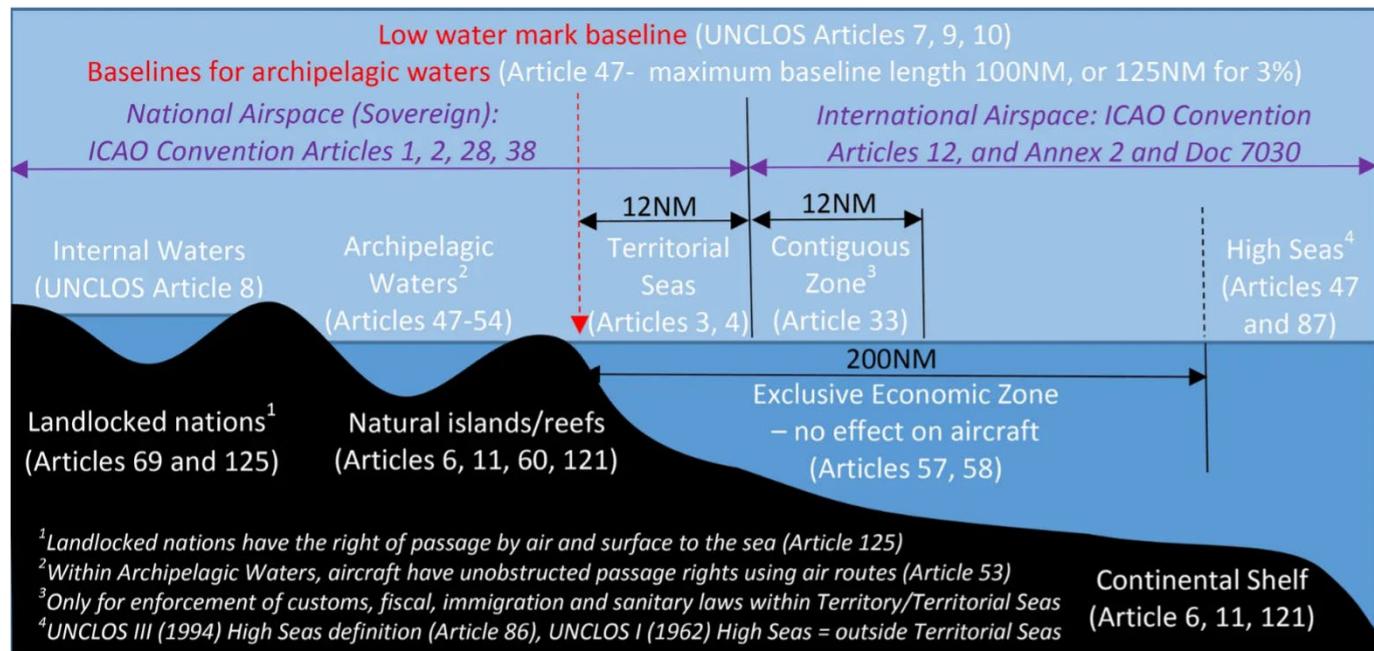


Figure 15 – Maritime and Airspace Volumes as Defined by UNCLOS (white/red = UNCLOS, purple = CC).

Appendix A. International Considerations and ICAO Context

As applied specifically to space launch and re-entry operations therefore, these concepts essentially mean States have the authority to approve or deny requests for a DANGER AREA received in the form of a NOTAM request, in accordance with the following guidance:

