A global and seamless air traffic management system:
What is it, how do we get there, the role of the International Civil Aviation Organization (ICAO)
A walk through history

I would like to begin my presentation at the beginning and address the history and evolution of Air Traffic Management (ATM). When the Wright Brothers flew the Kitty Hawk in 1903 there was no need for air traffic control. However, as soon as the second one became airborne and they both flew in the same area, air traffic control was borne. As I am from the United States, I will focus on the progression there however, Europe and the United States have followed a similar progression in their ATM evolution.

So let’s start with the technology and then I’ll move to air traffic control and summarize where we are today and where we are headed. Locating our position on Earth and determining the course to steer to arrive at the next desired point has fascinated man from earliest times. In early times, man marked his trails with sticks or built mounds with stones, something similar and eventually, using celestial navigation as he began to explore the seas and roam farther and farther from home.

In modern times, several methods of navigation were developed, making use of electronic means and instruments with great success.

For pilots, knowing where they were and how to get where they wanted to go was one of the first and most challenging obstacles to overcome especially as they flew longer and longer distances. In the very early days, bonfires were lit and at night...
pilots would navigate visually flying from bonfire to bonfire. One of the first technologies to be introduced to assist pilots in their navigation came along in 1919. Built at intervals of approximately 16 km, the standard beacon tower was 17 metres high, topped with a powerful rotating light. Below the rotating light, two course lights pointed forward and back along the airway. The course lights flashed a code to identify the beacon's number. The tower usually stood in the center of a concrete arrow 25 metres long. A generator shed, where required, stood at the "feather" end of the arrow. The beacons were spaced 10 miles apart. The beacons were depicted on navigation charts along with their number and Morse code.

In the late 1920s, a new type of navigational aid, the low frequency radio range (LFR), also known as the four-course radio range came along. This type of facility could provide guidance even when poor visibility made light beacons useless. By comparing two coded signals, pilots could tell whether they were drifting to the left or right of an airway. For those flying on course, the two signals merged into a single tone. Due to relatively low purchase, maintenance and calibration cost, they are still used to mark locations of smaller aerodromes and important helicopter landing sites although they are gradually being decommissioned.
In 1944, the Very High Frequency Omni-directional Radio Range (VOR) was introduced and large scale implementation continued through the 1950s. VORs, still used today, enable pilots of instrument-equipped aircraft to determine their position more efficiently. The VOR facility transmits two signals at the same time. One signal is constant in all directions, while the other is rotated about the station. The airborne equipment receives both signals, detects the difference between the two signals, and interprets the result as a radial from the station.
First U.S. air traffic controller

So that was a short history of early technology. Navigation was, as stated, the first major hurdle however, as more aircraft took to the skies, they became a problem for each other. Mr. Archie League is widely believed to be the first air traffic controller in the United States. Here, he is shown on duty in his summer office with rolled-up flags in the wheelbarrow and the dangling lunch box. His other equipment included a folding chair, drinking water, and a pad for taking notes.
Archie League – winter outfit

- His communication tools were simple: a red flag for "hold" and a checkered one for "go."

His winter tools were the same, a red flag for "hold" and a checkered one for "go." His uniform however, was a bit different.

Early radio equipped air traffic control tower

In 1930, Cleveland Municipal Airport established a radio-equipped airport control tower.

In the next five years, about twenty cities followed Cleveland's lead. Controller Bill Darby is shown with the latest equipment in this 1936 view of Newark tower.

As aircraft became more sophisticated, faster and increased in numbers, air traffic control also advanced. In 1930, Cleveland Municipal Airport established a radio-
equipped airport control tower. In the next five years, about twenty cities followed Cleveland's lead. Controller Bill Darby is shown with the latest equipment in this 1936 view of Newark tower.

