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INTRODUCTION

6.1 Air traffic management (ATM) is the dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management – safely, economically and efficiently – through the provision of facilities and seamless services in collaboration with all parties.

6.2 Significant fuel and emissions savings can be realised by an efficient ATM system. To ensure the environmental and operational efficiency of air traffic management, the three basic elements of ATM should be addressed and optimised: airspace management, air traffic services and air traffic flow management. New and established technologies and concepts of operations in Communications, Navigation, and Surveillance (CNS), such as data link, Performance-based Navigation (PBN), Automatic Dependent Surveillance (ADS), flexible use of airspace and Advanced Collaborative Decision Making (CDM) can provide opportunities to improve the efficiency of ATM.

6.3 It is vitally important to match airspace planning initiatives with operational limitations and requirements. Airspace planners need to consider factors such as flight operational requirements, aircraft equipage, airspace capacity (including adjacent airspace sectors), location of adjacent airports and routes, interdependencies between arriving and departing traffic, areas of restricted airspace, runway capacities, terminal capacities, taxiway limitations, restrictive terrain and any local or regional environmental regulations or procedures. Each of these areas can influence the effectiveness of air traffic management and the resultant environmental impacts of aircraft operations. It should be noted that operational efficiency solutions in one phase of flight should be balanced with possible greater inefficiencies in another flight-phase. ATM procedures and measures must be considered by all operational stakeholders, including the civil and military aviation authorities, air navigation service providers, air traffic controllers, pilots and aircraft operators.

6.4 This Chapter describes both the current opportunities and the strategic work underway to improve the efficiency of the global ATM system with the aim of reducing fuel consumption and related gaseous emissions. In each phase of flight, the opportunities and challenges for achieving fuel-optimised operations are described, including practical initiatives that can be taken locally. Bench marking is highlighted as a means for identifying and prioritising fuel savings and environmental performance improvements. The appendix to this Chapter gives information on two major regional programmes – NextGen in the United States and SESAR and the flight efficiency plan in Europe that are focussing on improving safety, capacity, fuel consumption and environmental impact. They are aligned with the Global Air Navigation Plan (Doc 9750), which was developed in consideration of the ICAO Global ATM Operational Concept and the Strategic Objectives of ICAO. In combination, these plans and programs provide the basis for an industry roadmap to ensure that focused efforts will lead to near and medium-term benefits. New initiatives will be added to the Global Plan as technologies mature and the supporting provisions are developed.

6.5 Other Chapters, particularly Airport Operations (Chapter2), Flight/Route Planning (Chapter 8), Take-off & Climb (Chapter 9), Cruise (Chapter 10) and Descent & Landing (Chapter 11), provide more details on other operational issues addressed in this Chapter.

STRATEGIC APPROACH

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6.6 A good principle, subject to the operational limitations mentioned above, for enhancing safety, efficiency and environmental benefits of air traffic management is:

a) Where capacity is inadequate (airspace/airports), pursue operational procedures and techniques designed for maximum capacity and efficiency. This may require extra track miles to be flown, but efficient throughput will have greater environmental benefits over procedures designed for maximum fuel efficiency of individual flights; and
b) Where capacity is not an issue, such as low-density airspace (defined geographically or by time), pursue air traffic procedures designed for maximum fuel efficiency (least track miles, continuous descent and climb profiles, etc.).

6.7 Although a perfect ATM system is a desirable goal, in reality, many aircraft compete for the best profiles in limited volumes of airspace. Fuel-optimised four-dimensional trajectories of aircraft unconstrained by the ATM system are shown on Figure 6.1.b. These profiles define the minimum volume of fuel that must be burned for a given aircraft to fly for a particular distance and an example of how they may compare to a more traditional profile, Figure 6.1.a. Note these diagrams are a simplification and generalisation of the traditional and optimal profiles shapes.

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Figure 6.1 a)

