ATTACHMENT A to STATE LETTER 0300

BACKGROUND INFORMATION ON AVIATION SYSTEM BLOCK UPGRADES (ASBUs)

WORKING DOCUMENT ON THE AVIATION SYSTEM BLOCK UPGRADES

THE FRAMEWORK FOR GLOBAL HARMONIZATION

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SECOND VERSION TO THE WORKING DOCUMENT FOR THE GLOBAL AIR NAVIGATION INDUSTRY SYMPOSIUM (GANIS)

Preface to this Edition

The International Civil Aviation Organization established a framework for global harmonization and interoperability of air space named the aviation system block upgrades (ASBUs). These are sets of capabilities that provide measurable, operational performance improvements organized into flexible and scalable building blocks that can be introduced and implemented as needed.

Draft ASBUs were presented at the Global Air Navigation Industry Symposium (GANIS), which was held at ICAO in September 2011, and were integrated in the GANIS working document. Since then, constructive feedback forms were received from both States and the Industry and all comments were reviewed by the Future Aviation Technical Team.

Based on the review of the Technical Team, the ASBUs have been revised and are available for review and comment using the forms provided for this purpose at http://www2.icao.int/en/GANIS/Pages/Aviation-System-Block-Upgrades.aspx. Feedback is of particular importance because the ASBUs will form part of the Global Air Navigation Plan (GANP) which will be the subject of a working paper at the Twelfth Air Navigation Conference (AN-Conf/12).

ICAO Aviation System Block Upgrades

Introduction

The 37th Session of the International Civil Aviation Organization (ICAO) Assembly (2010) directed the Organization to increase its efforts to meet the global needs for airspace interoperability while maintaining its focus on safety. ICAO therefore introduced the “Aviation System Block Upgrades” initiative as a programmatic framework that:

a) develops a set of air traffic management (ATM) solutions or upgrades;

b) takes advantage of current equipage;

c) establishes a transition plan; and

d) enables global interoperability.

ICAO estimates that US$120 billion will be spent on the transformation of air transportation systems in the next ten years. While NextGen and SESAR in the United States and Europe account for a large share of this spending, parallel initiatives are underway in many areas including the Asia/Pacific, North and Latin America, Russia, Japan and China. Modernization is an enormously complex task but the Industry needs the benefits that these initiatives will bring as traffic levels continue to rise. It is clear that to safely and efficiently accommodate the increase in air traffic demand, as well as to respond to the diverse needs of operators, the environment and other issues, a renovation of ATM systems is needed to provide the greatest operational and performance benefits.

Aviation system block upgrades comprise suites of modules, each having the following essential elements:

a) a clearly defined and measurable operational improvement and success metric;

b) necessary equipment and/or systems in aircraft and on the ground, along with an operational approval or certification plan;

c) standards and procedures for both airborne and ground systems; and

d) a positive business case over a clearly defined period of time.

Modules are organized into flexible and scalable building blocks that can be introduced and implemented in a State or a region depending on need and level of readiness, while recognizing that all the modules are not required in all airspaces.

The concept of the block upgrades originates from existing near-term implementation plans and initiatives providing benefits in many regions of the world. The block upgrades are largely based on operational concepts extracted from the United States’ Next Generation Air Transportation System (NextGen), Europe’s Single European Sky ATM Research (SESAR) and Japan’s Collaborative Actions for Renovation of Air Traffic Systems (CARATS) programmes. Also included was the feedback from States with evolving modernization programmes received at the recent Global Air Navigation Industry Symposium. The block upgrades are also aligned with the ICAO *Global Air Traffic Management Operational Concept* (Doc 9854). The intent is to apply key capabilities and performance improvements drawn from these programmes across other regional and local environments with the same level of performance and associated benefits on a global scale.

