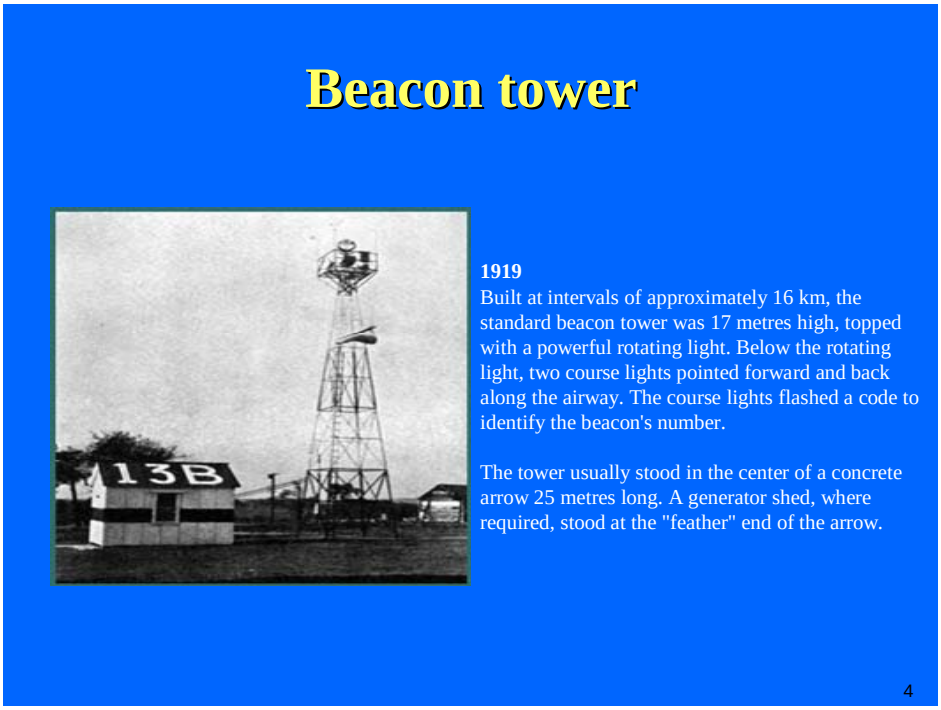
Vince Galotti

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)

Vince Galotti
International Civil Aviation Organization

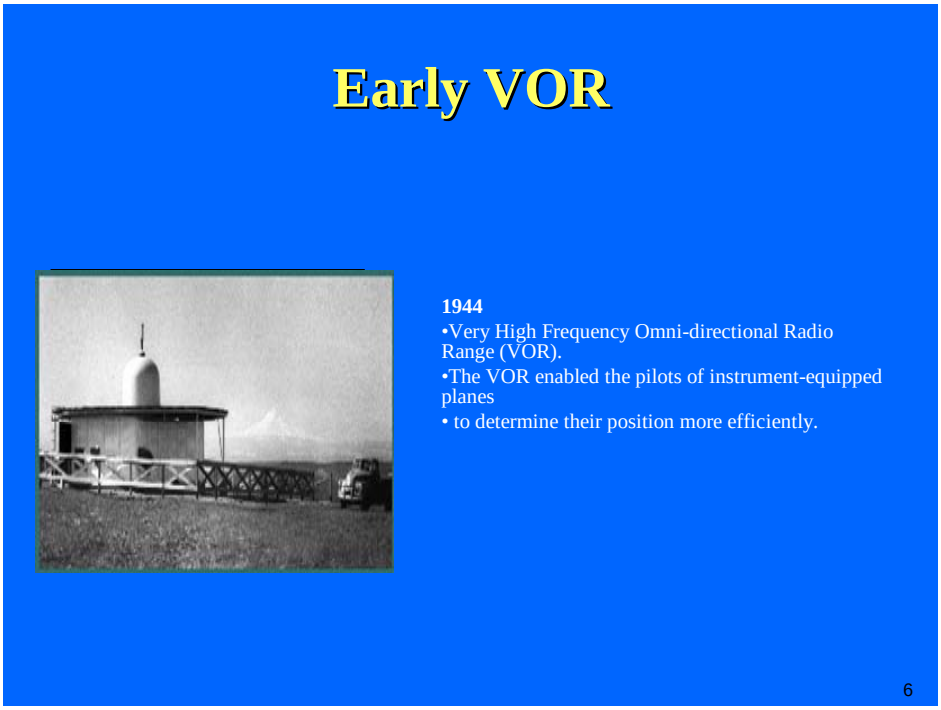
A walk through history

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



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.