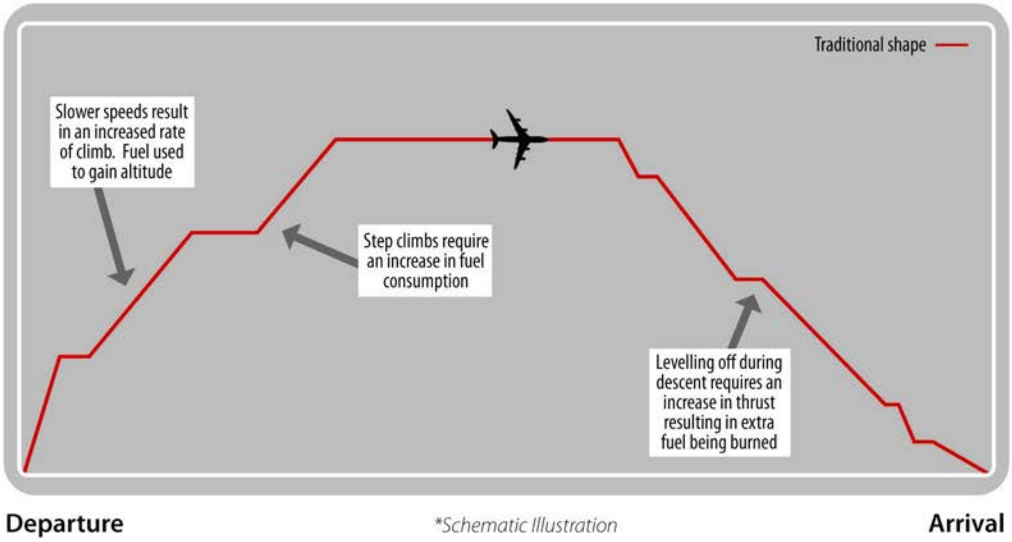

Figure 6.1 b)

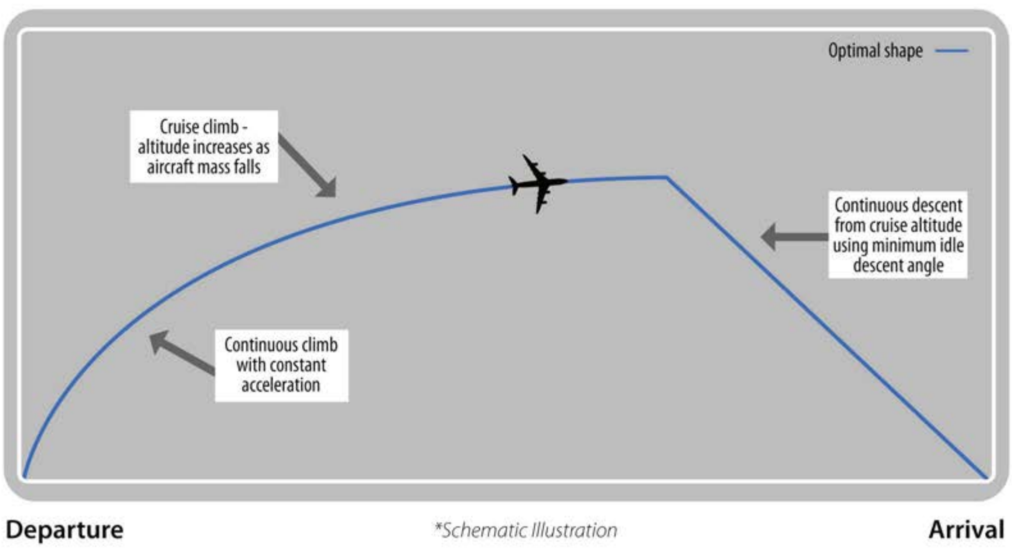

Figure 6.1 Flight Profiles

6.8 Specific details of a particular fuel-optimised profile are highly dependent upon the aircraft type and the distance flown; however the diagram above gives an indication of the nature of an optimised profile that would increase fuel efficiency and hence reduce the CO_2 emissions.

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6.9 Improved fuel efficiency can be achieved through improved aircraft energy management, which relies on the aircraft constantly changing speed and altitude. It is recognized that aircraft may not fly these trajectories for a number reasons, including the provision of safe separation, the existence of restricted airspace, delay management, and weather avoidance. However, reference to these profiles for comparison with current performance allows the identification of potential areas for improvement in fuel efficiency.

AIR NAVIGATION SERVICES

6.10 Airspace design that takes advantage of Area Navigation (RNAV) and Required Navigation Performance (RNP) capabilities of Performance-based Navigation (PBN) with an objective to allow unrestricted climbs and descents will maximise the environmental benefits of aircraft operations.

6.11 In all of the examples listed below, consideration should be given to the work already underway at the regional and global levels when operational improvements are being determined, and efforts should be made to integrate the national or local efforts with the wider implementation activities. Air navigation services should consider the following:

a) **Air routes – general principles**

i) Routes defined by navigating from navaid to navaid are usually the most environmentally inefficient means of navigation. RNAV and RNP routes represent greater fuel savings in a fixed route environment. The *Performance-based Navigation (PBN) Manual* (Doc 9613) provides the concept and definition of PBN, as well as guidance on its implementation. In areas of low-density traffic, published flexible tracks that take forecast upper winds into consideration or allowing the operations at user preferred routes (UPRs) based on their specific operational and legal requirements, e.g. winds, temperature, availability of en-route alternate airports, etc., represent the greatest potential in fuel and environmental savings. As an example, the implementation of UPR's in the South Pacific between the United States and Australasia has demonstrated a reduction of CO_2 emissions of 3100-3700 kg per flight.

