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Agenda Item 1 **General Matters**
1.3 Analysis of ICAO and GREPECAS guidance on global, inter and intra-regional air navigation activities

EVOLUTION TO THE GLOBAL AIR NAVIGATION PLAN INITIATIVES

(Presented by the Secretariat)

1. Introduction

1.1 ICAO works to achieve its vision of efficiency, secure and sustainable development of civil aviation through cooperation amongst its member States.

1.2 The Global Air Navigation Plan (Doc 9750 – AN/963), presents twenty three strategy initiatives as a near and medium term vision, in order to harmonize the air navigation regional work which is presented in the **Appendix** to this note.

1.3 The second amendment of the Global Air Navigation Plan will be published during 2007, with the revised version of the twenty three Global Plan Initiatives

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APPENDIX

EVOLUTION TO GLOBAL PLAN INITIATIVES

INTRODUCTION

1.1 This chapter of the Global Plan describes a strategy aimed at achieving near and medium term ATM benefits on the basis of available and foreseen aircraft capabilities and ATM infrastructure. It contains guidance on ATM improvements necessary to support a uniform transition to the ATM system envisioned in the global ATM operational concept (Doc 9854). The operational concept presents the ICAO vision of an integrated, harmonized and globally interoperable ATM system. A global ATM system can be described as a worldwide system that, on a global basis, achieves interoperability and seamlessness across regions for all users during all phases of flight; meets agreed levels of safety; provides for optimum economic operations; is environmentally sustainable; and meets national security requirements.

1.2 There are many ways to present a transition map and it would be difficult to address all aspects of ATM transition in one presentation. Therefore, the Global Plan focuses on one perspective, which is the operational and technical improvements that will bring near and medium term benefits to aircraft operators. Long term initiatives, necessary to guide the evolution to a global ATM system as envisioned in the operational concept, will be added to the Global Plan as they are developed and agreed to.

1.3 On the basis of the above, planning will be focused on a set of “Global Plan Initiatives” (“initiatives”). Initiatives are options for ATM improvements that when implemented, result in direct performance enhancements. States and regions should choose initiatives that meet performance objectives, identified through an analytical process, specific to the particular needs of a State, region, homogeneous ATM area or major traffic flow. Planning tools will assist with the analytical process.

PLANNING PROCESS

Achieving a global ATM system

1.4 The basis for developing a global ATM system is an agreed-to structure of homogeneous ATM areas and major traffic flows/routing areas. These areas and flows tie together the various elements of the worldwide aviation infrastructure into a global system. Appendix I contains the Homogeneous ATM areas and major traffic flows/routing areas as identified by the PIRGs. Further identification, update and analyses of these areas and traffic flows are carried out by PIRGs on an ongoing basis, in collaboration with the aircraft operators, reflecting the latter’s requirements. For an up-to-date version of the major traffic flows or homogeneous ATM areas in any particular region, refer to relevant ICAO regional offices.

Homogeneous ATM area

1.5 A homogeneous ATM area is an airspace with a common ATM interest, based on similar characteristics of traffic density, complexity, air navigation system infrastructure requirements or other specified considerations wherein a common detailed plan will foster the implementation of interoperable ATM systems. Homogeneous ATM areas may extend over States, specific portions of States, or groupings of States. They may also extend over large oceanic and continental areas. They are considered areas of shared interest and requirements.

1.6 The method of identifying homogeneous ATM areas involves consideration of the varying degrees of complexity and diversity of the worldwide air navigation infrastructure. Based on these considerations, planning could best be achieved, at the global level, if it were organized based on ATM areas of common requirements and interest, taking into account traffic density and the level of sophistication required.

Major traffic flows/routing areas

1.7 A major traffic flow refers to a concentration of significant volumes of air traffic on the same or proximate flight trajectories. Major traffic flows may cross several homogeneous ATM areas with different characteristics.

1.8 A routing area encompasses one or more major traffic flows, defined for the purpose of developing a detailed plan for the implementation of ATM systems and procedures. A routing area may cross several homogeneous ATM areas with different characteristics. A routing area specifies common interests and requirements among underlying homogeneous areas, for which a detailed plan for the implementation of ATM systems and procedures either for airspace or aircraft will be specified.

1.9 The basic planning parameter is the number of aircraft movements that must be provided with ATM services. Estimates and forecasts of annual aircraft movements over the planning period are required for high-level planning. The capabilities of the aircraft population are also important planning parameters that must be identified for the planning process. Forecasts of aircraft movements in peak periods, such as during a particularly busy hour, are needed for detailed planning. Additionally, appropriate civil/military coordination and consideration of special use airspace (SUA) is required.

1.10 Homogeneous ATM areas and major traffic flows are related primarily to enroute airspace. However, addressing capacity and efficiency improvements in the terminal control area (TMA) and at aerodromes and working on the basis of a set of common initiatives, as described in this chapter, will serve as an important building block toward achieving a global ATM system. Therefore, several of the initiatives (Table 1 refers) were developed specifically to improve TMA and aerodrome operations.

Work programme

1.11 After identifying the homogeneous ATM areas and major traffic flows, which all regions have already progressed substantially, planners should conduct a survey of the current and foreseen aircraft population and its capabilities, predicted traffic figures, and also the ATM infrastructure, including human resource availability and requirements, among other things. An analysis of the data gathered should lead to the identification of "gaps" in performance. The Global Plan initiatives would then be evaluated against these gaps to identify those that would most appropriately provide the operational improvements necessary to meet performance objective(s). This planning process would continue with development of scenarios for implementation of initiatives, cost-benefit analyses of the various scenarios and preliminary development of infrastructure support requirements. Additional steps would include development of implementation plans and funding profiles, further review of human resource requirements to support the identified initiatives, followed by further cost-benefit analyses. Finally, national and regional implementation plans would be developed or amended based on the selected initiatives. This is an iterative process which may require repetition of several steps until a final choice of initiatives is selected. The planning tools will assist planners in carrying out the above steps. Figure 1 below is an illustration of a planning flow chart.