The block upgrades describe ways to apply the concepts defined in the ICAO *Global Air Navigation Plan* (Doc 9750) with the goal of achieving regional performance improvements. They will include the development of technology roadmaps to ensure that standards are mature and to facilitate synchronized implementation between air and ground systems and between regions. The ultimate goal is to achieve global interoperability. Safety demands this level of interoperability and harmonization which must be achieved at a reasonable cost with commensurate benefits.

Leveraging upon existing technologies, block upgrades are organized in five-year time increments starting in 2013 continuing through 2028 and beyond. Such a structured approach provides a basis for sound investment strategies and will generate commitment from States, equipment manufacturers, operators and service providers.

The block upgrades will be formalized at the Twelfth Air Navigation Conference in November 2012 and will form the basis of the new or revised Global Air Navigation Plan (GANP).

The development of block upgrades will be realized by a shift in focus from top-down planning to more bottom-up and pragmatic implementation in the regions. The ASBU initiative will influence ICAO's work programme in the coming years, specifically in the area of standards development and associated performance improvements.

Stakeholder Roles and Responsibilities

Stakeholders, including service providers, regulators, airspace users and manufacturers, will face increased levels of interaction as new, modernized ATM operations are implemented. The highly integrated nature of capabilities covered by the block upgrades requires a significant level of coordination and cooperation among all stakeholders. Working together is essential for achieving global harmonization and interoperability.

For ICAO and its governing bodies, the block upgrades will enable the development and delivery of necessary Standards and Recommended Practices (SARPs) to States and Industry in a prompt and timely manner to facilitate regulatory and technological improvement and to ensure operational benefits worldwide. This process will be facilitated by the standards roundtable process, which involves ICAO, States and Industry, and by various technological roadmaps.

States, operators and Industry will benefit from the availability of SARPs with realistic lead times. This will allow regional regulations to be identified, the development of adequate action plans and, if needed, investment in new facilities and/or infrastructure.

Stakeholders worldwide must prepare the ATM system for the future. The block upgrades initiative should constitute the basis for future ATM modernization plans. Where plans are already in place, they should be aligned with objectives defined in the block upgrades.

For the Industry, the ASBU initiative forms the basis for planning future development and delivering products to the market at the proper target time.

For service providers or operators, block upgrades should serve as a planning tool for resource management, capital investment, training, as well as for potential reorganization.

What is an Aviation System Block Upgrade?

An aviation system block upgrade (ASBU) designates a set of improvements that can be implemented globally to enhance the performance of the ATM system. There are four components of a block upgrade.

Module — a deployable package based on performance or capability. It offers a clear operational benefit, supported by procedures, technology, regulation/standards as necessary, and a business case. A module will be also characterized by the operating environment within which it may be applied.

It is important that each module be both flexible and scalable to the point where its application could be managed through any set of regional plans and still realize the intended benefits. The preferential basis for the development of the modules relied on the applications being adjustable to fit many regional needs as an alternative to being made mandated as a one-size-fits-all application. Even so, it is clear that many of the modules developed in the block upgrades will not be necessary to manage the complexity of air traffic management in many parts of the world.

Thread — a series of dependent modules reaching across successive block upgrades which represents a coherent evolution over time from basic to more advanced capability and associated performance while reflecting key aspects of the global ATM concept. The date considered for allocating a module to a block is that of the initial operating capability (IOC)

Block — is made up of modules that, when combined, enable significant improvements and benefits.

The notion of blocks is based on five year intervals. Detailed block descriptions can include more accurate implementation dates, often not at the exact reference date of a block. The purpose, however, is not to indicate when a module implementation must be completed, unless dependencies among modules logically suggest such a completion date.

Performance Improvement Area (PIA) — sets of modules in each block are grouped to provide operational and performance objectives in the environment to which they apply, thus forming executive high-level view of the intended evolution. The PIAs facilitate comparison of ongoing programmes.

The four performance improvement areas are as follows:

1. *Greener Airports*
2. *Globally Interoperable Systems and Data* – through globally interoperable system-wide information management
3. *Optimum Capacity and Flexible Flights* – through global collaborative ATM
4. *Efficient Flight Path* – through trajectory-based operations

Figure 1 illustrates the relationships between the modules, threads, blocks, and performance improvement areas.