ii) In areas of high-density traffic, closely spaced unidirectional parallel tracks expand the capacity and allow aircraft to operate at more fuel-efficient altitudes. However, airspace planners must be able to address how to segregate or manage crossing traffic flows when determining if all altitudes can be made available to the unidirectional traffic flows.

b) **Air route lengths and dimensions**

Straight "great circle" routes usually provide the best fuel savings for short haul routes that are less than 1000 nm between departure and destination. However, for longer routes, the upper winds determine the routing for minimum fuel consumption. For city pair distances that are further apart, the variance on what comprises the most fuel efficient route of flight also increases, and varies seasonally as well as daily based on the fluctuating upper wind patterns. It is not uncommon for the minimum fuel burn track for a 12-hour flight to deviate geographically by more than 1000 nm from the "straight" great circle track. For example, a one-year study of the most fuel-efficient user preferred routes for a westbound city-pair of Los Angeles to Hong Kong revealed a 2700 nm difference between the northernmost track and the southernmost track. At no time was the "shorter" great circle track the most fuel efficient route.

c) **Wind Effects**

Aircraft generally want to fly routes and altitudes that avoid prevailing headwinds or take advantage of prevailing tailwinds. For example, the best route of flight for a westbound flight between San Francisco and Tokyo will be significantly different from the eastbound route that seeks to ride the prevailing westerly tailwinds. See Figure 6.2. Therefore, operators flying long haul routes will need numerous routing options to meet the operational and legal requirements that vary from day to day.

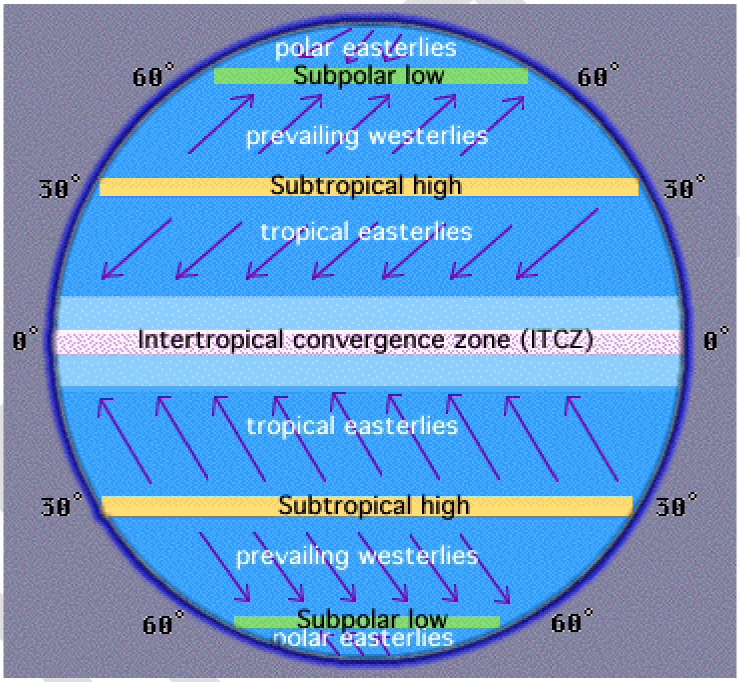

Figure 6.2 Wind Effects

d) **Standard Instrument Departures (SIDs) and Standard Instrument Arrivals (STARs)**

Aircraft routings during climb out and descent are in a critical phase of flight in terms of fuel consumption and CO_2 emissions. Consequently, SIDs and STARs that consider aircraft operational performance and ATC separation criteria offer tangible fuel savings and consequential environmental benefits. They should be designed using the ICAO criteria. Best practices for environmental savings incorporate RNAV or RNP SIDs and STARs that join anchor points for UPRs or published airways and routes for a truly integrated system.

e) **Civil and military airspace**

In continental airspace and even near international airports, it is sometimes difficult to navigate off a fixed track or route due to the location and differing requirements for special use airspace. Civil and military authorities and Air Navigation Service Providers should establish a mechanism that allows coordination and facilitates a more flexible use of the airspace and enables more efficient airspace sharing.

f) **Establishing local forums to improve the efficiency of air traffic operations**