Traffic continued to grow and a few major mid-air collisions resulted in political pressure and newer and more efficient means of air traffic control (ATC). For effective ATC, people and systems on the ground must know the position of aircraft on a continuous basis and be able to estimate their future position. Generally, the idea of keeping track of an aircraft is referred to as surveillance. The most basic way of knowing an aircraft’s position is to communicate directly with the aircraft. The first ATC centres in the United States were equipped with rudimentary communication facilities and controllers tracked progress and kept airplanes apart from each other using blackboards at first and eventually, racks of paper flight strips as a means of noting flight data. However, the system still relied on indirect communications and mental calculations.
The pressure of the military during the Second World War compressed a quarter century of normal peacetime aviation development into a few years. The most important breakthrough for ATC, which emanated from the war, was radar. As the ATC system developed throughout the world, radar became the most important tool used by controllers for surveillance of aircraft and weather. Radar allows the position of an aircraft to be presented on a display, where a controller provides radar control. Radar control is preferable to non-radar or procedural control and allows controllers to bring aircraft much closer together and provide much better flight profiles.

ATC radar in its simplest form, known as primary radar, provides the controller with a visual indication, on a cathode ray tube, of all radar echoes reflected from aircraft within line of sight of the ground based radar facility. The display presented to the controller provides information on the range and azimuth of reflected objects, including aircraft. Because primary radar equipment in no way relies on any action on the part of the pilot or aircraft, it is known as independent surveillance. Secondary surveillance radar (SSR) is composed of a ground interrogator and airborne transponder equipment. The ground interrogator equipment is normally collocated with a primary radar so that targets provided by the primary radar and those provided by SSR could be presented simultaneously on the controller's radar display and, in automated systems, appear as one single target.
Automation

- By the mid-1970s, most developed States had begun implementing semi-automated ATC systems based on a marriage of radar and computer technology.
- By automating certain routine tasks, the system allowed controllers to concentrate more efficiently on the vital task of providing separation.
- Data appearing directly on the controllers' scopes provided the identity, altitude, and groundspeed of aircraft carrying radar beacons.

By the mid-1970s, most developed States had begun implementing semi-automated ATC systems based on a marriage of radar and computer technology. By automating certain routine tasks, the system allowed controllers to concentrate more efficiently on the vital task of providing separation. Data appearing directly on the controllers' scopes provides the identity, altitude, and groundspeed of aircraft carrying radar beacons.

International Civil Aviation Organization

I would like to conclude this portion of the presentation by providing a synopsis of where we stand today in terms of technology and the air traffic management (ATM) system.

The systems described above suffered many limitations. Although the effects of the limitations were not the same for every part of the world, one or more of them inhibited the desired development of ATM almost everywhere.
Communication, Navigation, Surveillance/Air traffic Management (CNS/ATM)

CNS/ATM systems have been under development for 25 years and implementation is moving along very well and many benefits are being attained. With CNS/ATM systems, the transmission of voice continues to take place over existing very high frequency (VHF) channels; however, these same VHF channels are increasingly being used to transmit digital data. Satellite data and voice communications, capable of global coverage, are also being introduced along with data transmission over high-frequency (HF) channels. The secondary surveillance radar (SSR) Mode S, which is increasingly being used for surveillance in high-density airspace, is also being used to transmit digital data between air and ground.

Improvements in navigation include the introduction of area navigation (RNAV) capabilities along with the global navigation satellite system (GNSS). These systems provide for world-wide navigational coverage and are being used for en-route navigation and for non-precision approaches. With appropriate augmentation systems and related procedures, these systems will eventually support most precision approaches.

Improvements in surveillance will see the traditional SSR continue to be used however, there is a gradual introduction of SSR Mode S taking place in both terminal areas and high-density continental airspace. Another major improvement is also taking place with the introduction of automatic dependent surveillance (ADS). ADS allows aircraft to automatically transmit their position, and other data, such as heading, speed and any useful information contained in the flight management system (FMS), via satellite or other communication links, to an ATC unit where the position of the aircraft is either displayed on a screen or is used by automation to update flight information. ADS-broadcast (ADS-B) is another technology used to disseminate aircraft position information. Using ADS-B, aircraft periodically broadcast their position. Any user, whether airborne or on the ground, within range of the broadcast, receives and processes the information. All users of the system have real-time access to precisely the same data, via similar displays, allowing a vast improvement in traffic situational awareness.