Archie League – winter outfit

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

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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.

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As aircraft became more sophisticated, faster and increased in numbers, air traffic control also advanced. In 1930, Cleveland Municipal Airport established a radio-

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.

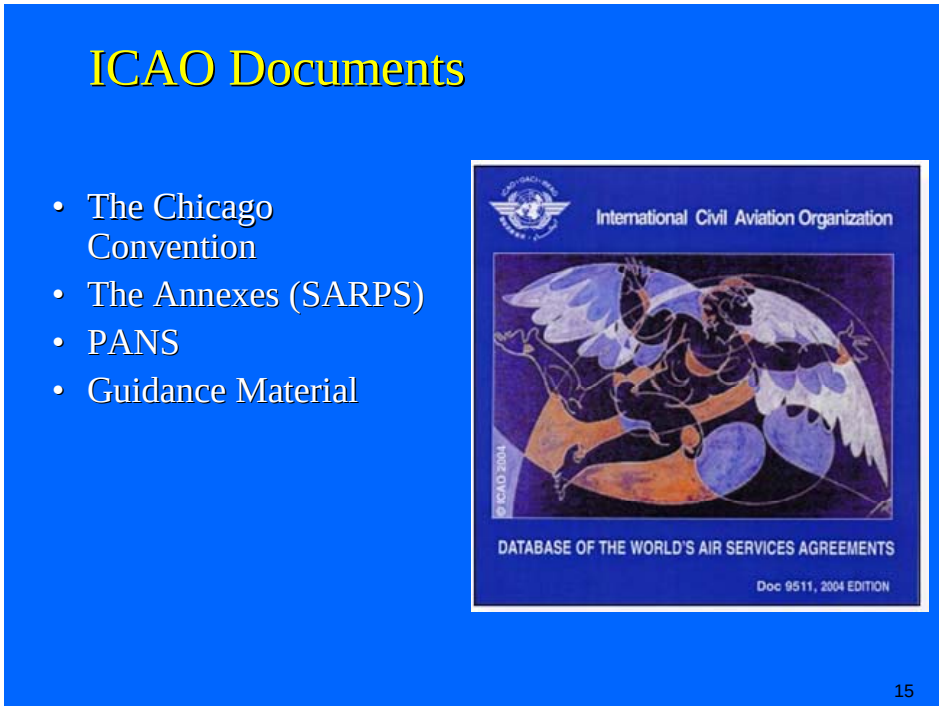
Communication, Navigation, Surveillance/Air traffic Management (CNS/ATM)

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



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

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.

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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;

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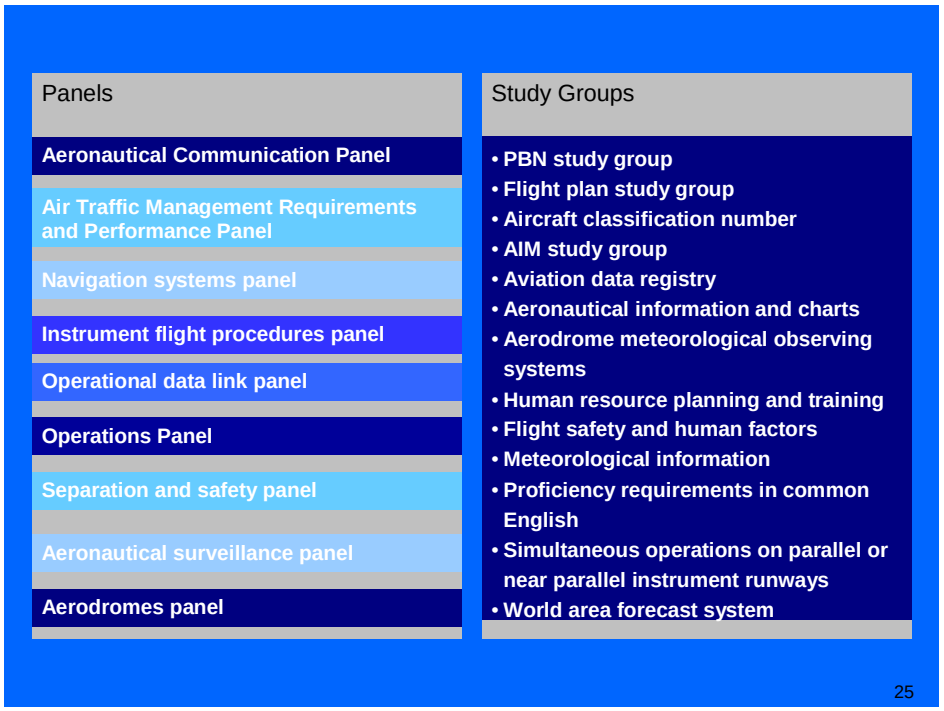
ICAO has an Assembly, a Council and several supporting bodies. The Assembly is considered as the sovereign body of ICAO and is what makes ICAO a global organization. It normally meets every three years to review the work of the Organization in detail and to establish the operating budget for ICAO. The 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