Opportunities to reduce fuel consumption and environment impacts and increase the safety and efficiency of air traffic operations can be identified through collaboration among all operational stakeholders. Since air traffic operations at any airport are unique to local conditions, circumstances and limitations, enhancements can be achieved by the establishment of local forums that allow all stakeholders to assess and understand the airspace and its constraints and explore what can be done to improve the safety and efficiency of air traffic management. Areas to consider include:

i) Allowing departures to takeoff in the direction of flight. Airborne fuel flow is 6 times higher than ground idle, i.e. 18 minutes taxi equals 3 minutes of airborne operation;
ii) Allowing early arriving flights to slow down to prevent gate holds and ramp congestion;
iii) Providing opportunities for authorized aircraft to execute rolling take-offs;
iv) Allowing cruise climbs; block clearances or step climbs in oceanic and remote airspace;
v) Allowing flexible flight planning so that airlines can plan routes and entry/exit points based on the best operational conditions, such as upper wind conditions;
vi) Educating controllers on the operational impact of optimum cruising levels. For example, a long haul flight burns about 140 kg extra fuel per hour if it flies 2000 feet below optimum altitude and about 450 kg extra fuel per hour if 4000 feet below optimum level. At 8000 feet below optimum cruising level the fuel penalty is about 1200 kg extra fuel burned; and
vii) Providing tactical routing or altitude options to pilots, such as offering a small departure delay or alternate routing as an alternative to a penalising en-route altitude. This may result in a significant fuel savings and emissions reduction, especially for long haul flights that may be restricted for hours at an inefficient cruising altitude.

BEST PRACTICES FOR ENVIRONMENTALLY FRIENDLY AIR TRAFFIC SERVICES

6.12 The following information and checklists provide examples of areas where current air traffic services can be evaluated against generally accepted best practices available today for the provision of environmentally friendly air traffic services:

On Ground/At the Airport

6.13 The airport is critical to ATM efficiency and has the potential to contribute significantly to reducing delays and fuel consumption, and therefore, CO_2 emissions. In searching for fuel consumption

and emissions savings, it is critical to analyse the use of an airport's assets (runways, stands, taxiways and tugs, etc.) to ensure a balance between operational and environmental needs. Technology offers the opportunity to progress the continuous improvement of ATM like the introduction of Collaborative Decision Making (CDM) processes, which brings together all airport data and shares it with all stakeholders. The use of CDM can improve the efficiency of ground operations at an airport and deliver fuel and emissions savings and can also contribute to significant savings in the departure, en-route and arrival phases of flight. By acting collaboratively, airspace users, airport and ATM stakeholders can absorb known delays by holding aircraft on the ground rather than in the air, where delay or inefficiency leads to higher fuel burn penalties.
In particular:

a) At the departure gate/stand: ATC should keep flight crews informed of pushback and departure delays. This allows them to use the most efficient ground power source;
b) If traffic permits, consider gate holds instead of taxi-holds;
c) Early notification of departure sequence, e.g. “you are number 3 for take-off’’, allows the flight crew to safely and efficiently start an engine(s) shut down during taxi, reducing fuel consumption and possibly reducing taxiway congestion caused by a late engine start or checklist completion;
d) To the extent possible, arrange tactical ground aircraft movements and give timely taxi clearances which allow for uninterrupted taxiing and will avoid stop-starts of aircraft;
f) Prioritize moving aircraft to ground vehicles;
g) Consider a marginally longer taxi to allow aircraft to depart on a runway more aligned with its direction of flight;
h) If possible and authorized, allow rolling take-offs;
i) Offer or authorize optimized climb speeds; and
j) Cancel inefficient SID’s as soon as feasible.

Departure

6.14 Departure is a critical phase of flight as aircraft can be at their maximum weight. It is particularly important for heavy wake turbulence category aircraft. Consequently, any restrictions on the aircraft’s climb-out to an optimum en-route cruising level will increase fuel burn and emissions.

6.15 A full load of fuel means the aircraft is heavier and has to burn more to climb. This phase of flight is therefore important in terms of optimisation - any efforts to reduce inefficiency will result in proportionately greater fuel and emissions savings. As the demand for aviation has grown, airspace around airports has typically become busier, resulting in increased complexity in airspace terms. In order to manage this complexity, airspace design has focused on ensuring that traffic flows are strategically de-conflicted by using additional track miles and periods of level flight for climbing and descending aircraft. This compromise means aircraft often climb in a series of steps separated by periods of level flight to keep them separated from arrival traffic flows and aircraft from other airports. If departures are required to level off at low altitudes or climb at a speed below what is operationally efficient, the pilots must employ flap settings that increase drag. Such flap settings require additional thrust to maintain operational control of the aircraft, which increases fuel burn and CO_2 emissions. One potential ATM solution in the climb phase is to seek to ensure that an aircraft is able to conduct an optimum continuous climb from the runway to cruise altitude. Airspace design to strategically de-conflict arrival and departure flows can facilitate better achievement of continuous climb procedures and therefore delivers better fuel burn performance.

6.16 In the departure phase, there may be significant trade-offs between providing noise relief and emissions reductions. Noise abatement procedures were first developed in the 1960's in response to the widespread introduction of the first generation of turbojet air carrier aircraft. Since then, through the evolution of new engine technologies and ICAO noise standards, there has been considerable reduction in source noise. As a consequence, the noise footprints of new jet aircraft are significantly smaller than those of the early generation jet aircraft they replaced.