In the field of ATM, a more appropriate term is being used to describe the global system we are evolving toward and which has supplanted CNS/ATM. That term: “Global Air Traffic Management”, more appropriately identifies that the advancements in CNS technologies serve to support ATM. When referring to ATM
in this context, however, much more than just air traffic control in the traditional sense is meant. In fact, ATM refers to a system's concept of management on a much broader scale.

The ICAO Global Air Traffic Management (ATM) Operational Concept presents the ICAO vision for an integrated, harmonized and globally interoperable, ATM system and defines ATM as the dynamic, integrated management of air traffic and airspace, safely, economically, and efficiently, through the provision of facilities and seamless services in collaboration with all parties.

The vision statement in the operational concept is to achieve an interoperable global ATM system for all users during all phases of flight that meets agreed to levels of safety, provides for optimum economic operations, is environmentally sustainable, and meets national security requirements.

A key point to note is that the operational concept, to the greatest extent possible, is independent of technology; that is, it recognizes that within a planning horizon of more than twenty years, much of the technology that exists or is in development today may change or cease to exist. This operational concept has therefore been developed to stand the test of time.

**ICAO**

- One of 19 intergovernmental organizations related to the United Nations through special agreements.
- The only internationally recognized governmental body charged with:
  - Establishment of global technical standards and recommended practices
  - Development of guidance material for international civil aviation
  - Foster implementation of air navigation facilities and services
To understand more clearly the development and implementation of a global ATM system, it is also important to understand the International Civil Aviation organization (ICAO). Have you ever wondered how an aircraft manufactured in the United States or Russia can fly from Saudi Arabia to London or New York or from Kiev to Tokyo, or an aircraft manufactured in Brazil can fly from Sweden to France with a German or Norwegian pilot at the controls? How about common standards and accepted practices and regulations for licensing and qualification procedures of the pilots; certification of airframes, engines, communications and avionics equipment? Are they the same in every nation of the world? What responsibility do individual nations have to install navigational facilities and to provide services and other aviation infrastructure? What kind of procedures do air traffic controllers follow in different countries and how would a pilot know what these are? In what language do the pilots and controllers speak to each other? What about customs, security, the carriage of dangerous goods, aircraft registration and markings, noise and environmental regulations? Are there universal reaction times and procedures for fire fighters and rescue operations? Or universal standards for airfield and approach lighting and markings? These are just a few of the many elements that must be looked at when considering the complexities of international civil aviation.

ICAO provides the machinery for the achievement of international cooperation in the air. The primary way in which ICAO accomplishes this is through the
establishment of international Standards and Recommended Practices (SARPs) which cover the technical fields of aviation.

**Standards are Mandatory**

- Standards are binding on all Contracting States
- If a State finds it impossible to comply it must inform ICAO of any differences.
- Recommended Practices are not notified to ICAO but should be published in Aeronautical Information Publications (AIPs)

**ICAO Annexes**

- Annex 1 – Personnel Licensing
- Annex 2 – Rules of the Air
- Annex 3 – Meteorological Services
- Annex 4 – Aeronautical Charts
- Annex 5 – Units of Measurement
- Annex 6 – Operation of Aircraft
- Annex 7 – Aircraft Nationality and Registration Marks
- Annex 8 – Airworthiness of Aircraft
- Annex 9 – Facilitation
- Annex 10 – Aeronautical Telecommunications
- Annex 11 – Air Traffic Services
- Annex 12 – Search and Rescue
- Annex 13 – Aircraft Accident Investigation
- Annex 14 – Aerodromes
- Annex 15 – Aeronautical Information Services
- Annex 16 – Environmental Protection
- Annex 17 – Security
- Annex 18 – The Safe Transport of Dangerous Goods by Air
**Article 12**

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

**Article 28 – Air navigation facilities and standard systems**

Each Contracting State undertakes, so far as it may find practicable to provide in its territory, airports, radio services, meteorological services and other air navigation facilities to facilitate international air navigation, in accordance with the standards and practices recommended or established from time to time, pursuant to this convention;
Article 28 (Continued)

Adopt and put into operation the appropriate standard systems of communications procedure, codes, markings, signals, lighting and other operational practices and rules which may be recommended or established from time to time, pursuant to this convention; and Collaborate in international measures to secure the publication of aeronautical maps and charts in accordance with standards which may be recommended or established from time to time, pursuant to this convention."