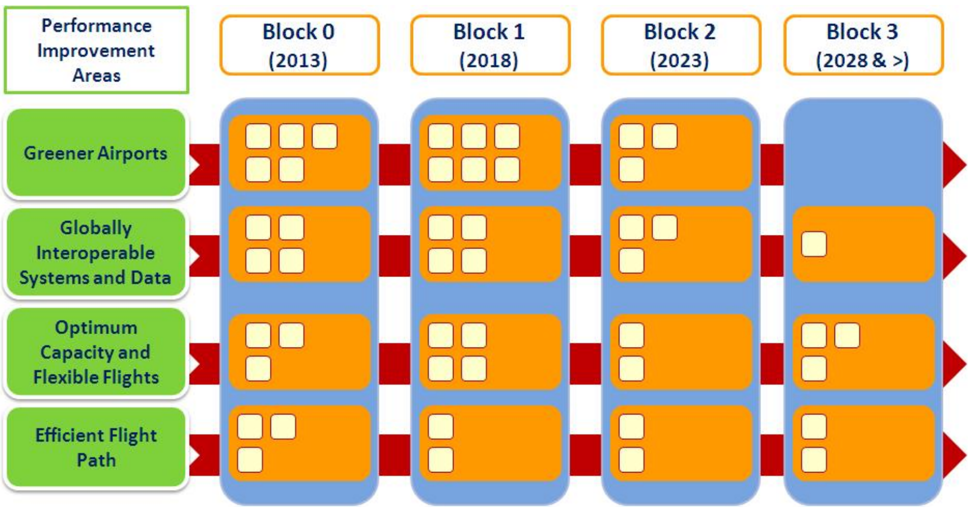

Figure 1. Summary of Blocks Mapped to Performance Improvement Areas

Note that each block includes a target year. Each of the modules that form the block must meet a readiness review that looks at the availability of standards (including performance standards, approvals, advisory and guidance documents, etc.), avionics, infrastructure, ground automation and other enabling capabilities. To provide a community perspective each module should have been fielded in two regions and should include operational approvals and procedures. This allows States wishing to adopt the blocks to draw on the experience gained by those already employing those capabilities.

Figure 2 illustrates the relative timing of each block. Note that early lessons learned are included in preparation for the initial operating capability date. For the Twelfth Air Navigation Conference it is recognized that Blocks 0 and 1 represent the most mature of the modules. Blocks 2 and 3 provide the necessary vision to ensure that earlier implementations are on the path to the future.

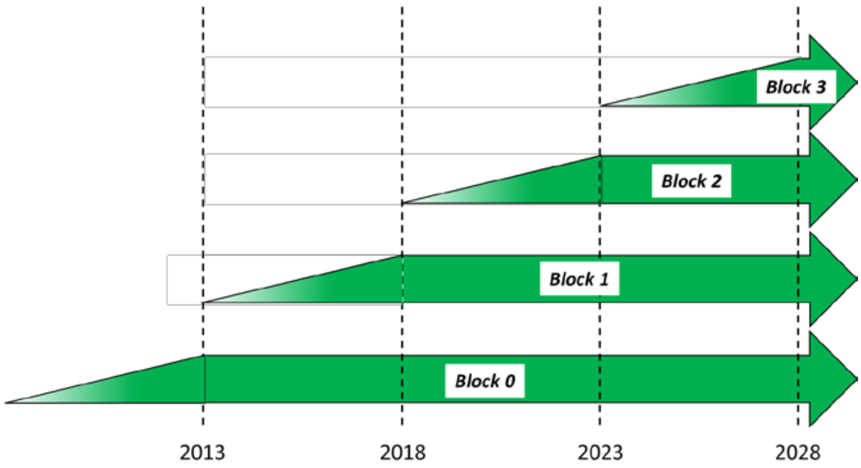

Figure 2. Timing Relationships Between Blocks

An illustration of the improvements brought by Block 0 for the different phases of flight is presented in Figure 3. It highlights that the proposed improvements apply to all flight phases, well as to the network as a whole, to information management and to infrastructure.