1. If the geographical area of a launch or re-entry DANGER AREA NOTAM remains entirely within the geographical extent of the sovereign airspace belonging to the State receiving the DANGER AREA NOTAM request (as defined in Article 2 of the Chicago Convention), then under international law, that State has the authority to approve or deny the request.
2. If the geographical area defined in a DANGER AREA NOTAM request crosses from sovereign airspace of a State (as defined by Article 2 of the Chicago Convention) into international airspace that is part of an ICAO delegated FIR, then both the ANSP responsible for managing the sovereign airspace and the ANSP responsible for managing the FIR (delegated airspace) are responsible for publishing the DANGER AREA NOTAM. It is possible they are the same ANSP, in which case only one DANGER AREA NOTAM needs to be published.
3. If the geographical area defined in a DANGER AREA NOTAM request lies entirely outside of the sovereign airspace of any State (as defined by Article 2 of the Chicago Convention) but in international airspace that is part of an ICAO delegated FIR, then the ANSP responsible for managing the FIR (delegated airspace) is responsible for publishing the DANGER AREA NOTAM since the STO is an activity potentially hazardous to civil aviation in accordance with ICAO Doc. 10066 (Procedures for Air Navigation Services – Aeronautical Information Management).

With all that as relevant background information, it is still very important for space operators to understand that although States are supposed to follow the ICAO SARPS for their Delegated and Sovereign airspaces, differences between the ICAO SARPS and local regulations are inevitable and exist in nearly all airspace volumes. When that happens, the State is responsible (per Article 38 of the Chicago Convention) for publishing the differences between their National

regulations and the ICAO SARPS in their Aeronautical Information Publication (AIP) as a formal Notification of Differences.



Appendix B. Examples of FIRs Frequently Impacted by STOs

This appendix contains specific examples of FIRs frequently impacted by STO. In each image, FIR lateral boundaries are outlined in blue, while an example of a re-entry DANGER AREA is shown in red. The associated danger area NOTAM is included below each picture and the depiction on known traffic volume is shared.

B.1 Argentina FIR

Ezeiza FIR (SAEF) and Comodoro FIR (SAVF):

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace



Figure 16 – Argentina FIRs

Ezeiza FIR (SAEF) - Argentina

A1598/25 NOTAMN

Q. SAEF/QRDCA/IV/BO/W/000/999/4001S02029W276

A. SAEF

B. 2504220240 C. 2504280105

D. 22 0240-0325, 23 0220-0305, 24 0155-0240, 25 0130-0215, 26 0105-0150, 27 0045-0130, 28 0020-0105

E. DANGEROUS ZONE SPACE VEHICLE FRAGMENTS FALL INTO THE ATLANTIC OCEAN - AORRA COORD GEO 390000S/0261400W 390000S/0203880W 410300S/0413900W 424300S/0160700W AFFECTS SRR/ FIR EZEIZA - OCEANIC SECT

F. MSL G. UNL

B.2 Auckland FIR (NZZO)

Auckland FIR requests LRO Danger areas remain south of the blue line depicted below.

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace

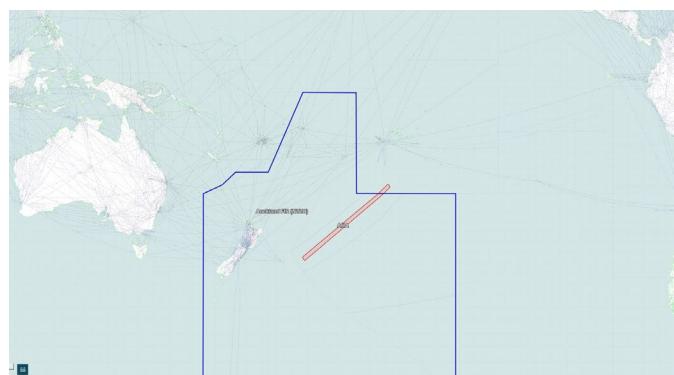


Figure 17 – Auckland FIR

B2861/25 NOTAMN

Q. NZZO/QRDCA/IV/BO/W/000/999/3705S15936W655

A. NZZO B. 2504210915 C. 250421105

E. TEMPO DANGER AREA NZD091 (AUCKLAND OCEANIC FIR) IS PRESCRIBED AS FOLLOWS:

ALL THAT AIRSPACE BOUNDED BY A LINE JOINING:

30 00 S 149 53 W

43 53 S 170 28 W

43 13 S 171 10 W

30 00 S 151 15 W

30 00 S 149 53 W

ACTIVITY: SPACE DEBRIS RETURN

USER AGENCY: FOREIGN SPACE AGENCY

PREScribed PURSUANT TO CIVIL AVIATION RULE PART 71 UNDER A DELEGATED AUTHORITY ISSUED BY THE DIRECTOR OF CIVIL AVIATION

F. SFC G. UNL

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.3 Chile FIR (SCFZ)

This re-entry danger area in red would span multiple FIRs, but only part of it is depicted here. The LRO has the responsibility to coordinate with each individual FIR that is affected by their danger area(s).

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace



Figure 18 – Chile FIRs

R0127/25 NOTAMN

Q. SCIZ/QRDCA/IV/BO/W/000/999/2415S09759W715
A. SCIZ B. 2505100225 C. 2505160625
D. MAY 10 BTN 0225-0703 MAY 11 BTN 0211-0649 MAY 12
BTN 0157-0635 MAY 13 BTN 0147-0625 MAY 14 BTN 0147-
0625 MAY 15 BTN 0147-0625 MAY 16 BTN 0147-0625
E. ZONE...D...SECT WEST PACIFIC DUE TO RE-ENTRY
SPACEX STARLINK 15-4

STAGE 2 REENTRY ACTIVITY. THE AREA IS BOUNDED
BY GEO COORD:

3000S/12153W

3000S/12000W

2843S/12000W

5909S/09534W

5958S/09905W

3000S/12153W

INSTRUCTIONS: SANTIAGO OCEANIC CONTROL 10024

KHZ FANS 1A EQUIPPED ACFT LOG ON SCEZ

F. SFC G. UNL

B.4 Havana FIR (MUFH)

- Polar Launches from the Kennedy Space Center may impact Havana FIR
- The FAA International Office, and the US State Department, will be involved with coordination of danger areas impacting MUFH FIR
- Avoid during peak volume periods daily from 1100-1900 UTC
- Avoid Cuba's 12NM inner Air Defense Identification Zone (ADIZ) airspace
- A danger area should avoid impacting both URSUS and ZEUS intersections due to the volume of air traffic (Example below)
- Please be aware that some of the Havana FIR lies within the Bahamas' sovereign airspace so additional coordination with The Bahamas' ANSP is recommended when operating in the northeast portion of that FIR

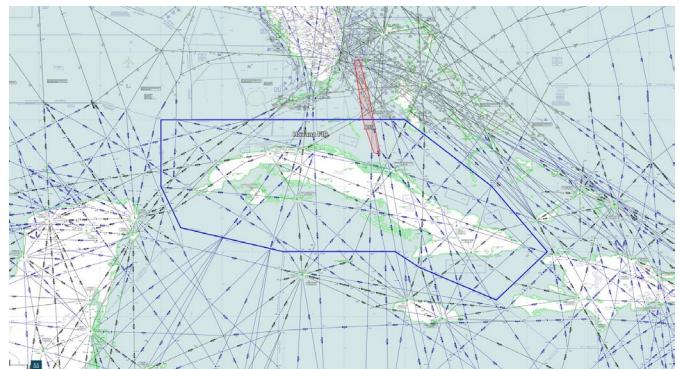


Figure 19 – Havana FIR

Cuba - MMUF FIR

A3889/25 NOTAMN

Q. MUFH/QRDXX/IV/BO/W/000/999/2107N07944W999
A. MUFH B. 2504020142 C. 2504080701
E. DANGER ZONE NOTICE DUE TO SPACE LAUNCH
FROM CABO CANAVERAL IN THE AREA 2400N7923W
2400N7901W 2258N7849W 2300N7901W 2356N7922W
DATES/TIMES:

PRIMARY: 2 APR 0142 TO 0701, BACKUP: 3 APR 0142
TO 0701, BACKUP: 4 APR 0142 TO 0701, BACKUP: 5 APR
0142 TO 0701, BACKUP: 6 APR 0142 TO 0701, BACKUP: 7
APR 0142 TO 0701, BACKUP: 8 APR 0142 TO 0701
F. SFC G. UNL

Figure 20 – Affected Fixes/Routes/Airspace

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.5 Johannesburg FIR (FAJO)

For planning purposes:

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace

Note: Operations to Antarctica between November and February must sometimes be considered.