These SARPs are incorporated into the eighteen Annexes to the Convention on International Civil Aviation which was established in Chicago in 1944. The set of international standards incorporated under these Annexes has become the core set of standards and regulatory material for world aviation.

Regional Air Navigation Meetings

- To prepare, amend, or supplement a regional plan for facilities, services and procedures.
- Committees
  - AIS, AOP, ATS, COM, MET
- Regional plans
  - Set forth in detail the facilities, services and procedures required for international air navigation within a specified area
  - Governments follow in programming the provision of their air navigation facilities and services, with the assurance that they will form an integrated system
ICAO has an Assembly, a Council and several supporting bodies. The Assembly is considered as the sovereign body of ICAO and is what makes ICAO a global organization. It normally meets every three years to review the work of the Organization in detail and to establish the operating budget for ICAO. The Council is the governing body of ICAO. One of the major duties of the Council is to adopt international SARPs prior to their incorporation into the Annexes. Once a standard is adopted by the Council, Contracting States have an obligation to implement them. As aviation technology advances, the standards are reviewed and amended in order to keep them up to date.

Although the Council has the responsibility for adopting the international standards and approving the procedures associated with these, the principal body responsible for the development of these standards and procedures is the ICAO Air Navigation Commission.

The Council, the Air Navigation Commission and the various committees are assisted in their work by an internationally recruited secretariat. Headed by a Secretary General, it provides the permanent organizational framework for ICAO and provides technical and administrative support to the Contracting States.

Shortly after the establishment of ICAO in 1944, the interim Council recognized a need to divide the world into air navigation regions in order to facilitate the planning and implementation of
ground services and facilities necessary for international air transport operations. While the Headquarters of ICAO is located in Montreal, Canada, there are seven regional offices which are located in Bangkok, Cairo, Dakar, Lima, Mexico City, Nairobi and Paris. As part of regional planning activities, the ICAO Council developed regional planning bodies, which are made up of representatives of nations who meet as the need arises and develop and keep up to date, a regional air navigation plan, which is reviewed and approved by the ICAO Council. This plan establishes the requirements for necessary facilities and services for the further development of international civil aviation. Contracting States agree to implement these facilities in line with the ICAO Convention. The regional plan thus serves as a sort of “contract” between the airspace users and the service providers. There are nine ICAO air navigation regions covering the whole of the Earth. The implementation of all of the regional air navigation plans would lead to a globally harmonized air navigation system.

**Air Navigation Conferences and Divisional Meetings**

- Make recommendations for new Standards and Recommended Practices, Procedures for Air Navigation Services and makes other recommendations.

- A conference is convened when its task encompasses a substantial number of interrelated subjects of world-wide scope falling within several air navigation fields.

Conference and Divisional Meetings make recommendations for new Standards and Recommended Practices, Procedures for Air Navigation Services and make other recommendations as necessary. A conference is convened when its task encompasses a substantial number of interrelated subjects of world-wide scope falling within several air navigation fields.
<table>
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<th>Study Groups</th>
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<tr>
<td>• PBN study group</td>
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<tr>
<td>• Flight plan study group</td>
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<td>• Aircraft classification number</td>
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<tr>
<td>• AIM study group</td>
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<tr>
<td>• Aviation data registry</td>
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<tr>
<td>• Aeronautical information and charts</td>
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<tr>
<td>• Aeronautical meteorological observing systems</td>
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<tr>
<td>• Human resource planning and training</td>
</tr>
<tr>
<td>• Flight safety and human factors</td>
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<tr>
<td>• Meteorological information</td>
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<tr>
<td>• Proficiency requirements in common English</td>
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<tr>
<td>• Simultaneous operations on parallel or near parallel instrument runways</td>
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<td>• World area forecast system</td>
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<tr>
<th>Panels</th>
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</thead>
<tbody>
<tr>
<td>Aeronautical Communication Panel</td>
</tr>
<tr>
<td>Air Traffic Management Requirements and Performance Panel</td>
</tr>
<tr>
<td>Navigation systems panel</td>
</tr>
<tr>
<td>Instrument flight procedures panel</td>
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<td>Operational data link panel</td>
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<tr>
<td>Separation and safety panel</td>
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<td>Aeronautical surveillance panel</td>
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<td>Aerodromes panel</td>
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- Identification of current and future technical requirements for communication systems
- Transition planning to new communication systems
- Technical requirements for air-ground data links
- Frequency spectrum requirements for aviation
- Aeronautical Telecommunication network
Air Traffic Management Requirements and Performance Panel