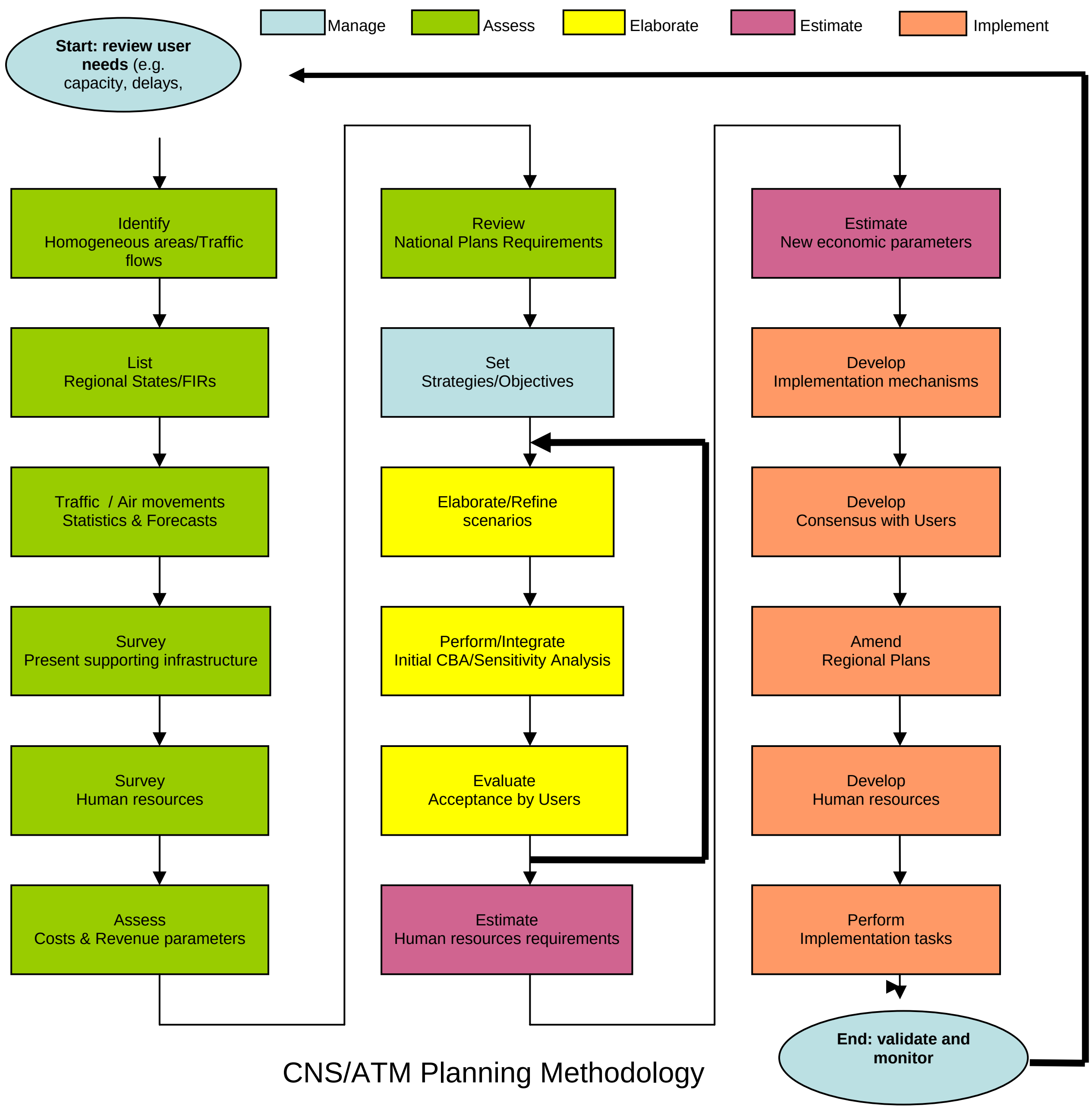

Figure 1. Planning flow chart

1.12 The planning process described in this volume of the Global Plan has been developed on the basis of the planning model contained in the previous version of the Global Plan which served as a step in the evolution toward a global ATM system. The updated process supports that evolution. Existing detailed plans are in different stages of implementation. Some plans have already identified performance objectives. The revised planning process, with its planning tools, will aid in furthering the work and provide the necessary guidance to complete the transition process.

1.13 Development of work programmes must be based on the experience and lessons learned in the previous cycle of the CNS/ATM implementation process. This Global Plan therefore, focuses efforts toward maintaining consistent global harmonization and improving implementation efficiencies by drawing on the existing capabilities of the infrastructure and successful regional implementations over the near and medium terms.

Planning tools

1.14 This Third Edition of the Global Plan is supported by planning tools which take various formats (e.g., software applications, planning documentation, web-based reporting forms, project management tools, etc). As States and PIRGs consider implementation of the initiatives, they will use common programme templates contained in the planning tools as the basis for establishing performance objectives and implementation time lines, as well as to develop a comprehensive schedule and programme of planning activities to accomplish the work associated with the initiatives. In addition, the planning tools will provide links to relevant guidance material and documentation in order to assist the planner throughout the planning process. This will ensure a uniform approach to implementation of the initiatives.

EVOLUTION

Building an ATM system based on the operational concept

1.15 Achieving the global ATM system sought after will be accomplished through the implementation of many initiatives over several years on an evolutionary basis. The set of initiatives contained in this Global Plan are meant to facilitate and harmonize the work already underway within the regions and to bring needed benefits to aircraft operators over the near and medium term. ICAO will continue to develop newer initiatives on the basis of the operational concept which will be placed in this Global Plan. In all cases, initiatives must meet global objectives based on the operational concept. On this basis, planning and implementation activities begin with application of available procedures, processes and capabilities. The evolution would progress to application of emerging procedures, processes and capabilities and ultimately, migrate to the ATM system based on the operational concept. Figure 2 depicts the Global Plan evolution.