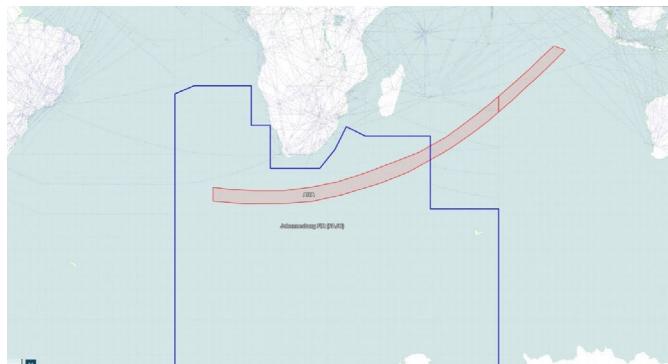


Figure 21 – Johannesburg FIRs

A1731/25 NOTAMN

Q. FAJO/QWMLW/IV/BO/W/000/999/5152S01651E999
A. FAJO B. 2505041045 C. 2505101316
D. 04 MAY 1045-1552, 05 MAY 1019-1526, 06 MAY 0953-1500, 07 MAY 0927-1434, 08 MAY 0901-1408, 09 MAY 0835-1342, 10 MAY 0809-1316
E. AREA BOUNDED BY (4256S 00224W, 4045S 00221W, 3210S 05700E, 3515S 05700E): SPACEX STARLINK 6-84 STAGE 2 ROCKET RE-ENTRY TAKING PLACE. APPLICABLE AIRSPACE DOWNGRADED TO CLASS G.
F. SFC G. UNL

B.6 Mauritius FIR (FIMM)

For planning purposes:

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace



Figure 22 – Mauritius FIR

A0120/25 NOTAMN

Q. FIMM/QRALW/IV/NBO/W/000/999/2530S06515E999
A. FIMM B. 2505041045 C. 2505101316 EST
D. 04 1045-1552
05 1019-1526
06 0953-1500
07 0927-1434
08 0901-1408
09 0835-1342
10 0809-1316
E. STATIONARY ALTITUDE RESERVATION FOR HAZARDOUS OPERATIONS FROM SFC TO UNL FOR ATMOSPHERIC RE-ENTRY AND SPLASHDOWN OF SPACE X STARLINK 6-84 ROCKET WI AN AREA BOUNDED BY FLW COORD:
3210S 05700E
3012S 06109E
2033S 07500E
2422S 07500E
3216S 06310E
3515S 05700E TO BEGINNING
PRIMARY RE-ENTRY BTN 1045 AND 1552 ON 04 MAY 2025. BACK UP RE-ENTRY BTN 05 MAY 2025 AND 10 MAY 2025 AS PER FIELD D.
F. SFC G. UNL

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.7 Melbourne FIR (YMMM)

For planning purposes:

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace
- In the southern portion of the FIR, low traffic volume airspace seven days a week, 24 hours a day



Figure 23 – Melbourne FIR

E1174/25 NOTAMN

Q. YMMM/QRDCA/IV/BO/W/000/999/1613S08242E750

A. YMMM

B. 2505041045 **C.** 2505101316

D. 2505041045 TO 2505041552

2505051019 TO 2505051526

2505060953 TO 2505061500

2505070927 TO 2505071434

2505080901 TO 2505081408

2505090835 TO 2505091342

2505100809 TO 2505101316

E. TEMPO DANGER AREA ACT DUE ROCKET LAUNCH

FLW RECEIVED FROM GOVERNMENT OF UNITED STATES OF AMERICA: HAZARDOUS OPS WILL BE CONDUCTED FOR ATMOSPHERIC RE-ENTRY AND SPLASHDOWN OF SPACEX STARLINK 6-84 STAGE 2 WI THE FOLLOWING AREAS: 2033S07500E, 0746S08927E, 0853S09228E, 2422S07500E TO BEGINNING.