- Navigation systems panel
- Instrument flight procedures panel
- Operational data link panel
- Operations Panel
- Separation and safety panel
- Aeronautical surveillance panel
- Aerodromes panel

- Operational concepts for a global and seamless air traffic management system
- ATM operational requirements for technical systems
- Performance based ATM transition planning
- Flight Object
- Collaborative decision making
- Integration of NextGen and SESAR into the global ATM system
- Transition guidance for implementation of the new ICAO flight plan

Aeronautical Communication Panel

- Air Traffic Management Requirements and Performance Panel
- Navigation systems panel
- Instrument flight procedures panel
- Operational data link panel
- Operations Panel
- Separation and safety panel
- Aeronautical surveillance panel
- Aerodromes panel

- Identification of all current and future technical requirements of navigation
- Ground based augmentation systems
- Transition planning to new navigation systems
- Satellite based augmentation systems
- Planning for introduction of and operational use of GNSS
• Identification of all current and future requirements for flight procedures
• PANS-OPS criteria for flight procedures
• Performance based navigation flight procedures
• Collision risk modeling

• Operational use and implementation of ATS data link applications
• Automatic dependent broadcast (ADS) broadcast and contract
• Controller pilot data link communication (CPDLC)
• Concept of required communication performance
Air Traffic Management Requirements and Performance Panel

Navigation systems panel

Instrument flight procedures panel

Operational data link panel

Operations Panel

Separation and safety panel

Aeronautical surveillance panel

Aerodromes panel

- Extended range operations
- Independent parallel runway operations
- Land and hold short procedures
- All weather operations
- Flight management systems
- Noise preferential runways
- New fuel carriage requirements
- Thrust settings for optimum fuel burn

Legend:
- Development of horizontal and vertical separation minima
- Establishment of ATS routes using performance based navigation
- Use of RNAV
- Safety assessment methodology for reductions in separation minima
- Safety studies for implementation of CNS/ATM systems
- Operational requirements for implementation of airborne separation assurance systems (ASAS)
Much of the technical work leading to SARPs is carried out by ICAO Panels of the Air Navigation Commission. ICAO Panels are formed in order to advance solutions to technical problems which cannot be solved adequately or expeditiously by the already established facilities of the Commission or the Secretariat. Panels therefore assist the Commission in its work. Panels constitute small technical groups of
qualified experts, nominated by Contracting States and international organizations. Panel members act in their personal expert capacity and not as representatives of any State or organization. The use of panels has evolved and now brings together the best available experts from around the world, under the ICAO umbrella, to examine specialized problems and to find technically feasible solutions which are acceptable to the Contracting States as a whole.

In order to further establish a clear vision of the desired ATM system that the global community should be migrating toward in follow-up of the work already accomplished, the ICAO Air Navigation Commission, in March, 1998, established the Air Traffic Management Operational Concept Panel (ATMCP) to undertake specific studies with a view to developing SARPs, procedures and guidance material necessary for the evolutionary implementation of a globally integrated ATM system. The ATMCP membership was comprised of experts who had been intricately involved with operational concept development work. The International Federation of Air Line Pilots’ Associations (IFALPA) and the International Federation of Air Traffic Controllers’ Associations (IFATCA) were also represented on the ATMCP. This wide range of participation helped to ensure consensus on delicate issues. their work resulted in a global ATM operational concept that was later adopted at the 11th Air Navigation Conference in 2003.

