IFALPA
The Global Voice of Pilots

Position

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IFALPA Vision for the Future of Air Navigation and Weather Information

This document (18POS03) replaces 15POS18 - The Future of Air Navigation and Weather Information. The changes include the removal of some outdated images and charts.

INTRODUCTION

Since its founding in 1948, IFALPA has always striven to be at the forefront of developments within aviation. In some areas of this endeavour there have been dramatic changes in air navigation, the pace has been gradual with periodic step changes. However, in recent years with the advent of the liberalisation of the airline industry there has been an unprecedented growth in air traffic volume. The growth has, at times, threatened to overwhelm the existing system capacity and a paradigm shift is required for the system to safely keep pace with the explosion in demand. Against this challenging background, and apart from Air Traffic Management (ATM) driven needs for new technologies there have also been developments in the military sector, specifically the growth in Remotely Piloted Aircraft (RPA) technology which has entered the civil arena. Clearly, this also presents significant threats not only for the future of the profession but more importantly, the safety of the air transport system. While the vision originally outlined in this document was rooted in Air Traffic Management work it rapidly became apparent that the outcome of this technical revolution would have an impact on the profession in a much wider context.

ICAO'S ROLE

IFALPA played an active role in the development of the International Civil Aviation Organization (ICAO) ATM Operational Concept (Doc 9854) which set out to create, "a comprehensive concept of an integrated and global ATM system, based on clearly established operational requirements." This concept has set the framework for developing ATM systems that are able to cope with future challenges. As traditional methods and technologies must change to accommodate expected traffic levels, a paradigm shift is considered necessary. The ICAO Global Air Navigation Plan (GANP) (Doc 9750) was developed and represents, "a 15-year strategic methodology which leverages existing technologies and anticipates future developments based on State/industry agreed operational-objectives. The Block Upgrades are organized in five-year time increments that started in 2013. This structured approach provides a basis for sound investment strategies and will generate commitment from States, equipment manufacturers, operators and service providers."

ICAO DOC 9750 contains the following Statement: *"To ensure that continuous safety improvement and air navigation modernization continue to advance hand-in-hand, ICAO has developed a strategic approach linking progress in both areas. This will now allow States and stakeholders to realize the safe, sustained growth, increased efficiency, and responsible environmental stewardship that societies and economies globally now require."*

GOVERNMENT ROLES

Around the world, political leaders have accepted the need for changes to the air transport system and, through Legislation, are making it possible for air navigation service providers (ANSP) to make the changes needed to make the vision a reality. However, the challenge remains that politicians and government officials often lack the detailed knowledge of aviation needed to make informed decisions while also having to take into account the challenges posed by environmental, economic and other issues. In many countries there is the drive to reduce government spending by consolidation of responsibilities. We must guard against that as in certain cases in the ATM environment, there is clear evidence that a separation of service provision from regulation brings significant safety benefit.

Air transport is a global activity and it is essential that flight operations work within a common set of standards and procedures all over the world. It is essential that the resulting system is seamless, with the "right" systems (that is, hardware, software and new or enhanced technologies) being used in the "right" way in order that a total air navigation system can deliver a logical, efficient and safe system.

REGIONAL/NATIONAL ANSP ROLES

In the regions where traffic levels are at their highest, ANSPs have embarked on work to implement new concepts in ATM, the SESAR programme in Europe and the United States' NextGen programme are good examples of this work. It is interesting that while it's stated that each of these initiatives have as a goal, a harmonisation of future system development, this aim has been revealed as one that is fraught with parochial interests and localised political pressures. Accordingly, it is clear that these developments need a firm hand capable of global leadership.

THE AVIATION INDUSTRY'S ROLE

The aviation industry (airlines and operators, manufacturers and suppliers) are working to exploit these technologies and the opportunities they bring. It is developing, or at least promising, even newer technologies at a fast pace. However, it is not always certain that in this work they take into account the needs of the end user, specifically, pilots. This situation is aggravated by the fact that many of the initiatives and research and development programmes have progressed without any (or worse, with incorrect) operational input that brings a realistic perspective of day to day flight deck operation.