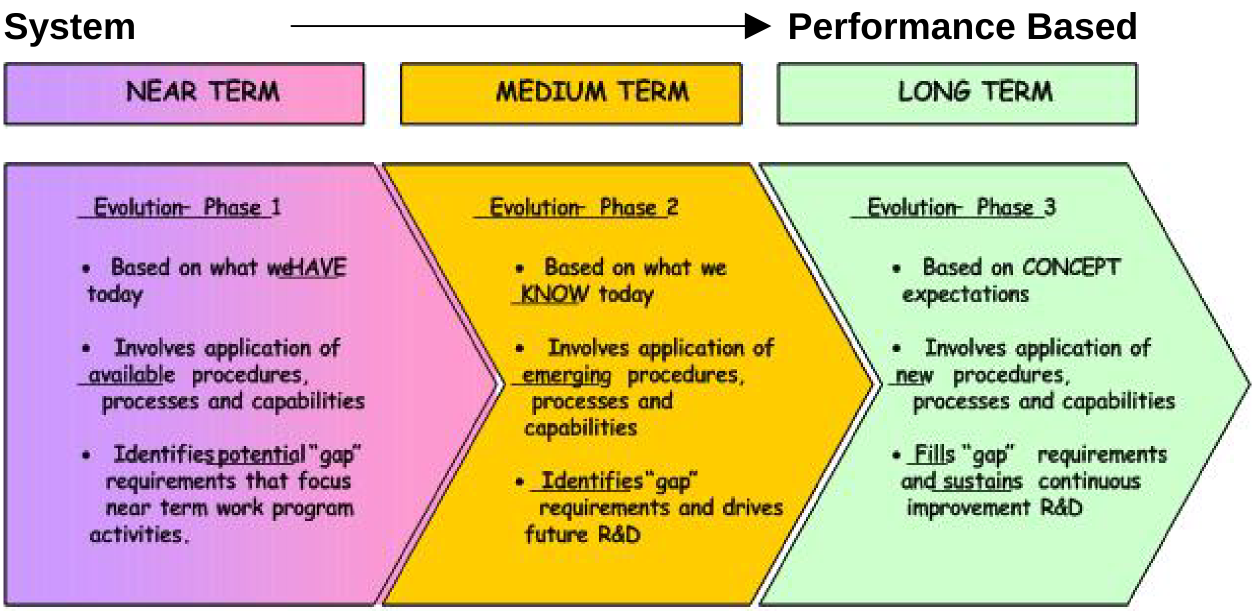

Figure 2. Global Plan Evolution

Global Plan initiatives

1.16 For each initiative, the objective and the strategy for implementation are described in general terms in the paragraphs below. Planning and implementation for each of the initiatives should be started in the near term and progressed in an evolutionary manner. Long term initiatives, necessary to guide the evolution to a global ATM system as envisioned in the operational concept, will be added to the Global Plan as they are developed and agreed to. The term: "related ATM objectives" when used in the initiative boxes on pages 7 through 29, refers to the set of operational improvements described in the previous version (Second Edition) of the Global Plan.

Integration of initiatives

1.17 The initiatives described in the following pages are provided to facilitate the planning process and should not be viewed as stand-alone work items, but rather, in many cases, as interrelated. Therefore, initiatives are quite capable of integrating with and supporting each other. In fact, integration is a sought after goal of a global ATM system. An example would be the achievement of full integration of arrival, departure and surface traffic management which would improve aerodrome throughput through the sequencing and metering provided by the integration of arrival, departure and surface management functions. Benefits are achieved through the creation of an optimized traffic flow from the top of descent through the aerodrome to the top of climb. This could effectively eliminate ground and airborne holding, leading to a more optimum use of the airspace, the runway system and ground facilities.

1.18 Achievement of the above, would require implementation of several initiatives, or various parts of different initiatives, including decision support systems, performance based navigation, collaborative airspace design and management, terminal area design and management and aerodrome design and management.

Table 1. Global plan initiatives and their relationships to the major groupings

G P I		En-route	Terminal Area	Aerodrome	Supporting Infrastructure
GPI-1	Flexible use of airspace	X	X		
GPI-2	Reduced vertical separation minima	X			
GPI-3	Harmonize level systems	X			
GPI-4	Align upper airspace classifications	X			
GPI-5	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		
GPI-12	FMS-based arrival procedures		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	X	X	X	X
GPI-17	Implementation of data link applications	X	X	X	X
GPI-18	Electronic information services	X	X	X	X
GPI-19	Meteorological systems	X	X	X	X
GPI-20	WGS-84	X	X	X	X
GPI-21	Navigation systems	X	X	X	X
GPI-22	Communication network infrastructure	X	X	X	X
GPI-23	Aeronautical spectrum	X	X	X	X

(GPI-1) FLEXIBLE USE OF AIRSPACE

Scope: The optimization and equitable balance in the use of airspace between civil and military users, facilitated through both strategic coordination and dynamic interaction.

Related ATM objectives: Airspace desegregation/flexible use of airspace

Description of strategy

1.19 The use of airspace should be optimized through the dynamic interaction of civil and military air traffic services including real-time civil/military controller-to-controller co-ordination. This requires system support, operational procedures and adequate information on civilian traffic position and intentions.

1.20 The flexible use of airspace (FUA) concept is based on the principle that airspace should not be designated purely as civil or military, but rather as a continuum in which all user requirements are accommodated to the greatest possible extent. FUA should result in the removal of large tracts of permanent or transient restricted airspace or special use airspace.

1.21 Where there are continued requirements to accommodate specific individual airspace uses, thereby blocking airspace of certain dimensions, this should be accommodated on a transient basis. Airspace should be released immediately after the operation requiring the restriction is complete.

(GPI-2) REDUCED VERTICAL SEPARATION MINIMUM

Scope: The optimization of the utilization of airspace and enhanced aircraft altimetry systems.

Related ATM objectives: Reduced vertical separation

Description of strategy

1.22 Reduced vertical separation minima (RVSM) reduces vertical separation to 300 metres (1 000 ft) above FL 290 from the current 600 metres (2000 ft), thereby providing six additional flight levels. The Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive provides specific guidance on implementation of (Doc 9574).

1.23 A great deal of experience has been gained with RVSM and all necessary Standards and Recommended Practices (SARPs) guidance material are available to support implementation.

(GPI-3) HARMONIZE LEVEL SYSTEMS

Scope: The adoption by all States of the ICAO Flight Level Scheme based on feet as contained in Appendix 3 to Annex 2 – *Rules of the Air*.

Related ATM objectives: nil

Description of strategy

1.24 The majority of ICAO Contracting States have chosen to use the imperial measurement system for referencing altitudes and levels, however, some States continue to use the metric system. To compound matters, some States that use the metric system, have adopted different vertical spacing standards than what is contained in ICAO Annex 2 — *Rules of the Air*.

1.25 Aircraft registered in States that have adopted the imperial system have altimetry systems calibrated in feet. Those registered in States that have adopted the metric system generally have altimeters calibrated in metres. Aircraft operating across boundaries into States with differing systems are required to carry additional altimeters, or to use conversion charts. Air traffic controllers handling such flights are also required to use conversion charts.