The ATMCP was reformed as the ATM Requirements and Performance Panel in 2003 and is now working on the advanced concepts and procedures necessary to support the global system. Experts from NextGen of the United States and SESAR of Europe participate in the panel and all three major programmes are now merging slowly together.
Eleventh Air Navigation Conference (AN-Conf/11) — Outcome

- That States and PIRGs consider the Global Air Navigation Plan for CNS/ATM Systems as a catalyst for change, providing a global safety and interoperability framework while allowing regional or local adaptation to efficiently meet regional and local needs.

ANC review of Global Air Navigation Plan for CNS/ATM Systems and establishment of ATMCP

- To attain the goal of an integrated, global ATM system, the Global Air Navigation Plan for CNS/ATM Systems needs to be complemented by an ATM operational concept.
- This will require a substantial effort.
- Global consensus will need to be reached.
- Established the Air Traffic Management Operational Concept Panel (ATMCP)
  - Define and study the feasibility of RTSP.
Eleventh Air Navigation Conference

- Endorsed the global ATM operational concept
- Requested ICAO to:
  - develop ATM system requirements
  - address interoperability and seamlessness
  - develop a performance framework
  - develop transition strategies
  - publish the operational concept
  - amend the Global Plan
  - harmonize interregional AN systems
  - establish an ICAO air navigation database

Eleventh Air Navigation Conference

- Corporatization and a more structured regulatory environment were placing increasing pressure on accountability
- It was essential that systems be developed in terms of objectives to be achieved
- An essential prerequisite for the development of a complex system was an understanding of the nature of its performance
The Eleventh Air Navigation Conference in 2003 brought together 1100 people from 122 Contracting States and 20 international organizations. The operational concept was endorsed by the Conference and several important recommendations were made that continue to guide the work toward implementation of a global ATM system. The Conference also recognized that the ICAO Global Air Navigation Plan would be an important implementation planning tool and recommended that ICAO update the document and that States and regional planning groups consider it as a catalyst for change, providing a global safety and interoperability framework while allowing regional or local adaptation to efficiently meet regional and local needs. The 35th Session of the ICAO Assembly endorsed the work of the Conference.
Global ATM – What is it

What is Global ATM

**Physical connectedness**

- A seamless, interoperable, worldwide system based on:
  - Homogeneous ATM areas and Major Traffic flows
  - Common requirements, Standards and procedures
    - Integration (TMAs, aerodromes)
    - Performance based equipment carriage requirements
  - Seamless safety across all regions
    - For all users during all phases of flight

What is Global ATM

**Seamlessness-Interoperability**
What is Global ATM
Meeting expectations

- Meeting the expectations of the aviation community
  - operate along their preferred 4D trajectories
  - scheduling
  - gate availability
  - Other business requirements
- Major impediments
  - the existing ATM system
  - thousands of aircraft operators each have their own best outcomes
  - best outcomes go beyond aircraft operators and extend outward to the larger ATM community as well

What is Global ATM
Wider planning perspectives

- To make even greater gains in efficiency far-reaching cooperation is necessary
- A global vision
- Wider planning perspectives
- Implementation of facilities and services over larger geographical areas
- A global framework for performance measurement
What is Global ATM
Working with ICAO

- ICAO has developed a global ATM Operational Concept which was widely endorsed
- ICAO provides the planning framework through the Global Air Navigation Plan, the regional air navigation plans and several other documents and tools
- Every ICAO Region has identified performance objectives and has developed work programs to foster near and medium term benefits while integrating those programmes with the extensive work already accomplished
- Global interoperability and harmonization are key to making further improvements

The wish of each and every aircraft operator flying in the increasingly complex global ATM system, is that their aircraft would be afforded the opportunity to operate along their preferred four dimensional trajectories (time, speed, vertical, horizontal) at all times. In most cases these preferred trajectories would be based on optimum fuel burn, but additional considerations such as scheduling, gate availability and having the right airplane at the right location would also become much more achievable in this ‘optimized’ air navigation environment.