F. SFC **G.** UNL

B.8 Mexico FIR (MMFR) and Mazatián Oceanic FIR (MMFO)

For planning purposes:

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace



Figure 24 – Mexico FIR

BO458/25 NOTAMR B0424/25

Q. MMFR/QRDCA/IV/BO/W/000/999

A. MMFR

B. 2504032254

C. 2504070216

D. 03 2254-0325, 04- 2232-0303, 05 2207-0238, 06 2145-0216

E. DANGEROUS AREA FOR REENTRY OF ROCKET LATERAL LIMIT AREA FORMED BY THE UNION OF THE FLW POINTS

30 51N 117 34W

30 53N 117 29W

30 57N 117 04W

30 05N 116 28W

29 42N 116 06W

29 18N 115 56W

28 58N 116 22W

29 12N 116 48W

29 32N 117 06W

30 27N 117 28W

30 51N 117 34W

MMFR

F. SFC **G.** UNL

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.9 Nassau FIR (MYNA)

High volume FIR 1200-1900 daily.

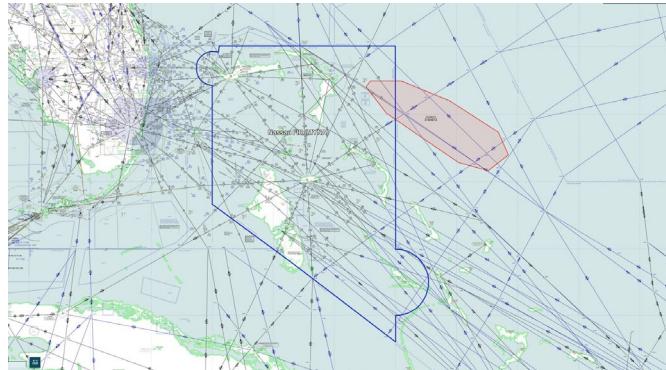


Figure 25 – Nassau FIR

A0237/25 NOTAMN

Q. MYNA/QRALW/IV/NBO/

W/000/060/2448N07725W010

A. MYNA

B. 2505040848 C. 2505071201

D. 04 0848-1319 05 0822-1253 06 0756-1227 07 0730-1201

E. AIRSPACE RESERVATION FOR EROP X2994 F9

STARLINK 6-84 WI COORD: 262400N0762900W
TO 262900N0762500W TO 263000N0760000W TO
255500N076000W TO 260100N0760900W TO POINT
OF ORIGIN. CTN SPACE LAUNCH/HAZARDOUS OPS
WITH POSSIBILITY OF FALLING SPACE DEBRIS.

F. SFC G. 6000FT AMSL

B.10 Tahiti FIR (NTTT)