1.26 The implementation of RVSM at the interface between States using the different systems has increased safety concerns and causes the loss of several levels resulting in a less efficient operation for aircraft and a loss in airspace capacity. In addition, certain States that utilize the metric system have not made certain high level cruising altitudes available; thereby, imposing significant operating restrictions on aircraft operating on long-range sectors.

1.27 Harmonization of level systems, whereby all States adopt the ICAO Flight Level Scheme based on feet, should be pursued.

(GPI-4) ALIGNMENT OF UPPER AIRSPACE CLASSIFICATIONS

Scope: The harmonization of upper airspace and associated traffic handling through application of a common ICAO ATS Airspace Class above an agreed division level.

Related ATM objectives: nil

Description of strategy

1.28 To the extent possible airspace should be structured as a continuum, free from operational discontinuities, inconsistencies and differing rules and procedures. Alignment of airspace classifications can help to achieve this goal. It would also facilitate the introduction and better utilization of data link communications, improved flight plan processing systems, and advanced airspace management coordination tools and message exchange capabilities, leading to progressively more flexible and dynamic management of airspace. Airspace classifications should be harmonized intra-regionally and, where possible, across several regions.

1.29 Air transport and most business aircraft operations should be contained within airspace within which positive air traffic control services are provided to all aircraft (i.e. Class A, B, C or D).

1.30 ATM provided in various airspace volumes should be based on the ICAO airspace classification system as defined in Annex 11 — *Air Traffic Services* (i.e. Class A to G), and those classifications should be implemented on the basis of a safety assessment, taking into account the volume of nature of the air traffic.

(GPI-5) PERFORMANCE BASED NAVIGATION

Scope: The incorporation of advanced aircraft navigation capabilities into the air navigation system infrastructure.

Related ATM objectives: Application of required navigation performance; Application of required surveillance performance; Reduced longitudinal separation; Reduced lateral separation

Description of strategy

1.31 The implementation of the concept of performance based navigation will lead to increased capacity and enhanced efficiency through reductions in separation minima, bringing benefits to aircraft operators that equip to meet performance requirements. Performance-based navigation will also improve safety, particularly on approach through a reduction of controlled flight into terrain.

1.32 A significant number of aircraft are capable of area navigation (RNAV) and required navigation performance (RNP). These capabilities should be further exploited to develop more efficient routes and aircraft trajectories that are not directly tied to ground-based navigation aids. Certain RNAV equipped aircraft also have a significantly enhanced capability to achieve sequencing requirements to runways, particularly through the use of the "required time of arrival" function within the flight management system (FMS).

1.33 The performance-based navigation concept, a variation of the RNP concept, recognizes that a clear distinction must be made in the designation of operations, between those aircraft operations that require onboard self-contained performance monitoring and alerting and those that do not. The specifications in Figure 4, will allow global harmonization, leading to greater efficiency and lower costs for aircraft operators. Furthermore, they are fully compatible with existing implementations.

Area of application	Navigation accuracy (NM)	Navigation specification (current)	Navigation specification (new)
Oceanic/remote	10	RNP 10	RNP 10
	4	RNP 4	RNP 4
Enroute continental	5	B-RNAV RNP 5	RNAV 5
Enroute continental/Terminal	2	USRNAV type A	RNAV 2
Terminal	1	USRNAV type B and P-RNAV	RNAV 1

Figure 4. Conversion of existing navigation specs to the new specs

1.34 The above figure only addresses the enroute and terminal segments. ICAO is also addressing performance-based navigation in the final approach phase through development of a manual that provides guidance for design and implementation of RNP0.3 scaleable to RNP0.1 approach procedures.

(GPI-6) AIR TRAFFIC FLOW MANAGEMENT

Scope: The implementation of strategic, tactical and pre-tactical measures aimed at organizing and handling traffic flows in such a way that the totality of the traffic handled at any given time or in any given airspace or aerodrome is compatible with the capacity of the ATM system.

Related ATM objectives: Centralized ATFM; Inter-regional cooperative ATFM; Establishment of ATFM databases; Application of ATFM strategic planning; Application of pre-tactical ATFM planning; Application of tactical ATFM planning

Description of strategy

1.35 The implementation of demand/capacity measures, commonly known as air traffic flow management (ATFM), implemented on a regional basis where needed, will enhance airspace capacity and improve operating efficiency.

1.36 In the event that traffic demand regularly exceeds capacity, resulting in continuing and frequent traffic delays, or when it becomes apparent that forecast traffic demand will exceed the available capacity, the appropriate ATM units, in consultation with aircraft operators, should consider implementing steps aimed at improving the use of the existing system capacity, and developing plans to increase capacity to meet the actual or forecast demand. Any such planning to increase capacity should be undertaken in a structured and collaborative manner.

1.37 States and regions should evolve to a collaborative based approach to capacity management. The ATM Operational Concept envisages a more strategic approach to ATM overall, and through collaborative decision-making, a reduction in the reliance on tactical flow management. It is inevitable that tactical flow intervention will continue to be required; however closer coordination between airspace users and ATM service providers can reduce the need for routine tactical intervention which is often disruptive to aircraft operations.

(GPI-7) DYNAMIC AND FLEXIBLE ATS ROUTE MANAGEMENT

Scope: The establishment of more flexible and dynamic route systems, on the basis of navigation performance capability, aimed at accommodating preferred flight trajectories

Related ATM objectives Fixed RNAV ATS routes; Contingency RNAV routes; Random RNAV routes; Application of required Navigation Performance; Dynamic Accommodation of user-preferred flight ; profiles; Trajectory conformance monitoring

Description of strategy

1.38 The implementation of ATS route structures that avoid concentrations of aircraft over congested points and implementation of an ATS routing environment that meets the needs of the airspace users to operate along preferred and dynamic flight trajectories, will increase capacity and increase aircraft operating efficiency.

1.39 RNAV routes are not restricted to the location of ground-based aids and provide benefits to aircraft operators and the ATM system. All modern aircraft are RNAV capable and every effort should be made to design and implement RNAV routes.

1.40 Dynamic route management involves the aircraft in the planning process. Typical scenarios include the generation of change-of routing requests by the dispatch functions of the aircraft operators, the processing and approval of these requests by ATS providers and transmission of the change-or-routing approval to the aircraft. Advanced scenarios would have the aircraft making requests directly to ATS providers who would process and modify the request if necessary and then forward the approved route to aircraft.