Panels
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
Study Groups
• PBN study group
• Flight plan study group
• Aircraft classification number
• AIM study group
• Aviation data registry
• Aeronautical information and charts
• Aerodrome meteorological observing systems
• Human resource planning and training
• Flight safety and human factors
• Meteorological information
• Proficiency requirements in common English
• Simultaneous operations on parallel or near parallel instrument runways
• World area forecast system
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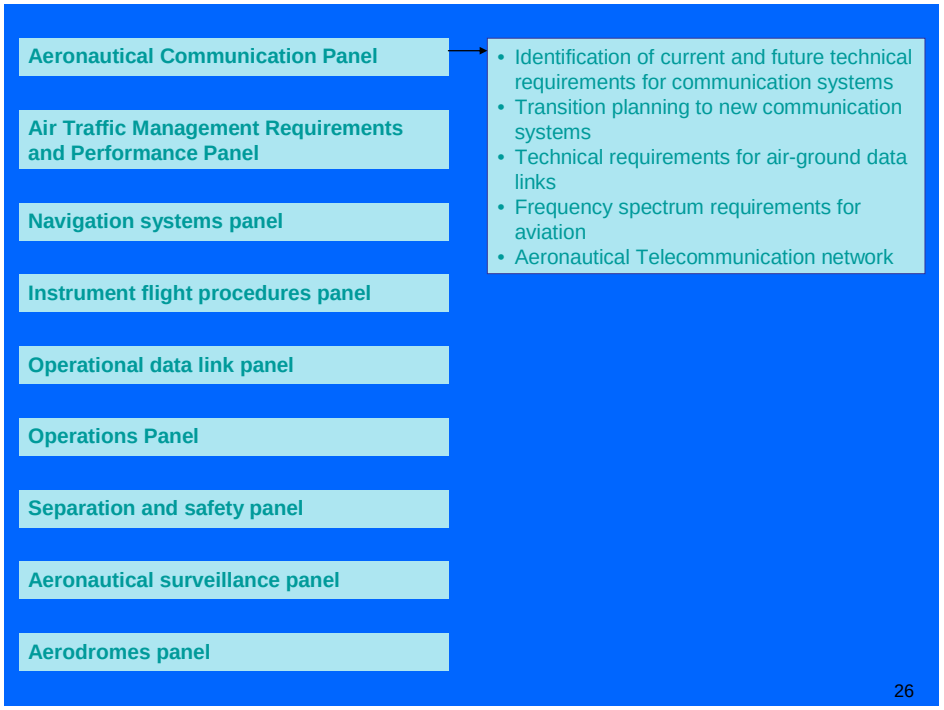
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Aerodromes panel
• Identification of current and future technical requirements for communication systems
• Transition planning to new communication systems
• Technical requirements for air-ground data links