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace

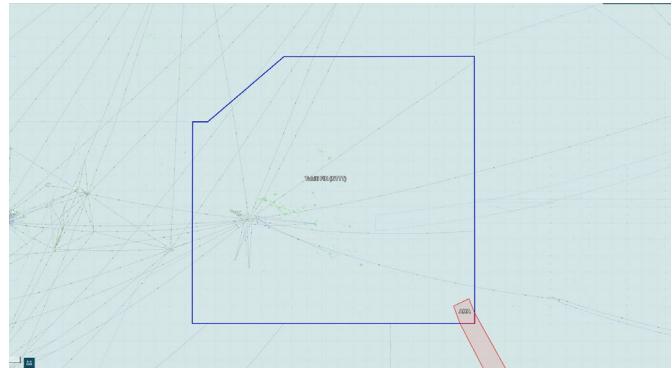


Figure 26 – Tahiti FIR

A0455/25 NOTAMN

Q. NTTT/QRDCA/IV/BO/W/000/999/2902S14933W120

A. NTTT

B. 2504210916 C. 2504270743

D. 21 0916-1002, 22 0853-0939, 23 0831-0917, 24 0805-0851, 25 0743-0829, 26 0720-0806, 27 0657-0743

E. TEMPORARY DANGEROUS AREA DUE TO
ATMOSPHERIC RE-ENTRY SPACEX CRS-32 UPPER
STAGE IN TAHITI FIR WITHIN AN AREA BOUNDED BY
FOLLOWING POINTS:

2746S 14845W - 2826S 14811W - 3000S 14953W - 3000S
15115W - 2746S 14845W - THIS ACTIVITY IMPACT NZZO
FIR AS WELL. AIRSPACE USERS ARE ADVISED OF
THE PARTICULARLY DANGEROUS NATURE OF THE
ACTIVITY AND ARE STRONGLY INVITED TO AVOID THE
AREA DURING THE ACTIVITY TIME SLOT. OPERATORS
ARE INVITED TO FILE THEIR FLIGHT PLAN WITH A
TRAJECTORY THAT ENSURES THAT THE AREA IS
CIRCUMNAVIGATED. THE FRENCH VERSION OF THIS
NOTAM IS C0921/25

F. SFC G. UNL

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.11 NO FIR (XX01)

ICAO has not delegated this airspace to a specific country. Ecuador issues the NOTAM for Space Ops for Second Stage Reentries; other ANSPs may issue NOTAMs for this airspace as well.

- Low traffic volume airspace seven days a week, 24 hours a day
- Low operational DANGER AREA impact airspace



Figure 27 – No FIR (a section of uncontrolled oceanic airspace in the eastern Pacific)

A0237/25 NOTAMN

Q. MYNA/QRALW/IV/NBO/W/000/060/2448N07725W010
A. MYNA
B. 2505040848 C. 2505071201
D. 04 0848-1319 05 0822-1253 06 0756-1227 07 0730-1201
E. AIRSPACE RESERVATION FOR EROP X2994 F9 STARLINK 6-84 WI COORD: 262400N0762900W TO 262900N0762500W TO 26300N0760000W TO 255500N076000W TO 260100N0760900W TO POINT OF ORIGIN. CTN SPACE LAUNCH/HAZARDOUS OPS WITH POSSIBILITY OF FALLING SPACE DEBRIS.
F. SFC G. 6000FT AMSL

NO FIR XX01

A1961/23 NOTAMN

Q. SEFG/QWWXX/IV/NBO/AW/000/999/0010S11654W272
A. SAXX B. 2309120826 C. 2309181129
D. SEP 12 0826-1248, SEP 13 0855-1317, SEP 14 0834-1255, SEP 15 0812-1234, SEP 16 0751-1212, SEP 17 0729-1151, SEP 18 0708-1129
E. FALCON 9 STARLINK 7-2 STAGE 2 REENTRY AND SPLASHDOWN IN THE UNASSIGNED FIR, SECT DELIMITED BY THE FOLLOWING COORD 0119S 11654W, 0010S 11516W, 1500S 10440W, 1500S 10724W, 0119S 11654W
F. SFC G. UNL

Appendix B. Examples of FIRs Frequently Impacted by STOs

B.12 Gander FIR (GZQX)

- The Gander Oceanic Control Area is international high seas airspace, delegated by ICAO to Canada to manage
- High volume airspace seven days a week, 24 hours a day
- Danger Areas are coordinated via Transport Canada and NAV CANADA
- Danger Areas significantly impact transoceanic long-haul traffic
- Avoid during peak volumes of 0130Z – 0430Z and 1100Z - 1500Z
- Even if the Danger Area is only in the Gander OCA FIR, routing impacts may affect Shanwick, Santa Maria, Reykjavik, Bodo, and New York FIRs