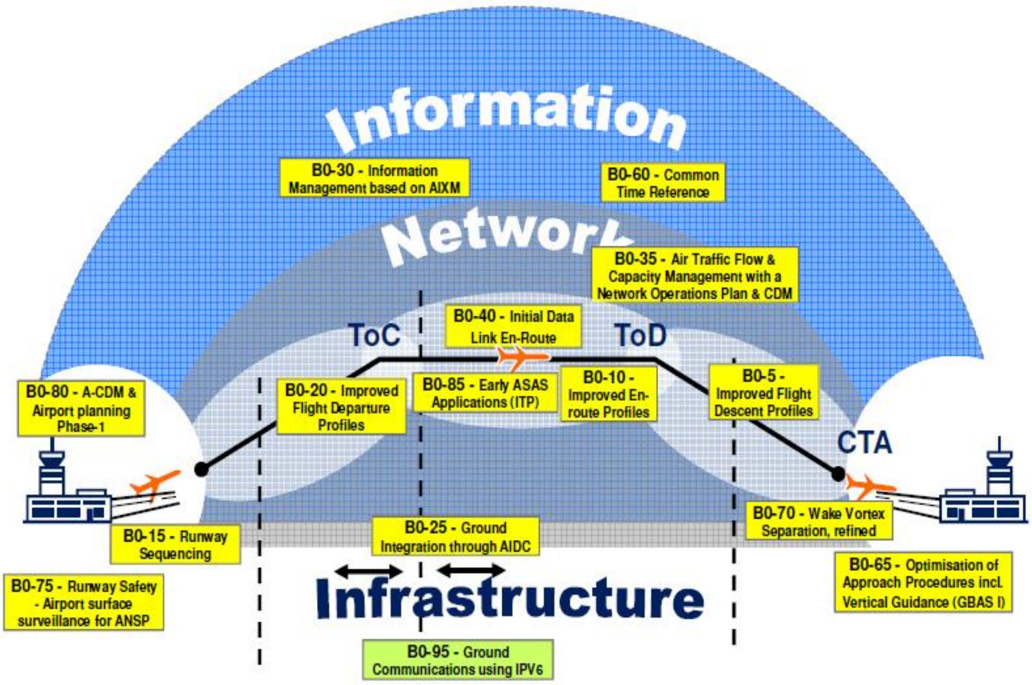

Figure 3. Block 0 in perspective

Global Air Navigation Plan

The GANP is a strategic document that has successfully guided the efforts of States, planning and implementation regional groups (PIRGS) and international organizations in enhancing the efficiency of air navigation systems. It contains guidance for systems improvements in the near- and medium-term to support a uniform transition to the global ATM system envisioned in the Global ATM Operational Concept. Long-term initiatives from the operational concept, however, are maturing and GANP must be updated to maintain its relevance and compatibility.

The United States and Europe share a common ATM modernization challenge as both operate highly complex, dense airspace in support of their national economies. Although quite different in structure, management and control, their systems are built on a safety-focused infrastructure while actively seeking and delivering the required efficiency gains. The United States has a single system that spans the entire country while Europe’s is a patchwork of systems, service providers and airspace defined mostly by State boundaries. Both legacy infrastructures must migrate to a new, upgraded and modernized operational paradigm.

Over the past ten years, as the ATM operational concepts were developed, the need was recognized to:

a) integrate the air, ground and regulatory parts, including airport operations, by addressing flight trajectories as a whole and sharing accurate information across the ATM system;

b) distribute the decision-making process;

c) address safety risks; and

d) change the role of the human being using improved integrated automation.

These changes will support new capacity-enhancing operational concepts and enable the sustainable growth of the air transportation system.