IFALPA'S ROLE

The Federation recognises the need to help guide development of the ATM system to ensure that the pilot perspective is adequately taken into account. Set out below are a series statements that are intended to influence the direction of current and future enhancements. They outline, on a functional level, how IFALPA would like to see the Air Navigation System develop from these précises and become detailed policies positions and specifications.

GLOBAL CONSIDERATIONS

A single air navigation system

Air transport is a global activity and it is essential that flight operations work within a common set of standards and procedures all over the world. It is essential that the resulting system is seamless, with the "right" systems (that is hardware, software and new or enhanced technologies) being used in the "right" way so that a total air navigation system can deliver a logical, efficient and above all, safe, system.

One set of procedures worldwide

For an integrated and collaborative air navigation system that is performance based and capable of meeting the needs of aviation in the 21st century, it is of the utmost importance that local procedures are in line with the ICAO provisions (found in the relevant Standards & Recommended Practices (SARPs), PANS and other guidance material) to ensure that pilots are able to safely use common procedures for the same function (in terms of Communication, Navigation and Surveillance) in a truly global and harmonized ATM environment. Clearly, the implementation of new capabilities will need to be deployed initially in the most complex and demanding airspaces and adopted by aircraft with appropriately advanced equipment while the system continues to accommodate less capable aircraft in less stringent requirements. The goal is to provide the best service for the most capable global operators rather than seeking to maximise efficiency by backward compatibility.

Performance Orientation

The air navigation system should deliver the performance standards that have been set out and agreed by the aviation community.

SAFETY IS THE MOST IMPORTANT PERFORMANCE INDICATOR

While air transport has enviable accident rates, the fact remains that if the accident rate does not fall as traffic rises then the number of accidents and casualties will increase. Therefore, a proportional improvement in safety levels must be sought if the risk to the travelling public is to be avoided. Accordingly, safety enhancement is the most important performance parameter in any air navigation system and as such, should never be sacrificed. In fact, the calculated safety level required should not be seen as a target to be reached but a threshold that must be exceeded. As part of the safety matrix, a high level of security is a prerequisite; accordingly the ATM system must be protected from all security threats. While there is no such thing as a zero risk operation, risk must be managed as far as possible at a strategic level. At the heart of this is the application of risk management tools like Safety Management Systems (SMS).

*ATM must serve the needs of the users, and continue to be a **safe** and **efficient** movement from departure to arrival.*

System Considerations

Capacity, efficiency (acceptable delays, costs, etc.), environmental impact and other performance parameters might need to be balanced carefully to achieve the best overall compromise, satisfying most of the expectations of the global aviation community.

AIR TRAFFIC MANAGEMENT (ATM) CONSIDERATIONS

ATM will still be a "Service"

ATM must serve the needs of the users, and continue to be **safe** and **efficient** movement from departure to arrival. Traffic management will continue to focus on synchronizing traffic flows and providing separation where required. As in the early days of Air Traffic Control, when pilots needed a better tool than their eyes to safely operate with ever increasing traffic, the ATM function must continue to facilitate safe and efficient aircraft movements. How air traffic of the future and traffic conflicts will be managed will change from current practices, but the decisive factor is the airspace user's desire for access to the airspace with as little modification of the user preferred trajectory as possible. ***The system must be designed to satisfy user demand***.