• Frequency spectrum requirements for aviation
• Aeronautical Telecommunication network
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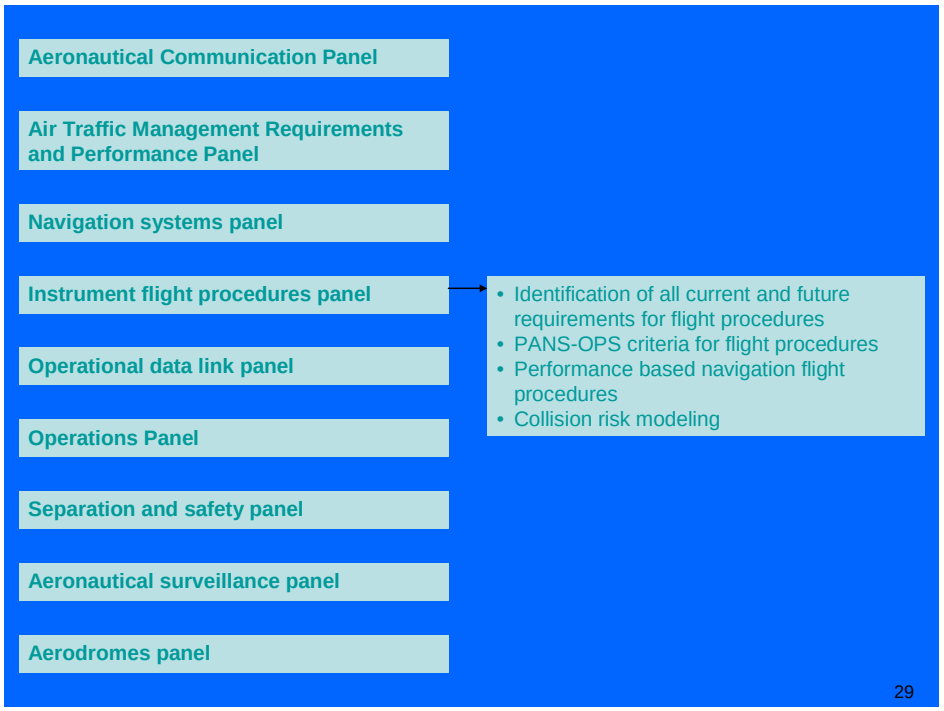
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• Identification of all current and future requirements for flight procedures
• PANS-OPS criteria for flight procedures
• Performance based navigation flight procedures
• Collision risk modeling
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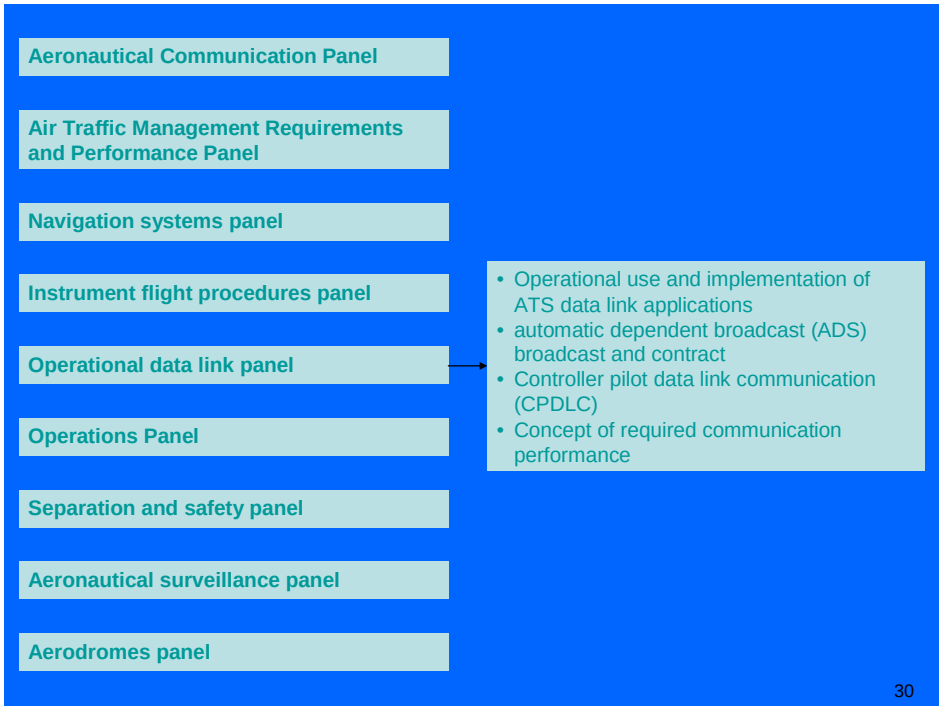
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Aerodromes panel
• Operational use and implementation of ATS data link applications
• automatic dependent broadcast (ADS) broadcast and contract
• Controller pilot data link communication (CPDLC)
• Concept of required communication performance
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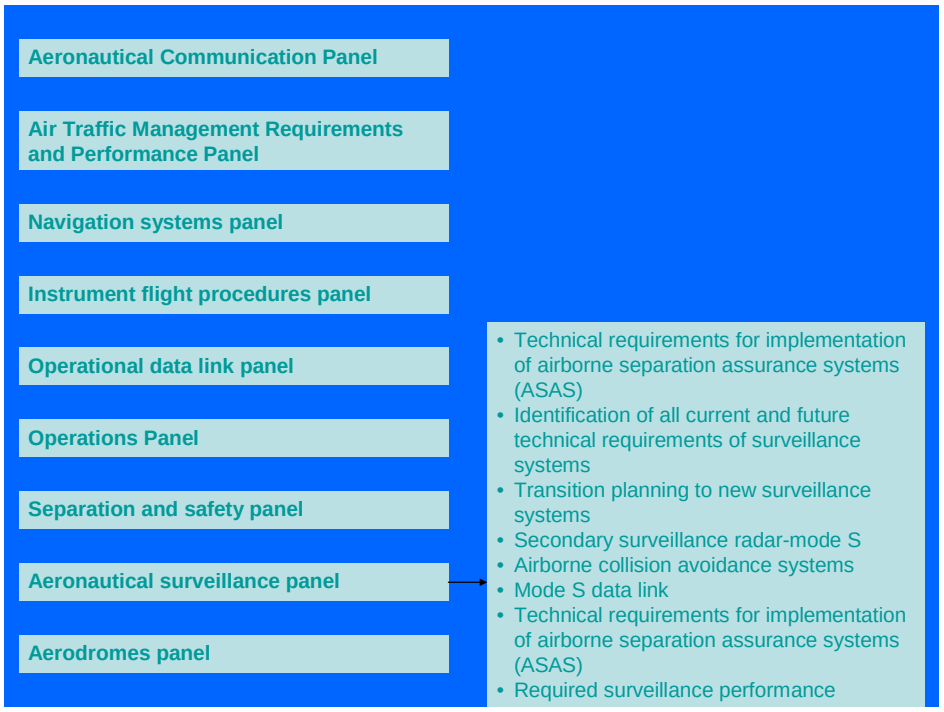