1.41 Random routing strategically or pre-tactically defines areas within which fixed routes are not designated and where aircraft determine an appropriate track from an entry point to an exit point.

1.42 User-preferred routes make use of the capability of aircraft operators to determine optimum tracks, based on a range of flight parameters. In accordance with this concept, ATS routes or tracks would not be fixed to pre-determined routes or waypoints, except where required for control purposes, however, trajectories would be available to ATM staff.

1.43 User-preferred routing requests are generated by the airspace user or their dispatch functions and submitted to the ATS provider for approval or renegotiation if a conflict is determined followed by their transmission to aircraft. Advanced scenarios would have the aircraft making requests directly to ATS providers who would process and modify the request if necessary and then forward the approved route to aircraft.

(GPI-8) COLLABORATIVE AIRSPACE DESIGN AND MANAGEMENT

Scope: The application of uniform airspace organization and management principles on a global basis, leading to a more flexible airspace design to accommodate traffic flows dynamically.

Related ATM objectives: Airspace desegregation/flexible use of airspace; Dynamic accommodation of user-preferred flight profiles

Description of strategy

1.44 Collaborative airspace design and management is aimed at organizing airspace in a cooperative manner involving all users so that airspace is managed to accommodate the preferred trajectories of the users. States and regions should take advantage of aircraft capabilities when designing airspace. In designing and implementing airspace changes, account needs to be taken of the fleet capabilities among airspace users within a given airspace. Furthermore, collaboration with airspace users will identify procedures and/or solutions that make use of available aircraft capabilities.

1.45 Other emerging developments such as collaborative decision-making, the "required time of arrival" function in the flight management system (FMS), the endorsement of the global ATM operational concept and the implementation of data link applications, will also allow improved airspace design and management.

1.46 Over an evolutionary period, dynamic airspace management should be applied. Dynamic airspace management comprises integrated decision making; demand-based capacity (see air traffic flow management, paragraph 1.36); and user preferred routes (see dynamic and flexible ATS route management, paragraph 1.39).

1.47 Integrated decision making is an extension of the principles of the flexible use of airspace concept to include airspace users in flight in decision making with respect to tactical assessment of the use of reserved airspace and requirements for transit times of special use airspace.

1.48 Aircraft FMSs can provide information on estimated time enroute for proposed route changes. In addition, data link communication through CPDLC, providing the ability to uplink and downlink flight planning information, can support deployment of integrated decision making.

(GPI-9) SITUATIONAL AWARENESS

Scope: Operational implementation of data link-based surveillance. The implementation of equipment to allow traffic information to be displayed in aircraft supporting implementation of conflict prediction and collaboration between flight crew and the ATM system. Improve situational awareness in the cockpit by making available electronic terrain and obstacle data of required quality.

Related ATM objectives: application of data link; Functional integration of ground systems with airborne ; ADS; ADS-B; SSR Mode S

Description of strategy

1.49 The further implementation of enhanced surveillance techniques (ADS-C or ADS-B) will allow reductions in separation minima and an enhancement of safety, increase in capacity, improved flight efficiency, all on a cost-effective basis. These benefits may be achieved by bringing surveillance to areas where there is no primary or secondary radar, when cost-benefit models warrant it. In airspaces where radar is used, enhanced surveillance can bring a further reductions in aircraft separation minima and improve, in high traffic density areas, the quality of surveillance information both on the ground and in the air, thereby increasing safety levels. The implementation of sets of quality assured electronic terrain and obstacle data necessary to support the ground proximity warning systems with forward looking terrain avoidance function as well as minimum safe altitude warning (MSAW) system will benefit safety substantially.

1.50 Implementation of surveillance systems for surface movement at aerodromes where weather conditions and capacity warrant will also enhance safety and efficiency while implementation of cockpit display of traffic information and associated procedures will enable pilot participation in the ATM system and improve safety through greater situational awareness.

1.51 In remote and oceanic airspace where ADS-C is used, FANS capabilities exist on many air transport aircraft and could be added to business aircraft. ADS-B can be used to enhance traffic surveillance in domestic airspace. in this respect, it should be noted that 1090 extended squitter is both available and should be accepted as the global choice for the ADS-B data link.

1.52 At terminal areas and at aerodromes surrounded by significant terrain and obstacles, the availability of quality assured terrain and obstacle databases containing digital sets of data representing terrain surface in the form of continuous elevation values and digital sets of obstacle data of features, having vertical significance in relation to adjacent and surrounding features considered hazardous to air navigation, will improve situational awareness and contribute to the overall reduction of the number of controlled flight into terrain related accidents.

(GPI-10) TERMINAL AREA DESIGN AND MANAGEMENT

Scope: The optimization of the terminal control area (TMA) through improved design and management techniques.

Related ATM objectives: Application of RNP; Functional integration of ground systems with airborne systems; Independent IFR approaches to closely spaced runways; Curved and segmented approaches; Application of data link; WGS-84

Description of strategy

1.53 There are many ways that a well designed and managed TMA can have an important impact on safety, capacity and efficiency. TMA design should be implemented uniformly across all TMAs within a State or Region and should provide benefits while minimizing pilot/controller communications and optimizing pilot and controller workload. TMA arrival acceptance rates should be based tactically on a collaborative decision-making process involving tower, TMA and en-route sectors, while strategically involving airspace users, to ensure optimum traffic handling.

1.54 The enhancement of TMA management includes:

1) Complete the implementation of WGS-84 (see WGS-84, paragraph 1.89 below);
2) Develop and implement RNAV approach and departure procedures (see also Performance-based navigation in paragraph 1.32 above);
3) Implement RNP-based RNAV procedures (see also Performance-based navigation in paragraph 1.32 above);
4) Implement optimized arrival procedures; and
5) Enhance traffic and capacity management.

1.55 The implementation of dynamic TMA management procedures may comprise several elements such as dynamic wake vortex detection and mitigation, and collaborative capacity management (see Capacity management at paragraph X.X above).

1.56 At those locations where a business case supports implementation, decision support tools should be developed and implemented to provide a more structured and efficient management of arrival and departure traffic flows and more efficient use of the runway(s); more fuel-efficient trajectories and reduced noise exposure.

(GPI-11) RNP AND RNAV STANDARD INSTRUMENT DEPARTURES (SIDS) AND STANDARD TERMINAL ARRIVALS (STARS)

Scope: The optimization of the terminal control area (TMA) through implementation of RNP and RNAV SIDs and STARs.