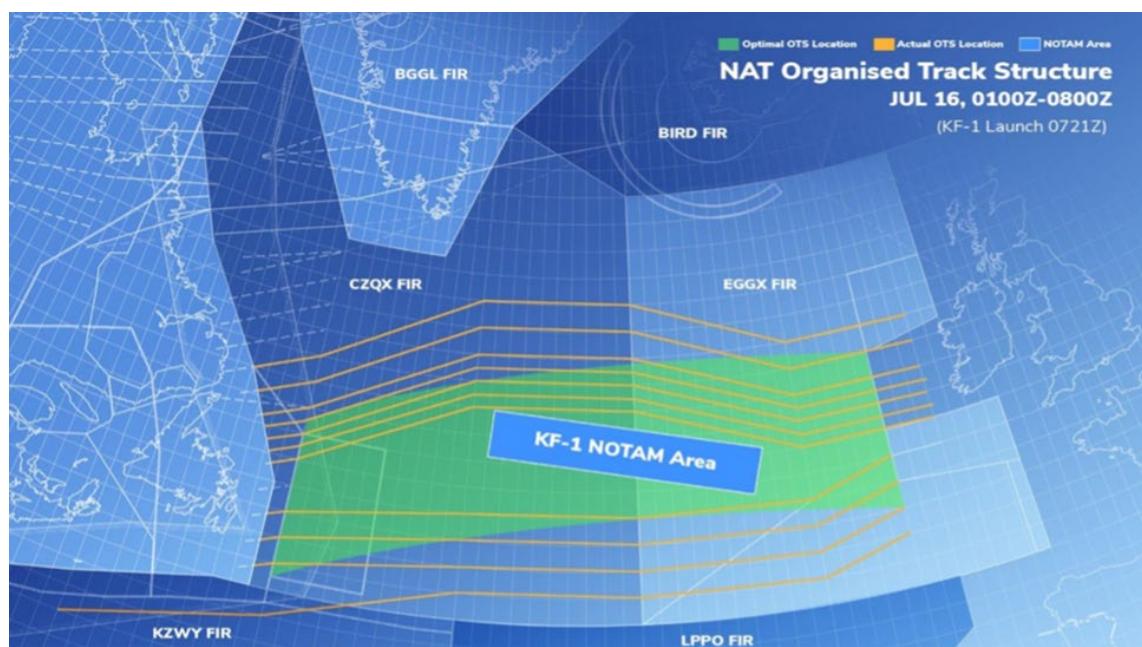


Figure 28 – Gander FIR

H3172/25 NOTAMN

- A. CZQX
- B. 2507160751
- C. 2507210721
- D. JUL 16 0751-0911, JUL 17 0731-0851, JUL 18 0711-0826, JUL 19 0651-0806, JUL 20 0626-0746, JUL 21 0606-0721
- E. DAH IS AMENDED AS FLW: CYD 796 GANDER FIR ROCKET HAZARD AREA IS ESTABLISHED AS FLW:

5220N 03756W

504400N 0232600W

495900N 0233800W

5135N 03809W

ACFT SHOULD REMAIN CLEAR OF AREA DUE TO DANGER FM FALLING DEBRIS FLW SEPARATIONS WILL BE PROVIDED WITHIN OCEANIC AIRSPACE: MNPS/NAT HIGH LEVEL AIRSPACE (HLA) 30 NM, NON-MNPS/NAT HLA 60NM

- F. SFC G. UNL

Appendix C. International Guidance Documents

North Atlantic Region

[Operational Guidance Material for Commercial Space Operations \(CSO\)](#)

Asia/Pacific Regional Guidance

[Asia Pacific Regional Guidance for Space Object Launch and Re-entry](#)