Scenario 2025: *If the cost of providing the necessary capacity becomes too high, the users will reduce their demand. It should however be recognized that at national/regional levels political decisions might be taken to limit capacity due to environmental considerations. Aerodrome Infrastructure must be provided with sufficient capacity to accommodate user requirements.*

Airspace will have to be organised (and provided with all the services necessary to accommodate the user preferred trajectories) in a way that provides the best overall efficiency. As airspace is a limited resource, there is a need to optimise the performance of the ATM system. Since commercial air transport is a competitive business, a "network efficiency function" should provide the best overall system efficiency and arbitrate between competing requests from all airspace users for airspace usage. Airspace users will include not only the air transport segment but also general and business aviation, remotely piloted aircraft, high altitude balloons, space based and others. The network efficiency function needs to be designed into the system to prevent unsafe competitive practices by rogue aircraft (those not complying with the network efficiency function).

Capacity/Flow Management and Collaborative Decision Making (CDM)

Where and when traffic capacity is limited (resulting in the need to modify a user preferred trajectory), the system shall offer a number of alternatives for the airspace user to choose his preferred alternate trajectory. This requires a high level of Collaborative Decision Making (CDM). The user community should be involved in pre-defining the above-mentioned alternatives. Flow management units (FMU) should accommodate the needs of airspace users and offer the required flexibility.

CDM should encompass airport operations to ensure seamless gate-to-gate or enroute-to-enroute operations. Airports should be designed "pilot-friendly" to reduce risk on a strategic level (runway incursions and excursions; RESA/EMAS; Surface Surveillance). ***A pilot-friendly airport is an airport where the operations are instinctively logical to the user*** (i.e. simple, globally standardized; no specific ops procedures to compensate bad design). No matter how advanced surface control technologies become, they will never completely eliminate the hazards and inefficiencies of poor airport design.

Planning vs. Flexibility

Proper and complete planning is necessary to maximise the usability of the available airspace. A badly designed system might eliminate the necessary flexibility of the system to accommodate normal and extraordinary occurrences (e.g. contingencies). Strategic and tactical planning must therefore ensure adequate flexibility within the ATM system.

Separation Responsibility and Collision Avoidance

The ATM system must provide a clear role and clear responsibilities for the separators in case of the necessity of tactical intervention. Current overlaps between separation provision and collision avoidance (TCAS) need to be eliminated. Within the overall responsibility for the safety of flights, pilots have a collision avoidance responsibility and use air traffic control's separation provision, onboard automation and decision support as tools to avoid collision.

ENVIRONMENTAL REQUIREMENTS

Environmental requirements and considerations will have to be taken into account whenever implementing new procedures. ***However, changes in present and future ATM systems must not degrade existing safety levels in order to satisfy environmental needs.***

TECHNOLOGY REQUIREMENTS

As the system will, to a large degree, depend on technology, it is paramount that the role of the human as the "master" of the automation is respected and the roles of pilots and controllers be clearly specified. Cockpit tech-

-nology, especially the information displays, should have globally standardised depictions for an application, yet able to accommodate individual preferences. There should only be a single and standardized display and supporting avionics for an application. Mixed equipage issues in an operator's fleet should be minimized for aircraft types.

CNS/ATM technology requirements:

Communication

A reliable, secure, redundant communication system should be available to pilots globally that meets or exceeds agreed communications performance requirements (RCP) for the airspace where the aircraft is operating. Communications will be a mix of voice and data link providing a link between the aircraft, Air Traffic Control, Air Operations Centre (AOC), and flight information services.

Scenario 2025: *Communications will be provided by a combination of terrestrial and space based systems resulting in direct communications with flight crews, the controllers, or other appropriate agencies.*

Navigation

A reliable, secure, redundant navigation system must meet or exceed the required navigation performance standards for a given airspace anywhere in the world. The high accuracy of the actual navigation performance from the GNSS and other navigation systems must not negatively affect safety levels and help prevent controlled flight into terrain.