ICAO aims for the block upgrades initiative to become the global approach for facilitating interoperability, harmonization, and modernization of air transportation worldwide. As implementation proceeds, the highly integrated nature of the block upgrades will necessitate transparency between all stakeholders to achieve a successful and timely ATM modernization.

The Twelfth Air Navigation Conference provides the opportunity for significant progress and to arrive at decisions for the globally coordinated deployment of the block upgrades, progress reviews and updates are planned at regular intervals following the first application the block upgrades.

Conclusion

The global aviation system block upgrade initiative constitutes a worldwide framework for ATM system modernization. Offering a structure based on expected operational benefits, it will facilitate investment and implementation processes, by clarifying the clear relationship between technology and operational improvements.

However, block upgrades will only play their intended role if sound and consistent technology roadmaps are developed and validated. As well, all stakeholders involved in worldwide ATM modernization should align their activities and planning to the related block upgrades. The challenge of the Twelfth Air Navigation Conference will be to establish a solid and worldwide endorsement of the aviation system block upgrades as well as the related technology roadmaps into the revised Global Air Navigation Plan, under the concept of One Sky.

Appendix A: Summary Table of Aviation System Block Upgrades Mapped to Performance Improvement Areas

Performance Improvement Area 1: Greener Airports

Block 0	Block 1	Block 2	Block 3
B0-65 **Optimization of approach procedures including vertical guidance** This is the first step toward universal implementation of GNSS-based approaches	**B1-65** **Optimized Airport Accessibility** This is the next step in the universal implementation of GNSS-based approaches		
B0-70 **Increased Runway Throughput through Wake Turbulence Separation** Improved throughput on departure and arrival runways through the revision of current ICAO wake vortex separation minima and procedures	**B1-70** **Increased Runway Throughput through Dynamic Wake Turbulence Separation** Improved throughput on departure and arrival runways through the dynamic management of wake vortex separation minima based on the real-time identification of wake vortex hazards	**B2-70 (*)** **Advanced Wake Turbulence Separation (Time-based)**	
B0-75 **Improved Runway Safety (A-SMGCS Level 1-2 and Cockpit Moving Map)** Airport surface surveillance for ANSP	**B1-75** **Enhanced Safety and Efficiency of Surface Operations (ATSA-SURF)** Airport surface surveillance for ANSP and flight crews with safety logic, cockpit moving map displays and visual systems for taxi operations	**B2-75** **Optimized Surface Routing and Safety Benefits (A-SMGCS Level 3-4, ATSA-SURF IA and SVS)** Taxi routing and guidance evolving to trajectory based with ground/cockpit monitoring and data link delivery of clearances and information. Cockpit synthetic visualization systems	
B0-80 **Improved Airport Operations through Airport-CDM** Airport operational improvements through the way operational partners at airports work together	**B1-80** **Optimized Airport Operations through Airport-CDM Total Airport Management** Airport operational improvements through the way operational partners at airports work together		
	B1-81 **Remote Operated Aerodrome Control T** The performance objective is to provide safe and cost-effective ATS to aerodromes where dedicated local ATS is no longer sustainable or cost effective, but where there is a local economic and social benefit from aviation		
B0-15 **Improved RunwayTraffic Flow through Sequencing (AMAN/DMAN)** Time-based metering to sequence departing and arriving flights	**B1-15** **Improved Airport Operations through Departure, Surface and Arrival Management** Extended arrival metering, integration of surface management with departure sequencing bring robustness to runway management and increase airport performances and flight efficiency	**B2-15** **Linked AMAN/DMAN** Synchronized AMAN/DMAN will promote more agile and efficient en-route and terminal operations	**B3-15** **Integrated AMAN/DMAN/SMAN** Fully synchronized network management between departure airport and arrival airports for all aircraft in the air traffic system at any given point in time

Performance Improvement Area 2:
Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management