Currently, the main impediment to the highly efficient scenario noted above is the existing ATM system. This is not the fault of those who provide ATM services—on the contrary, any air traffic controller will tell you that they consistently do their utmost to afford the most efficient flight paths to aircraft while ensuring safety. Air navigation service providers (ANSPs) are also continually making effective improvements—some more so than others—primarily through the implementation of technology and methodologies that make better use of aircraft capabilities; e.g. automatic dependent surveillance-broadcast (ADS-B), performance based navigation (PBN), reduced vertical separation minima (RVSM) and continuous descent arrivals.

Implementing new technology and making better use of aircraft capabilities are not all that can be done. Efforts to improve the productivity of the ANSPs through
identification of key performance areas (KPAs) and the establishment of key performance indicators (KPIs) will doubtless lead to reduced costs to aircraft operators as well as improved service levels across the board. It is logical therefore that aircraft operators are keenly interested in how effectively and efficiently the ANSPs conduct their core business.

The goal of providing a service that supports a four dimensional trajectory is worthy indeed, but the difficulty lies in the fact that thousands of aircraft operators now flying in the increasingly complex global ATM system each have their own best outcomes. To compound this further, best outcomes go beyond aircraft operators and extend outward to the larger ATM community as well.

As business processes improve and ATM community members become more adept at taking advantage of specific, local and organization dependent opportunities, scenarios for additional improvement become very difficult to develop. To make even greater gains in efficiency more far-reaching cooperation is necessary, requiring a global vision, wider planning perspectives, implementation of facilities and services over larger geographical areas and a global framework for performance measurement. Put another way, greater opportunities for efficiency gains will only come through implementation of a more global and seamless ATM system.

A global ATM system can be described as one which achieves interoperability and seamlessness across all regions for all users during all phases of flight. It needs to meet agreed levels of safety, provide for optimum economic operations, be environmentally sustainable and meet national security requirements.

Consider for a moment Reduced Vertical Separation Minimum (RVSM), which was first implemented in 1997 in the airspace of the North Atlantic followed by Europe, the Pacific, Asia, the Middle East, the Europe/South America corridor, the Caribbean and South and Central American Regions and in Africa. Implementation continues and RVSM will soon cover all airspace around the world.
The Challenge

- Disparate systems
- Rigid structures
- Limited collaboration
- Limited information exchange
- Advanced avionics capabilities underutilized
- Long lead times for system improvement

The Challenge

- Technology is not the problem
  - Safety assessment must be conducted at global and regional levels
  - Ensure that costs equal benefits
  - Aircraft equipage
  - Funding
  - Training
  - Approvals and regulatory issues
  - Transition strategies
Global ATM also refers to the fact that more and more, ATM user community expectations must be met. To meet expectations, targets must be established and performance measured. Additionally, requirements for equipment carriage and proliferation of operating procedures must be kept to a minimum through cooperation and harmonization. ICAO provides the guidance material to ensure that
everyone works together, in the same way toward establishing performance objectives and measuring progress. This guidance includes the ATM Operational Concept which provides the overall vision of a performance based ATM system, the Manual on ATM System requirements which converts the vision of the operational concept into material specifying the functional evolution of ATM, the Global Air Navigation Plan which identifies of the most appropriate operational improvements to achieve near-and medium-term benefits on the basis of current and foreseen aircraft capabilities and ATM infrastructure, and the Manual on global performance of the ATM system which provides a broad overview of the tasks needed to be undertaken to transition to such a system.
Performance Framework Form

- Performance objective:
- Regional performance objective:
- National performance objective:
- Benefits:
- Strategy:
- ATM operational concept components;
- Tasks:
- Timeframe:
- Responsibility:
- Status:
- Linkage to global plan initiatives (GPIs):

Performance framework

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<thead>
<tr>
<th>ATM OC COMPONENTS</th>
<th>TASKS</th>
<th>TIMEFRAME</th>
<th>RESPONSIBILITY</th>
<th>STATUS</th>
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<td>AOM</td>
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<td>- Reductions in fuel consumption;</td>
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<td>- Ability of aircraft to conduct flight more closely to preferred trajectories;</td>
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<td>- Facilitate utilization of advanced technologies (e.g., FMS based arrivals) and ATC decision support tools (e.g., metering and sequencing), thereby increasing efficiency;</td>
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<th>Proposed Metrics</th>
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<td>Total Number of PBN Routes</td>
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<td>Estimated saving in CO2 for each new route</td>
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NextGen SESAR Symposium