Related ATM objectives: Application of RNP; Functional integration of ground systems with airborne systems; RNAV SIDs and STARs; Curved and segmented approaches

Description of strategy

1.57 The implementation of optimized standard instrument departures (SIDs), standard instrument arrivals (STARs), instrument flight procedures, holding, approach and associated procedures, taking advantage of aircraft navigation capabilities such as RNP and RNAV, as well as ATM decision support systems, will improve capacity and efficiency substantially.

1.58 The use of SIDs and STARs, will maximize system capacity and predictability while easing the environmental impact, reducing fuel consumption, and reducing ATS coordination. States should take advantage of the performance characteristics that are currently available to design such route structures. Near-term benefits can be achieved by applying RNAV 5, 2 and 1 criteria to the design of SIDs and STARs allowing optimum spacing between the routes leading to greater capacity and efficiency benefits (see paragraph 1.3.2).

1.59 SIDs and STARs allow the efficient transit of aircraft from the runway to enroute flight and vice versa; the segregation of departing traffic from arriving traffic to provide safe aircraft spacing; the maintaining of obstacle clearance requirements; the meeting of environmental requirements; and provision of a predictable flight trajectory compatible with aircraft RNAV systems.

(GPI-12) FLIGHT MANAGEMENT SYSTEM (FMS)-BASED ARRIVAL PROCEDURES

Scope: The optimization of the terminal control area (TMA) to provide for more fuel efficient aircraft operations through FMS-based arrival procedures

Related ATM objectives: Functional integration of ground systems with airborne systems; RNAV SIDs and STARs; Curved and segmented approaches; Arrival metering, sequencing and spacing; Application of data link

Description of strategy

1.60 In recent years there have been several efforts to develop flight procedures that provide the most efficient trajectory during an aircraft's approach to the destination aerodrome. These procedures allow an uninterrupted flight trajectory from top of descent until the aircraft is stabilized for landing. For the purposes of design work, it may be necessary to implement these procedures in phases.

1.61 Continuous descent arrival (CDARR) is an unimpeded, low thrust vertical descent from an aircraft's commencement of descent until established on the continuous descent approach (CDAPP); CDAPP is an unimpeded, low thrust vertical descent from an appropriate intermediate altitude above the aerodrome elevation and within an appropriate distance from the landing runway threshold until the aircraft is configured for landing. A continuous descent final approach (CDFA) is a descent from a final approach fix to landing which is conducted in a continuous descent in a stabilized manner.

1.62 The design of en-route and arrival air routes and associated procedures should facilitate the routine use of continuous descent procedures. Similarly, the design of departure procedures should facilitate the routine use of unrestricted climb procedures.

(GPI-13) AERODROME DESIGN AND MANAGEMENT

Scope: The implementation of management and design strategies to improve movement area utilization.

Related ATM objectives: nil

Description of strategy

1.63 Improved design and management activities, including coordination and collaboration between ATM providers, vehicle operators and aircraft operators can have an important impact on safety and capacity at aerodromes.

1.64 In most cases, the operation of the parking areas at an aerodrome is the responsibility of either the aerodrome operator or the aircraft operator. The ability to get an aircraft from its gate to the departure holding position, or from the exit taxiway to its gate, is critical to meeting performance expectations. Efficient use of parking areas requires coordination between all parties. A surface traffic management function would also address the movement of ground vehicles on the manoeuvring area.

1.65 At many locations, aerodrome structural improvements will result in significant efficiency gains. These include, the installation of additional taxiways, parallel taxiways to main runways for two-way traffic flow to and from runways, additional runway exits including high speed or rapid exit taxiways and improved lighting and signage.

1.66 Local collaborative decision-making processes should lead to sharing of key flight scheduling data that would enable all participants (aerodrome, ATC, ATFM, aircraft operators, ground handling) to improve their awareness of aircraft status throughout the “turn around” process. This will allow minimal and precise ATFM measures to be applied and higher predictability of schedules to be achieved. Benefits would include more efficient use of aerodrome resources and ground handling, reduction in delays and higher predictability of schedules.

(GPI-14) RUNWAY OPERATIONS

Scope: Reduce runway occupancy times.

Related ATM objectives: A-SMGCS

Description of strategy

1.67 Enhancing the performance of runway operations begins with the establishment of runway capacity benchmarks which are usually defined as the maximum number of flights an aerodrome can routinely handle in an hour for above Category I weather minimum. These benchmarks are estimates that vary with runway configurations and the mix of aircraft types. It should be an objective to utilize aircraft capabilities and available runways in the most appropriate manner to move the all weather throughput as close to the visual throughput as possible.

1.68 Achieving the optimum capacity for each runway is a complex task involving many factors, both tactical and strategic. In order to effectively manage that task it is essential to measure the effects of changes and to monitor performance of the airspace users and ATM providers. The latter case will be applicable to the analysis of pilot and controller performance and must recognize the requirement to maintain the confidence of the users and to work within the existing culture of safety. A system of performance indicators that forms the basis of measurements and analyses should be devised. Tactical factors affecting runway occupancy include flight operations and ATM factors. The flight operations aspects include operator performance; effects of company procedures; use of the airfield infrastructure; and aircraft performance issues.

1.69 Runway capacity constraints are defined by procedures, surface area design, aircraft performance capabilities, surveillance capabilities, aircraft spacing, and weather limitations. Improved procedures for minimizing spacing such as reduced runway separation, precision runway monitoring (PRM) and RNP RNAV approaches for closely-spaced parallel runways will optimize spacing capability.

(GPI-15) MATCH IMC AND VMC OPERATING CAPACITY

Scope: Improve the ability of aircraft to manoeuvre on the aerodrome surface in adverse weather conditions.

Related ATM objectives: A-SMGCS

Description of strategy

1.70 It should be an objective of the ATM system to utilize all airborne and service provision capabilities to maintain VMC capacity during IMC conditions to the greatest practical extent. More use should be made of the capability of modern aircraft systems and ground systems in evolving toward this objective. Taxiway design and guidance capability should then be matched to those conditions.

1.71 Implementation of A-SMGCS, decision support tools and associated procedures offer the best solution for aircraft to operate in all weather conditions. At those locations where benefit/cost analysis indicate a positive value, the improved guidance and control of taxiing aircraft and moving vehicles on the movement area as well as impending conflict alert may be fully automated.