6.17 Noise abatement procedures may come at the expense of additional fuel burn. The ICAO Standard for noise abatement (Annex 16, Vol 1, Part V) states, "a*ircraft operating procedures for noise abatement shall not be introduced unless the regulatory authority, based on appropriate studies and consultation, determines that a noise problem exists*". Additionally "*aircraft operating procedures for noise abatement should be developed in consultation with the operators which use the aerodrome concerned*". Civil Aviation Authorities should routinely review noise abatement departure procedures and discontinue noise abatement procedures where they are not justified.

6.18 The need to avoid noise sensitive areas at low altitudes can lead to extra track mileage and fuel burn in the TMA. There is potential for RNAV departure routes to optimise the noise performance of departing aircraft while simultaneously reducing flight track miles at lower altitudes. They have the potential to allow aircraft to optimise fuel uplift. Carrying extra contingency fuel can significantly affect the weight of the aircraft and therefore its fuel burn performance. Airline industry flight planning tools are increasingly tuned to reduce carriage of extra fuel. Shorter RNAV routes can enable less fuel to be carried.

En-route Operations

6.19 The aircraft cruise performance varies, depending on factors such as weight, range, wind and weather conditions and airspace characteristics. Modern onboard flight management systems can determine the most efficient cruise altitude and speed to optimise fuel burn. ATM can assist in this process by providing capacity in the en-route phase of flight that offers aircraft the cruise levels and speeds they request.

6.20 Further efficiency gains are also enabled when ATM offers aircraft routing or altitude changes to take advantage of favourable wind conditions.

6.21 As aircraft approach the end of their en-route phase of flight (top of descent), ATM can potentially offer improved streaming to enable continuous descents and required times of arrival (RTA) to improve the efficiency of flows and reduce holdings.

Specific actions include:

a) Allow cruise or stepped climbs at pilot discretion where traffic permits;
b) Offer higher altitudes when available, even when not requested by the pilot;
c) Approve speed variances when requested;
d) Cancel speed restrictions when no longer required;
e) Offer direct or wind optimised routes where available; and
f) If a coordination mechanism is in place, offer direct routing through military airspace when not in use.

Descent

6.22 Opportunities for reductions in fuel burn and emissions in the descent phase through ATM facilitation include delaying the aircraft's descent from cruise, where fuel burn rates are more optimal and the use of sophisticated arrivals management tools to better sequence and flow aircraft to minimize holdings. To achieve overall flight efficiency in the descent phase, a balance should be struck between expediting traffic, meeting airport capacity, and reducing flight times and distances, fuel burn, emissions and noise within the overall requirement for safe operations.

6.23 When considering any solutions described for descent, it should be noted that these measures should not introduce or increase inefficiencies in another flight-phase. Examples include interdependencies:

- between climbing and descending aircraft (e.g. interference with continuous departure procedures);
- with other simultaneous descent operations; and
- with operations using adjacent airspace or airports.

6.24 Continuous descent operations ideally from cruise flight levels, offer the opportunity for significant fuel savings, reduced emissions, quieter operations, as well as improved safety. The optimum vertical profile takes the form of a continuously descending path, with a minimum of level flight segments only as needed to decelerate and configure the aircraft, or to establish the aircraft on the final approach segment. It should be tailored to the operating capability of the aircraft, with low engine thrust settings and, where possible, a low drag configuration. Aided by appropriate airspace and procedure design, air traffic control (ATC) clearances will enable the execution of a continuous descent. Ideally, ATC should refrain from tactical interference in the lateral and vertical flight path during the execution of a continuous descent. When vectoring is unavoidable, providing timely and accurate distance-to-go information to the pilot will facilitate resumption or continuation of an optimum descent profile to the extent possible. A continuous descent can save 150-600 kg of CO_2 per arrival. If a STAR or instrument approach procedure does not specify a continuous descent, the same reduction of CO_2 emissions can result, if the controller can authorize a descent clearance at the pilot's discretion, or provides a predictable flight path with distance-to-go information to the pilot, again allowing descent in a fuel-efficient profile.

6.25 Particular actions to minimise fuel use during descent include:

a) For sequencing, if possible, offer speed control as far out as possible in lieu of radar vectoring;
b) Allow 'path-stretching' in lieu of holding, where possible;
c) Allow continuous descent to the initial approach fix;
d) Use RNAV/RNP STARs that have been designed for continuous descent;
e) When traffic permits, allow pilot discretion descents, ideally from the top of descent;
f) Avoid late descent clearances, as height energy must be dissipated with drag; and
g) Minimize holding at low altitude and provide pilots with realistic holding times.