- 8 to 10 September
- How do we serve these programmes
- How do we ensure everyone works under one umbrella
- How do we integrate the standards making efforts
- How do we ensure a global seamless ATM system
- How do we ensure that we are meeting the needs of every ICAO region
- Establish a steering committee to integrate the standards making and guidance development process

SESAR & ICAO

- SESAR Definition Phase outputs are consistent with latest ICAO guidance
  - Performance target setting, planning and transition
  - Operational Concept
  - Global Plan
- SESAR is prepared to further efforts on worldwide standardisation supporting its goals and facilitating transition
- Success of European developments is both
  - A model and catalyst for other regions
  - Dependent on global progress
- Appreciation of recent achievements under ICAO auspices
  - PBN, PBT manual, AIXM v5
SESAR & ICAO

• SESAR needs more ICAO material to ensure interoperability
  Information Management (data models, quality of service requirements, sharing rules, distribution process)
  – New flight plan / flight object
  – New procedures, in particular for trajectory exchanges & “contracts”
  – D/L applications for trajectory data exchange

• These are prerequisite to new technological considerations
  – Choice of enabling CNS technologies should limit proliferation of systems in a short period of time

• Suggested area for particular attention
  – UAS (sense & avoid: new rules & technologies)

SESAR & ICAO

• ATM Master Plan underlines the importance of ICAO action, leading to global interoperability, in particular
  – Timely availability and effective application of SARPS & PANS material based on validated concepts/technologies, allowing regions with early needs to progress at the pace required by their traffic volumes/density
  – Coordinated, synchronised plans for synergies across regions and consistent requirements on airspace users
**NextGen**

- The NextGen and SESAR concept are based on the ICAO Global ATM Operational Concept which represents a globally harmonized set of concepts for the future.

- We recommend that ICAO assess NextGen and other future systems to advance harmonization efforts and to ensure global collaboration in the development and acceleration of standards for required future systems.

- Continue to evolve the guidance through the ATMRPP.
SESAR/NEXTGEN/ICAO relationship

• There should be a roadmap detailing delivery by all to meet the ICAO Global Plan
  – without this there will be 3 separate deliverables with regional deliverables as others pick and choose the best from either.
• IFATCA has stated that it is focused on meeting ICAO aspirations through its delivery of the Global Vision
• If we want to cement our position with ICAO we must be supportive of that process and ensure that SESAR and NEXTGEN are fully integrated and deliverables are reinforced through SARPS etc.
• What cannot happen is regional based solutions be it ADS B/4D/trajectory/conflict management etc without it having global regulation and harmony.
The aviation community has been working on ATM operational improvements steadily since the 1920s. The work accelerated with the onset of CNS/ATM systems. Technology development has been more rapid in recent years and improvements are now coming about more quickly. A major operational improvement was the implementation of RVSM, which brought significant operational benefits to aircraft operators in terms of reduced fuel burn, availability of optimal flight levels, an increase in capacity, as well as environmental benefits.

ICAO has a central role to play in planning for the implementation of operational improvements. In addition to developing the necessary standards and guidance material, ICAO has developed a global ATM Operational Concept that was widely endorsed and used as the basis for planning. ICAO also provides the planning framework through the Global Air Navigation Plan and several other documents and tools that support planning and implementation efforts.

Every ICAO Region has identified performance objectives and has developed work programs to foster near and medium term benefits while integrating those programmes with the extensive work already accomplished.
Global interoperability and harmonization are key to making further improvements to the global ATM system. In fact, most improvements can only be made through recognition of the need to work at the global level and to cooperate at a global level. This requires a broader more inclusive vision, a wider planning perspective and planning for implementation of facilities and services over larger geographical areas. It also requires a global framework for performance measurement.

Both NextGen and SEAR, the two largest ATM implementation efforts are working toward integration and harmonization, through ICAO as we continue our work toward implementation of a more global and seamless ATM system.