Scenario 2025: *for space based navigation systems, an augmentation is required; to reduce collision risk due to the high accuracy of satellite navigation systems an Advanced Strategic Offset Concept according to IFALPA's Policy on Embedded Default Lateral Offset is needed.*

Surveillance

A reliable, secure, redundant surveillance system should be available globally to allow direct control of a flight and may be provided by a combination of space based and terrestrial technologies. The surveillance system must be secure, accurate and timely to give not only the air traffic controller the needed information to support their flight management but shared with the flight crews allowing them to make better decisions concerning their flights. The airspace and application will drive the required surveillance performance (RSP) for that operation which may limit or expand the capability of that aircraft operation. Improved surveillance technologies should then allow for changes in the separation standards and collision avoidance. These Airborne Separation Assurance Systems (ASAS) shall be designed to support the human operators' needs.

Air transport is a highly dynamic undertaking in a complex environment, therefore it requires flexibility. This capability is the stronghold of humans and must be central in human- machine interfaces.

Scenario 2025: *A flight will be under positive control by a controller from pushback to gate arrival no matter the location globally or the airspace to be flown through.*

ROLE OF THE HUMAN VS AUTOMATION

The role of the human will be by initial design and not a compromised result of available technology. Air transport is a highly dynamic undertaking in a complex environment, therefore it requires flexibility. This capability is the stronghold of humans and must be central in human-machine interfaces. The future ATM system should therefore be designed to make best use of the strengths of the system operators (e.g. pilots and air traffic controllers/man agers), while supporting them with appropriate tools, such as automation or decision support. The human should however always be in control and be regarded as the ultimate safeguard of system safety. The level of automation and operational flexibility needs to go hand-in-hand.

The human shall remain the final decision maker as to what level of automation is appropriate and what level of flexibility is needed to execute a specific task (e.g. ASAS applications). A change management process will be necessary and will affect recruitment, training and skill requirements in order for the human/pilot to remain the ultimate decision maker.

Current ***RPAS*** technology is not capable of replacing human capabilities, particularly in complex and safety-critical situations. Even if RPA are very sophisticated, they must always be under the command of a human operator.

Automation

The future ATM system will see a high level of automation, with adequate decision support tools. Humans will remain central in the future air navigation system and will be the manager of the automation and act as decision maker. Automation needs to be designed to support the human decision makers. The cooperation of all the human and automated elements (this includes also Remotely Piloted Aircraft in non-segregated airspace) needs to be ensured. Strengths of the human and automation will be maximized. System functions and operator functions need to be clearly separated.

The Pilot in Command must remain in control maintaining responsibility for the safety of the flight even when certain functions are delegated to automation, e.g. uplinked ATC instructions. Under no circumstances shall future automation inhibit the pilot in command's capability to remain the ultimate decision maker and final authority for the safe operation of aircraft. Therefore, initiatives attempting to establish a form of "aircraft remote control" of civil air transport operations are unacceptable to IFALPA. Where humans will have to delegate the execution of tasks to automation they shall be made aware of the status of such automated tasks.

Legal considerations

Aviation regulations (Aviation Law) should always be developed and drafted to ensure the safety of the operation. Any increase in the level of automation must ensure that there are adequate legal protections for all operating personnel. In addition, it should be recognised that the ultimate responsibility and authority for the safe operation of a flight still rests with the pilot in command and therefore any new regulations should reflect that.

The legal considerations also need to reflect the increase in data networking which will include sensitive data being transmitted from air to ground and back again. This data, which will be recorded, voice and data, air and ground, needs to be securely protected by law to ensure that it is used correctly. Legal considerations will also need to ensure that all regulations rely upon a culture that has a rational, logical and objective response to mistakes made in a safety system with a constructive attitude to dealing with human fallibility.

OPERATIONAL CONSIDERATIONS (INCL. TRAINING)

A well structured and in depth training program should develop confidence in and proficiency with the human operators' automated functions. The training program should be required and defined by the national authority, so that every operator becomes familiar and competent with a new system.

Communications should always be appropriate for the phase of the operation and not distract human operators from other safety-critical tasks. A common language, English, should continue to be mandated with proficiency requirements for spoken and written messages. RPA operations must have a designated commander (PiC) and be operated under positive control at all times. The flight must be operated under Rules of the Air and state regulations. All approaches should have vertical guidance. The effect of wake turbulence should be taken into account for all separation standards.