Landing

6.26 For landing, the following should be considered:

a) Provide advance taxi information to allow pilots to plan for fuel savings techniques with respect to the landing roll;

b) Publish coded taxi route instructions for efficient runway exit and reduced ATC radiotelephony;
c) If possible assign the runway that is closest to the passenger terminal and minimizes taxi time; and
d) Clear to vacate the runway via a high speed taxiway.

EVOLUTION TO A GLOBALLY HARMONIZED PERFORMANCE BASED SYSTEM

6.27 Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems are known for the benefits they have delivered to civil aviation in past years. As CNS systems continue to evolve they serve as key enablers in delivering to the aviation community a paradigm shift from an environment of Air Traffic Control (ATC) to that of Global Air Traffic Management (ATM).

6.28 The Global Air Traffic Management System is transitioning from a technology-based system to one driven by the provision of services. These services are based on the expectations and performance requirements of the aviation community as a whole. Such performance requirements are enabled by appropriate technologies, which in turn allow it to achieve the interoperability and seamlessness across all regions in order to meet safety and efficiency benchmarks during all phases of flight. As aviation is a global system, it is crucial that requirements and enablers support a global framework that is safe, efficient and environmentally responsible.

6.29 The global ATM community continues to stride towards implementing a system under a Transition Strategy through each of its stages of implementation, each of which delivers incremental benefits to the ATM System and to the environment. See Figure 6.3.

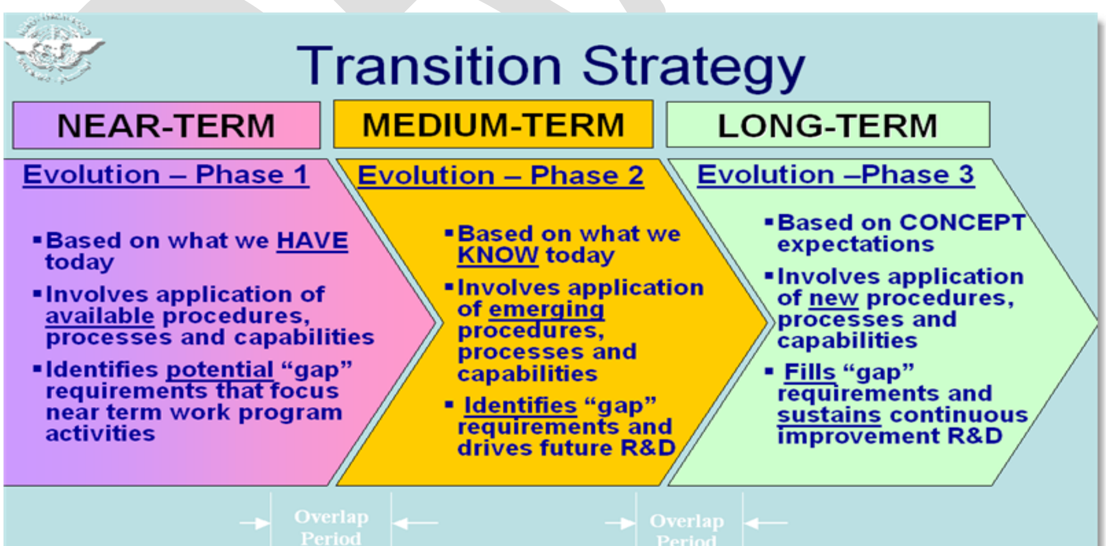

Figure 6.3 Transition strategy

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6.30 Owing to the many unique and diverse regional requirements, ICAO promotes regional implementation plans that fall within the global planning framework but are selectively prioritized and deliver benefits at the local and regional level, under the principle of 'Thinking Globally, Implementing Regionally".

6.31 The ICAO Global Air Traffic Management Operational Concept (Doc. 9854) and the Global Air Navigation Plan (Doc. 9750) provide the guiding principles for States and ICAO Planning and Implementation Regional Groups (PIRG's) to improve the safety, efficiency and capacity of their ATM systems with the related environmental benefits. Other documents that support implementation planning activities include the *Manual on Air Traffic Management System Requirements (Doc 9882),* which converts the overall vision of the operational concept into material specifying the functional evolution of ATM, and the *Manual on Global Performance of the Air Navigation System* (Doc 9883) which provides a broad overview of the tasks that need to be undertaken to transition to such a system and gives guidance on how to establish a performance based approach to planning of facilities and services.

6.32 Regional Planning, Implementation and Management Programs are designed around near term, medium term and long-term objectives based on a clearly established and agreed transition strategy. For regional planning and implementation processes to remain effective, States and service providers work closely with airspace users as stakeholders in the value chain. For this purpose, ICAO has embedded the strategic planning principles as applicable to each region under a unique Regional Air Navigation Plan.