1.72 Synthetic vision, based on detailed aerodrome map, can enhance situational awareness under adverse weather conditions where runway/taxiway markings may be obscured. Head-up display and guidance systems that can synthesize enhanced vision sensor data and synthetic vision images can offer an integrated solution to enhance situational awareness.

1.73 Enhanced conflict detection and alerting technologies and procedures will improve the aerodrome surface movement throughput while meeting established levels of safety. Controllers should also have access to systems to help them develop and maintain situational awareness of all traffic on the movement area in all weather conditions.

(GPI-16) DECISION SUPPORT AND ALERTING SYSTEMS

Scope: Implement decision support tools to assist air traffic controllers and pilots in detecting and resolving air traffic conflicts and in improving traffic flow

Related ATM objectives: Minimum safe altitude warning; Conflict prediction; Conflict alert; Conflict resolution advice; Trajectory conformance monitoring; Functional integration of ground systems with airborne systems

Description of strategy

1.74 Decision support systems facilitate early resolution of potential conflicts, provide basic levels of explorative probing to optimize strategies and reduce the need for tactical action. The executive role of controllers is thereby enhanced, giving scope for management of more traffic within acceptable workload limits.

1.75 Several tools are available that have the ability to substantially enhance safety. These include minimum safe altitude warning systems, short term conflict alert and runway incursion alerting tools. Tools that can improve efficiency include automated flight data processing systems, longer term conflict prediction and sequencing tools and online data interchange systems.

1.76 Conflict prediction tools span several sectors and permit improved sectoral planning, thereby providing the advantage of more expeditious traffic flow and less potential conflicts within established arrival schedules. This will allow sector teams to operate more effectively and will result in more optimum and efficient arrival flows.

1.77 The automation of coordination tasks between adjacent sectors improves the quality of information on traffic transiting between sectors and makes it more predictable, thereby allowing reduced separation minima, decreased workload, and increased capacity and more efficient flight operations.

(GPI-17) IMPLEMENTATION OF DATA LINK APPLICATIONS

Scope: Increase the use of data link applications.

Related ATM objectives: Application of data link; Functional integration of ground systems; with airborne systems; ATS inter-facility data communication (AIDC)

Description of strategy

1.78 The implementation of less complex data link services (e.g. pre-departure clearance, oceanic clearance, D-ATIS, automatic position reporting, etc) can bring immediate efficiency benefits to the provision of ATS. Transition to the use of data link communications for more complex safety related uses that take advantage of a wide variety of Controller Pilot Datalink Communication (CPDLC) messages, including ATC clearances is already being successfully implemented.

1.79 Use of CPDLC and implementation of other data link applications can bring significant advantages in terms of workload and safety over voice communication for both pilots and controllers. In particular, they can provide efficient linkages between ground and airborne systems, improved handling and transfer of data, reduced channel congestion, reduced communication errors, interoperable communication media and reduced workload. The reduction of workload per flight translates into capacity increases and enhances safety.

1.80 Communication data link and data link surveillance technologies and applications must be selected and harmonized for seamless and interoperable global operations. ADS-C, ADS-B and CPDLC are in service in various regions of the world but lack global harmonization. Current regional initiatives, including utilizing unique message subsets and CPDLC procedures, hinder efficient development and acceptance for global aircraft operations. Existing and emerging technologies should be implemented in a harmonized global manner in the near term to support long-term goals. Harmonization will define global equipage requirements and therefore minimize user investment.

1.81 FANS-1/A and ATN applications support similar functionality, but with different avionics requirements. Many internationally operated aircraft are equipped with FANS-1/A avionics initially to take advantage of data link services offered in certain oceanic and remote regions. FANS-1/A equipage on international business aviation aircraft is underway and is expected to increase.

(GPI-18) AERONAUTICAL INFORMATION

Scope: To make available in real-time, quality assured electronic information (aeronautical, terrain and obstacle).

Related ATM objectives: Functional integration of ground systems with airborne systems; ATS-inter-facility (AIDC) communications

Description of strategy

1.82 RNAV, RNP, computer-based navigation systems and ATM requirements introduced a need for new corresponding AIS requirements for quality and timeliness of information. To be able to cope and manage the provision of information and satisfy these new requirements, the traditional role of aeronautical information service will change into an information management service with changing duties and responsibilities.

Electronic information

1.83 To facilitate coordination, improve efficiency and safety and ensure that the ATM Community shares the same information when collaborating on decisions, availability, in real-time, of quality assured electronic information (aeronautical, terrain and obstacle) is essential. Electronic information will enhance pilots' situational awareness during enroute, terminal and aerodrome operations by loading onboard equipment with geo-referenced data sets containing enroute, terminal and aerodrome information. The same information may be made available at different ATC positions, pre-flight planning units as well as for access by airlines flight planning departments or private/general aviation users. The electronic information can be tailored and formatted so that it satisfies ATM user requirements and applications. Standardized data formats will be used in creating the information databases which will then be populated with quality assured data sets.

(GPI-19) METEOROLOGICAL SYSTEMS

Objective: To improve the availability of meteorological information in support of a seamless global ATM system.

Related ATM objectives: nil

Description of strategy

1.84 Enhancements of the World Area Forecast System (WAFS), the International Airways Volcano Watch (IAVW) and the ICAO tropical cyclone warning system to improve the accuracy, timeliness and usefulness of the products issued will facilitate optimization of the use of airspace. Increasing use of data-link to downlink and uplink meteorological information to assist in the automatic sequencing of aircraft on approach will contribute to the maximization of capacity.

1.85 The global ATM system will require immediate access to real-time, global meteorological information. Such stringent requirements will dictate that most meteorological systems must be automated. Automatic downlink of MET information included in ADS messages will provide accurate upper wind fields and real-time wind profiles. The use of data-link to uplink information related to meteorological conditions to aircraft on approach and departure should increase, including the implementation of Digital-Automatic Terminal Information Service (D-ATIS) and D-VOLMET.

1.86 The foregoing enhancements will provide ATC units with access to accurate background upper wind fields for display, both in the form of WAFS global upper wind forecasts and "real-time" wind fields and wind profiles derived from the wind information reported automatically by aircraft using automatic dependent surveillance (ADS), and to reports and forecasts of hazardous weather, particularly volcanic ash, tropical cyclones, thunderstorms, clear-air turbulence, icing and wind shear. This information will assist ATM in tactical decision-making for aircraft surveillance, air traffic flow management, and flexible/dynamic aircraft routing, and will contribute to the optimization of the use of airspace.