WEATHER INFORMATION

Few factors affect air operations as much as weather: It can impact the safe conduct of flights, but astonishingly, the meteorological information available to pilots before and during their flight has remained almost unchanged over the last decades. By contrast, on the ground, everyone is connected, or will be, in the very near future, when the improvements from the ICAO Aviation System Block Upgrades (ASBUs) Block 1-AMET will come online.

There are many delivery methods of MET information to the cockpit, it is a fact. On the other hand, meteorology is an integral part of the single, seamless air navigation system that is pilots require. By extension, one set of procedures based on an agreed set of MET information is required. Advances in science and new developments will be embraced, but backward compatibility is required. The main driver for changes, for improvements is better performance in all aspects. It is important to remember that safety is the most important performance indicator, and that only with improved MET information will pilots be able to make better, safer decisions in the future.

PILOTS' VIEW OF PRESENT-DAY MET

Weather briefings for airline crews may come out of a brown paper envelope, or appear on the latest devices from Apple or Microsoft. Some private or corporate pilots get internet-based briefings before they fly, even with updates during flight. Others fly with printed or even faxed weather documentation. Low-cost airlines may operate without ACARS, for example, so their pilots have to listen to old-style VOLMET broadcasts. At the same time, other airlines are starting to get benefits from en-route weather updates to the Electronic Flight Bags (eFBs) available in their cockpits, like severe weather avoidance.

ONE STANDARD FOR INFORMATION DEPICTION

With regards to modernisation of weather information and its updates, what is available in the cockpit often lags behind what is available to users on the ground. Some crews work with paper charts, others with computers, and while dispatchers work with other display types. It depends on the technology available. It is clear that very different kinds of meteorological information will co-exist for the foreseeable future. There will be weather representations and forecast in chart form, and electronic information for more advanced applications and users. There will always be cases where electronic information is not available, so provisions must be made for this.

SHARED SITUATION AWARENESS

The weather charts as defined in ICAO Annex 3 will be modernized, because they need to be compatible with the electronic, colour-displays of information across the air navigation system of the future. Colour charts are a requirement. Colour increases situational awareness for the users of paper charts. Pilots will have a more precise understanding of the weather conditions along their flight route using improved charts, and controllers will have access to the same information. The result is ONE picture of the weather ahead, for both pilots and controllers.

HUMAN FACTORS AND TRAINING

All over the world, red traffic lights mean stop. But in aviation meteorology, giant hurricanes are represented by a small symbol, snow isn´t even shown and some weather information arrives as a mix of letters and numbers in the cockpit. The controllers´ weather updates can be completely different. New systems and depictions have to be developed. They will have clear and easy to interpret interfaces, making use of the latest research into information presentation, and will indicate possible dangers and limitations.

SUPPORTING BRIEFING NEEDS

Aviation weather-information is provided by State Organisations in many areas of the world. Each State has its own weather service of aviation weather. Long range flights need global weather information, supplemented by regional products for arrival and departure. Short and medium-range flights need high-quality, regional information. To support easy access to this range of weather information, we need portals covering sizeable areas of the globe. Portals will offer both regional and global meteorological information, charts and displays. They can also serve as a test-bed, where new weather products for aviation can be put online for testing by pilots and controllers.

ELECTRONIC WEATHER INFORMATION

Many airlines have equipped their pilots with eFB, and some are using the second or already third generation of these devices. They make it possible to provide pilots with the same information that is available in ground systems. It is essential that the computing and display capabilities of modern eFB are utilized, with colour for superior visualization of weather information. They have to work roughly similar to car navigation systems, with moving displays and easy handling.