THE GLOBAL PLAN INITIATIVES

6.33 The ICAO Global Air Navigation Plan provides the blueprint for an efficient ATM System. The Global Plan Initiatives (GPI's) as well as the transition strategy contained therein, provide the best path to achieve this objective. An abbreviated form of these GPI's is presented in Table 6.1. These principles must be considered when implementing local solutions, in order to ensure specific benefits do not stymie those that can be achieved through the macro benefits of a global ATM.

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Table 6.1. Global plan initiatives and their relationships to the major groupings

GPI		**En-route**	**Terminal Area**	**Aerodrome**	**Supporting Infrastructure**
GPI-1	Flexible use of airspace	X	X		
GPI-2	Reduced vertical separation minima	X			
GPI-3	Harmonization of level systems	X			
GPI-4	Alignment of upper airspace classifications	X			
GPI-5	RNAV and RNP (Performance-based navigation)	X	X	X	
GPI-6	Air traffic flow management	X	X	X	
GPI-7	Dynamic and flexible ATS route management	X	X		
GPI-8	Collaborative airspace design and management	X	X		
GPI-9	Situational awareness	X	X	X	X
GPI-10	Terminal area design and management		X		
GPI-11	RNP and RNAV SIDs and STARs	X	X		
GPI-12	Functional integration of ground systems with airborne systems		X		X
GPI-13	Aerodrome design and management			X	
GPI-14	Runway operations			X	
GPI-15	Match IMC and VMC operating capacity		X	X	X
GPI-16	Decision support systems and alerting systems	X	X	X	X
GPI-17	Data link applications	X	X	X	X
GPI-18	Aeronautical information	X	X	X	X
GPI-19	Meteorological systems	X	X	X	X
GPI-20	World Geodetic System-84 (WGS-84)	X	X	X	X
GPI-21	Navigation systems	X	X	X	X
GPI-	Communication	X	X	X	X

22	infrastructure				
GPI-23	Aeronautical radio spectrum	X	X	X	X

BENCHMARKING

6.34 An important step in the improvement of fuel and emissions efficiency of the Global ATM system is the development of a clear understanding of the current level of efficiency in the system. From that point, opportunities for improvement can be highlighted and addressed using the operational opportunities for improvement described by phase of flight.

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APPENDIX

REGIONAL PROGRAMMES

1. Europe's Flight Efficiency Plan

1.1 The Flight Efficiency Plan is a joint initiative launched by Eurocontrol, IATA and CANSO in September 2008 to drive immediate efficiency improvements. The five action points of the Flight Efficiency Plan are:

a. Enhancing European en-route airspace design through annual improvements of European ATS route network, high priority being given to:

- Implementation of a coherent package of annual improvements and shorter routes;
- Improving efficiency for the most mileage and altitude penalized city pairs;
- Implementation of additional Conditional Routes (to enable better use of military airspace) for main traffic flows;
- Supporting initial implementation of free route airspace - allowing aircraft to route more directly on point to point routes.

b. Improving airspace utilization and route network availability through:

- Actively support and involve aircraft operators and the computer flight plan service providers in flight plan quality improvements ;
- Gradually applying route availability restrictions only where and when required;
- Improving the utilization of civil/military airspace structures.

c. Efficient terminal manoeuvring area design and utilization, through:

- Implementing advanced navigation capabilities (such as Area Navigation (RNAV))
- Implementing Continuous Descent Approaches (CDAs), improved arrival/departure routes, and optimized departure profiles.

d. Optimizing airport operations, through:

- Implementation of Airport Collaborative Decision Making.

e. Improving awareness on performance

1.2 The implementation of the improvements is expected to bring benefits of approximately 0.5 million tonnes of fuel bum (1.5 million tonnes of CO_2) per year, which equates to just over 1 % improvement over the 2005 baseline for Europe.

2. Europe's SESAR Programme

2.1 The Single European Sky Air Traffic Management Research programme, SESAR, is the European Union's €30 billion air traffic management modernization programme. The current patchwork of 35 air traffic control organizations are based largely on national borders; through the SESAR programme this pattern will be replaced by 'functional airspace blocks' based on operational requirements - in particular, traffic flows. SESAR aims at developing the new generation air traffic management system capable of ensuring the safety and fluidity of air transport worldwide over the next 30 years.

2.2 The SESAR Consortium joins the forces and expertise of 29 companies and organizations together with 20 associated partners. It includes airspace users, airports, air navigation services providers, the supply industry, safety regulators, military, pilot & controller associations and research centres, as well as expertise from EUROCONTROL. SESAR will have some overlap with the initiatives highlighted in the Flight Efficiency Plan above.

2.3 SESAR is a performance-driven programme designed to ensure sustainable air transport system development in Europe. By 2020 the aim is to bring about a threefold increase in capacity, to improve safety by a factor of 10 and to reduce by 10% the environmental impact per flight while cutting ATM-related costs by 50%.