1.87 To achieve this, States and regions will have to implement the following improvements in accordance with planned dates:

1) *WAFS*: binary universal form for the representation of meteorological data (BUFR)-coded significant weather (SIGWX) forecasts; improvements to the spatial and temporal resolutions of WAFS forecasts; and GRIB2-coded forecasts of turbulence, icing and convective clouds

2) *IAVW:* selected State volcanological observatories

3) *Tropical cyclone* (TC) warning system: graphical tropical cyclone advisories

4) *Data link:* ICAO provisions related to the use of data link taking due account of the implementation of ADS and SSR Mode S data link; replacement of VOLMET broadcasts by D-VOLMET in the regions where appropriate data link communications are available.

(GPI-20) WGS-84

Objective: The implementation of WGS-84 by all States.

Related ATM objectives: Implementation of WGS-84

Description of strategy

1.88 The geographical coordinates used across various States in the world to determine the position of runways, obstacles, aerodromes, navigation aids and ATS routes are based on a wide variety of local geodetic reference systems. With the introduction of RNAV, the problem of having geographical coordinates referenced to local geodetic datum's is more evident and has clearly shown the need for a universal geodetic reference system. ICAO, to address this issue, adopted in 1994 the World Geodetic System – 1984 (WGS-84) as a common horizontal geodetic reference system for air navigation with an applicability date of 1 January 1998.

1.89 Fundamental to the implementation of GNSS is the use of a common geographical reference system. ICAO adopted the WGS-84 Geodetic Reference System as that datum, and many States have implemented, or are implementing the system. Failure to implement, or a decision to use an alternative reference system will create a seam in ATM service, and will delay the full realization of GNSS benefits. Completion of the implementation of the WGS-84 Geodetic Reference System is a prerequisite for a number of ATM enhancements, including GNSS.

(GPI-21) **NAVIGATION SYSTEMS**

Scope: Enable the introduction and evolution of performance-based navigation supported by a robust navigation infrastructure providing an accurate, reliable and seamless global positioning capability.

Related ATM objectives: WGS-84; NPA; Precision approach; Required navigation performance

Description of strategy

1.90 Airspace users need a globally interoperable navigational infrastructure that delivers benefits in safety, efficiency and capacity. Aircraft navigation should be straight-forward and conducted to the highest level of accuracy supported by the infrastructure.

1.91 To meet those needs, the progressive introduction of performance-based navigation must be supported by an appropriate navigation infrastructure consisting of an appropriate combination of global navigation satellite systems (GNSS), self-contained navigation systems (inertial navigation system) and conventional ground-based navigation aids.

1.92 GNSS provides standardised positioning information to the aircraft systems to support precise navigation globally. One global navigation system will help support a standardisation of procedures and cockpit displays coupled with a minimum set of avionics, maintenance and training requirements. Thus, the ultimate goal is a transition to GNSS that would eliminate the requirement for ground-based aids, although the vulnerability of GNSS to interference may require the retention of some ground aids in specific areas.

1.93 GNSS-centered performance-based navigation enables a seamless, harmonised and cost effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity.

1.94 GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. Near-term applications of GNSS are intended to enable the early introduction of satellite-based area navigation without any infrastructure investment, using the core satellite constellations and integrated multisensor airborne systems. The use of these systems already allows for increased reliability of non-precision approach operations at some airports.

1.95 Medium/longer term applications will make use of existing and future satellite navigation systems with some type of augmentation, or combination of augmentations required for operation in a particular phase of flight.

(GPI-22) COMMUNICATION NETWORK INFRASTRUCTURE

Scope: To evolve the aeronautical mobile and fixed communication infrastructure, supporting both voice and data communications, accommodating new functions as well as providing the adequate capacity and quality of service to support ATM requirements.

Related ATM objectives: AMSS; HF data; VHF data; SSR Mode S; ATN

Description of strategy

1.96 ATM depends extensively and increasingly on the availability of real-time or near real-time, relevant, accurate, accredited and quality-assured information to make informed decisions. The timely availability of appropriate aeronautical mobile and fixed communication capabilities (voice and data) to accommodate ATM requirements and to provide the adequate capacity and quality of service requirements is essential. The aeronautical communication network infrastructure should accommodate the growing need for information collection and exchange within a transparent network in which all stakeholders can participate.

1.97 The gradual introduction of performance-based SARPs, system-level and functional requirements will allow the increased use of commercially available voice and data telecommunication technologies and services. In the framework of this strategy, States should, to the maximum extent possible, take advantage of appropriate technologies, services and products offered by the telecommunication industry.

1.98 Considering the fundamental role of communications in aviation as an enabler, the common objective is to seek the most efficient communication network service providing the desired services with the required performance and interoperability required for aviation safety levels at minimum cost.

(GPI-23) AERONAUTICAL RADIO SPECTRUM

Scope: Timely and continuing availability of adequate radio spectrum, on a global basis, to provide viable air navigation services (communication, navigation and surveillance).

Related ATM objectives: nil

Description of strategy

1.99 States need to address all regulatory aspects on aeronautical matters on the agendas for ITU World Radiocommunication Conferences (WRC). Particular attention is drawn to the need to maintain the current spectrum allocations to aeronautical services.

1.100 The radio spectrum is a scarce natural resource with finite capacity for which demand from all users (aeronautical and non-aeronautical) is constantly increasing. Thus, the ICAO strategy on aeronautical radio spectrum, aims at long-term protection of adequate aeronautical spectrum for all radio communication, surveillance and radio navigation systems. The process of international coordination taking place in the International Telecommunication Union (ITU), obliges all spectrum users (i.e. aeronautical and non aeronautical) to continually defend and justify spectrum requirements. Civil aviation operations are expanding globally creating pressure on the already stressed and limited available aeronautical spectrum.

1.101 The framework of this initiative involves the support and dissemination by States of the ICAO quantified and qualified policy statements of requirements for aeronautical radio frequency spectrum agendas for ITU World Radio communication Conferences (WRC). This is necessary to maintain the current spectrum allocations to aeronautical services, ensure the continuing availability of adequate aeronautical radio spectrum and ultimately the viability of existing and new air navigation services globally.

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