Argentina

Hong Kong

CONNECTING TO THE GROUND NETWORKS

The majority of the information is, or will be, in electronic form, and has to reach the pilots. That is relatively easy on the ground, from briefing through cockpit-preparation, as access to the company network or the internet is available almost everywhere. During flight, providing continuous updates, appropriate to the stage and flight situation, is very different matter, as many aircraft don´t have the electronic connectivity.

STANDARDS

The Block 1-AMET module promotes the establishment of Standards for global exchange of information. These standards are essential to ensure that pilots can share the same information – content that´s moving through the ground networks. What is needed is the link that enables the appropriate weather information, like new satellite pictures, to reach the cockpit. Weather-development information and analysis will finally be available for pilots. Thus supported, they can they be expected to make more appropriate decisions, even when circumstances change.

OPTIONS FOR LINKING AIR AND GROUND

The technical form that such a link might take, will vary from airline to airline, and maybe from airplane to airplane. It might be an enhanced form of ACARS, VHF, data communications, or privileged access to (part of) the passenger satellite communications system. Whatever the link, what is important is that the pilots get the most recent information and updates.

THE INFORMATION REQUIREMENTS

Circumstances define what kind of information is needed; a hurricane near the flight path requires different information than a snow storm. For every flight, a basic information set for situation awareness will be required, as defined today in ICAO Annex 3. It is the task of ICAO and WMO, to define and update an appropriate, basic set of weather information, in colour.

BASIC INFORMATION REQUIREMENTS

The basic set of information today includes alphanumeric and graphical ATIS, METAR and forecasts for aerodromes of departure and destination. A set of charts is required, depicting forecast conditions enroute, like turbulence, wind, thunderstorms and more. This set of significant weather charts will include near real-time ground-radar and high resolution satellite pictures. The planned ground track of flights will be shown on all charts and pictures as this enables pilots to better evaluate the weather along the planned flight track.

SUPPLEMENTAL INFORMATION

When required, the basic sets of information need to be supplemented by defined sets of charts for tropical revolving storms, turbulence, volcanic ash, winter-weather conditions and more. Pilots will always be able to call up any weather information they find necessary, however, provision of situation-appropriate charts needs to be an automated process for consistency and completeness. Gaining access to supplemental information should be easy, via menu buttons on the eFB.

KEEPING IT CURRENT

All this information will be updated continuously, as conditions change, and on a regular basis, at shorter intervals as required by the meteorological phenomena. The computing and display capabilities of eFB will be used to provide displays that show the changing weather conditions along the route – synchronized with real or projected flight progress. Some eFB could exploit 3-D display capability for enhancement, improved interpretation. The new, electronic charts should be similar to and compatible with the paper charts.

ADVANCED CAPABILITIES

Weather impact prognosis systems or decision support tools are becoming available to decision makers on the ground, like dispatch. These systems will also become available in the cockpit. Pilots need the best tools: in developing situations, especially on longer flights, these tools may be giving concise warning long before they become apparent from conventional forecasts or actual met reports. This is envisaged for the B3-AMET timeframe, after 2028, but some of these systems are already available today.

TRAINING AND RULE-MAKING

Enhanced rule-making and training with regards to weather will be a further step towards safer flying: it´s a question of culture-change, of continued instruction and learning. Pilots have realized that aviation meteorology has advanced and has progressed. Some pilots may know of weather impact forecasting systems, but there are huge differences between airlines when it comes to weather. Training in the proper use of modern weather information systems is lacking but is required. An increasing number of weather problems on flights conditions needs to be addressed. Pilots need training on how to safely handle multiple weather phenomena, in combination.

OUTLOOK

Weather is very important to the pilot community. Meteorologists, controllers and pilots need to share their knowledge and add results of new technology and research. This will enable pilots to conduct safer and more efficient flights for everyone. Digital communication, machine-to-machine, makes it easy to overlook that pilots are the decision-makers on the flight deck. They need to be kept up-to-date, fully informed, about the meteorological situation. Thus, they can safely guide their airplanes, avoiding or making use of the weather, flying "with the weather."