2.4 The European Commission estimates that implementation of SESAR could save 16 million tones of CO_2 a year through more efficient air traffic control, shorter routings and fewer delays. This equates to a reduction of approximately 5 million tonnes of fuel burn per annum.

3. The SESAR Implementation plan

3.1 The aim of SESAR is to improve air traffic services resulting in flight operations which are better optimized. The latter has been translated into the following SESAR performance objectives:

- Achieve emission improvements as an automatic consequence of the reduction of gate-to-gate excess fuel consumption addressed in the KPA Efficiency. The SESAR target for 2020 is to achieve 10% fuel savings per flight as a result of ATM improvements alone, thereby enabling a 10% reduction of CO_2 emissions per flight;
- Improve the management of noise emissions and their impacts to ensure that these are minimized for each flight to the greatest extent possible;
- Improve the role of ATM in enforcing local environmental rules: ensure that flight operations comply 100% with aircraft type restrictions, night movement bans, noise routes, noise quotas, etc. Ensure that exceptions are only allowed for safety or security reasons;
- Improve the role of ATM in developing environmental rules: The aim is to ensure that all proposed environmentally related ATM constraints will be subject to a transparent assessment with an environment and socio-economic scope; and, following this assessment the best alternative solutions from a European Sustainability perspective are adopted.

3.2 More information about SESAR can be found at http://www.sesarju.eu/

4. USA's FAA Flight Plan

4.1 The FAA's Flight Plan is the strategic plan for the agency, and includes discussion of the US Next Generation Air Transportation System (NextGen) initiative, which is described below. The Flight Plan includes four goal areas: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence. Under the Greater Capacity goal, there are three objectives, including one related directly to the environment: "Address environmental issues associated with capacity enhancements."

4.2 The objective has two Performance Targets:

- Reduce the number of people exposed to significant noise by 4 percent per year through FY 2013, as measured by a three-year moving average, from the three-year average for calendar years 2000-2002; and
- Improve aviation fuel efficiency by another 1 percent over the FY 2008 level (for a total of 7 percent) through FY 2009, and 1 percent each subsequent year through FY 2013 to 11 percent, as measured by a three-year moving average of the fuel burned per revenue mile flown, from the three-year average for calendar years 2000-2002.

5. USA's NextGen Programme

5.1 The Next Generation Air Transportation System (NextGen) represents a comprehensive transformation and evolution of the U.S. air transportation infrastructure by the year 2025, as well as how the infrastructure is developed, operated and maintained. NextGen is a wide-ranging transformation of the entire national air transportation system to meet future demand and support the economic viability of the system while improving safety and protecting the environment. It is a unique coalition of government agencies and private sector partners, with the Federal Aviation Administration (FAA) managing the work.

5.2 To describe the transformation to NextGen, there are nine functional areas, listed below. A key element of NextGen is that it will replace ground-based technologies with new and more dynamic satellite based technology.

- Trajectory and Performance-Based Operations and Support
- Airport Operations and Support
- Safety Management
- Layered Adaptive Security
- Environmental Management Framework
- Weather Information Services
- Net-Centric Infrastructure
- Positioning, Navigation and Timing Services
- Surveillance Services

5.3 Since environmental constraints could limit system capacity, one of the primary strategies of the NextGen Integrated Plan is to develop environmental protection that allows sustained aviation growth. The NextGen vision includes the management of critical environmental resources and impacts through the Environmental Management Framework (EMF) functional area that is fully integrated into all NextGen operations. The EMF is an overall strategy designed to balance aviation operational growth with environmental protection goals to achieve a sustainable air transportation system. Objectives of the NextGen EMF include:

- Reduce significant community noise and air quality emissions impacts in absolute terms
- Limit or reduce the impact of aviation greenhouse gas emissions on global climate including the rate of fuel consumption
- Improve energy efficiency of air traffic operations
- Support alternative fuels development
- Proactively address other environmental issues.

DISCLAIMER - This document forms the basis of a new manual which will update the corresponding information in the existing ICAO Circular 303. It may be refined when incorporated into the final manual.

5.4 To help achieve these goals, the NextGen EMF promotes the development of a national Environmental Management System (EMS) approach. EMS includes a management process to help users systematically identify, manage, monitor, and adapt to the environmental demands associated with the high volume and dynamic nature of the air transportation system. The national EMS approach is intended to facilitate an effective and common process that is adopted by all applicable U.S. aviation organizations, and therefore provides a mechanism for integrating environmental protection objectives into the core business and operational decision making of NextGen. While EMF provides the overarching strategy needed to achieve environmentally sustainable aviation growth, EMS delivers a management process for achieving environmental protection in user actions.

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