Block 0	Block 1	Block 2	Block 3
B0-25 **Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration** Supports the coordination of ground-ground data communication between ATSU based on ATS inter-facility data communication (AIDC) defined by ICAO Doc 9694, *Manual of Air Traffic Services Data Link Applications*	**B1-25** **Increased Interoperability, Efficiency and Capacity though FF-ICE/1 Application before Departure** Introduction of FF-ICE step 1 to implement ground-ground exchanges using common flight information reference model, FIXM, XML and the flight object used before departure	**B2-25** **Improved Coordination through Multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)** FF-ICE supporting trajectory-based operations through exchange and distribution of information for multicentre operations using flight object implementation and IOP standards	
B0-30 **Service Improvement through Digital Aeronautical Information Management** Initial introduction of digital processing and management of information through the implementation of AIS/AIM making use of AIXM, moving to electronic AIP and better quality and availability of data	**B1-30** **Service Improvement through Integration of All Digital ATM Information** Implementation of the ATM information reference model integrating all ATM information using UML and enabling XML data representations and data exchange based on internet protocols with WXXM for meteorological information		**B3-25** **Improved Operational Performance through the Introduction of Full FF-ICE** All data for all relevant flights systematically shared between air and ground systems using SWIM in support of collaborative ATM and trajectory-based operations
	B1-31 **Performance Improvement through the Application of System-Wide Information Management (SWIM)** Implementation of SWIM services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximize interoperability	**B2-31** **Enabling Airborne Participation in Collaborative ATM through SWIM** Connection of the aircraft an information node in SWIM enabling participation in collaborative ATM processes with access to rich, voluminous and dynamic data including meteorology	

Performance Improvement Area 3:
Optimum Capacity and Flexible Flights – Through Global Collaborative ATM

Block 0	Block 1	Block 2	Block 3
B0-10 **Improved Operations through Enhanced En-route Trajectories** Implementation of performance-based navigation (PBN) and flex tracking to avoid significant weather and to offer greater fuel efficiency, flexible use of airspace (FUA) through special activity airspace allocation, airspace planning and time-based metering, and collaborative decision-making (CDM) for en-route airspace with increased information exchange among ATM stakeholders	**B1-10** **Improved Operations through Free Routing** Introduction of free routing in defined airspace, where the flight plan is not defined as segments of a published route network or track system to facilitate adherence to the user-preferred profile		**B3-10** **Traffic Complexity Management** Introduction of complexity management to address events and phenomena that affect traffic flows due to physical limitations, economic reasons or particular events and conditions by exploiting the more accurate and rich information environment of a SWIM-based ATM
B0-35 **Improved Flow Performance through Planning Based on a Network-wide View** Collaborative ATFM measure to regulate peak flows involving departure slots, managed rate of entry into a given piece of airspace for traffic along a certain axis, requested time at a way-point or an FIR/sector boundary along the flight, use of miles-in-trail to smooth flows along a certain traffic axis and re-routing of traffic to avoid saturated areas	**B1-35** **Enhanced Flow Performance through Network Operational Planning** ATFM techniques that integrate the management of airspace, traffic flows including initial user driven prioritization processes for collaboratively defining ATFM solutions based on commercial/operational priorities	**B2-35** **Increased User Involvement In The Dynamic Utilisation of The Network.** Introduction of CDM applications supported by SWIM that permit airspace users to manage competition and prioritization of complex ATFM solutions when the network or its nodes (airports, sector) no longer provide capacity commensurate with user demands	
	B1-105 **Better Operational Decisions through Integrated Weather Information (Planning and Near-term Service)** Weather information supporting automated decision process or aids involving: weather information, weather translation, ATM impact conversion and ATM decision support		**B3-105** **Better Operational Decisions through Integrated Weather Information (Near and Intermediate Service)** Weather information supporting both air and ground automated decision support aids for implementing weather mitigation strategies

Performance Improvement Area 3:
Optimum Capacity and Flexible Flights – Through Global Collaborative ATM

Block 0	Block 1	Block 2	Block 3
B0-85 **Air Traffic Situational Awareness (ATSA)** This module comprises two ATSA (air traffic situational awareness) applications which will enhance safety and efficiency by providing pilots with the means to achieve quicker visual acquisition of targets: • AIRB (enhanced traffic situational awareness during flight operations) • VSA (enhanced visual separation on approach).	**B1-85** **Increased Capacity and Flexibility through Interval Management** To create operational benefits through precise management of intervals between aircraft whose trajectories are common or merging, thus maximizing airspace throughput while reducing ATC workload and enabling more efficient aircraft fuel burn reducing environmental impacts	**B2-85** **Airborne Separation (ASEP)** To create operational benefits through temporary delegation of responsibility to the flight deck for separation provision between suitably equipped designated aircraft, thus reducing the need for conflict resolution clearances while reducing ATC workload and enabling more efficient flight profiles.	**B3-85** **Self-separation (SSEP)** To create operational benefits through total delegation of responsibility to the flight deck for separation provision between suitably equipped aircraft in designated airspace, thus reducing the need for conflict resolution clearances while reducing ATC workload and enabling more efficient flight profiles
B0-86 **Improved Access to Optimum Flight Levels through Climb/Descent Procedures Using ADS-B** The aim of this module is to prevent flights to be trapped at an unsatisfactory altitude for a prolonged period of time. The in trail procedure (ITP) uses ADS-B-based separation minima to enable an aircraft to climb or descend through the altitude of other aircraft when the requirements for procedural separation cannot be met.			
B0-101 **ACAS Improvements** Implementation of ACAS with enhanced optional features such as altitude capture laws reducing nuisance alerts, linking to the autopilot for automatic following of resolution advisories		**B2-101** **New Collision Avoidance System** Implementation of airborne collision avoidance system (ACAS) adapted to [take account of the] trajectory-based operations [procedures] with improved surveillance function supported by ADS-B and adaptive collision avoidance logic to reduce nuisance alerts and minimize deviations	

Performance Improvement Area 4:
Efficient Flight Path – Through Trajectory-based Operations

Block 0	Block 1	Block 2	Block 3
B0-05 **Improved Flexibility and Efficiency in Descent Profiles (CDOs)** Deployment of performance-based airspace and arrival procedures that allow aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with continuous descent operations (CDOs)	**B1-05** **Improved Flexibility and Efficiency in Descent Profiles (OPDs)** Deployment of performance-based airspace and arrival procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with optimized profile descents (OPDs)	**B2-05** **Optimized Arrivals in Dense Airspace** Deployment of performance-based airspace and arrival procedures that optimize the aircraft profile taking account of airspace and traffic complexity including optimized profile descents (OPDs), supported by trajectory-based operations and self-separation	
B0-40 **Improved Safety and Efficiency through the Initial Application of Data Link En-route** Implementation of an initial set of data link applications for surveillance and communications in ATC	**B1-40** **Improved Traffic Synchronisation and Initial Trajectory-based Operation** Improve the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD capability and airport applications, e.g.; D-TAXI, via the air-ground exchange of aircraft-derived data related to a single controlled time of arrival (CTA).		**B3-05** **Full 4D Trajectory-based Operations** Trajectory-based operations deploys an accurate four-dimensional trajectory that is shared among all aviation system users at the core of the system. This provides consistent and up-to-date information system wide which is integrated into decision support tools facilitating global ATM decision-making
B0-20 **Improved Flexibility and Efficiency in Departure Profiles** Deployment of departure procedures that allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity with continuous climb operations (CCOs)			

	B1-90	B2-90	B3-90
	Initial Integration of Remotely-piloted Aircraft (RPA) Systems into Non-segregated Airspace Implementation of basic procedures for operating RPAs in non-segregated airspace including detect and avoid	**Remotely-piloted Aircraft (RPA) Integration in Traffic** Implements refined operational procedures that cover lost link (including a unique squawk code for lost link) as well as enhanced detect and avoid technology	**Remotely-piloted Aircraft (RPA) Transparent Management** RPA operate on the aerodrome surface and in non-segregated airspace just like any other aircraft