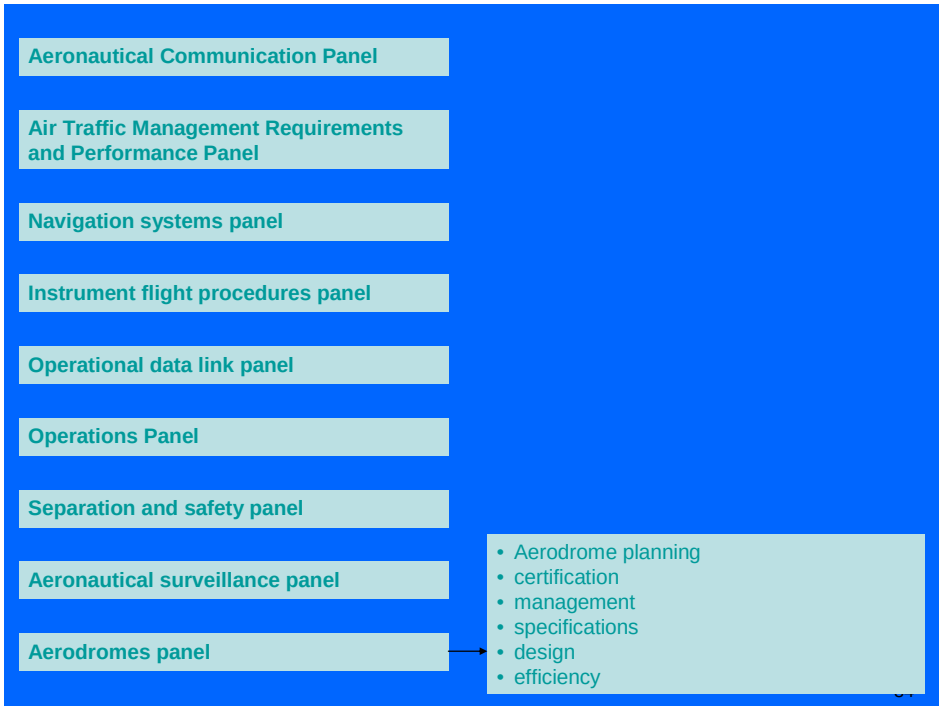

Much of the technical work leading to SARPs is carried out by ICAO Panels of the Air Navigation Commission. ICAO Panels are formed in order to advance solutions to technical problems which cannot be solved adequately or expeditiously by the already established facilities of the Commission or the Secretariat. Panels therefore assist the Commission in its work. Panels constitute small technical groups of

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

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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

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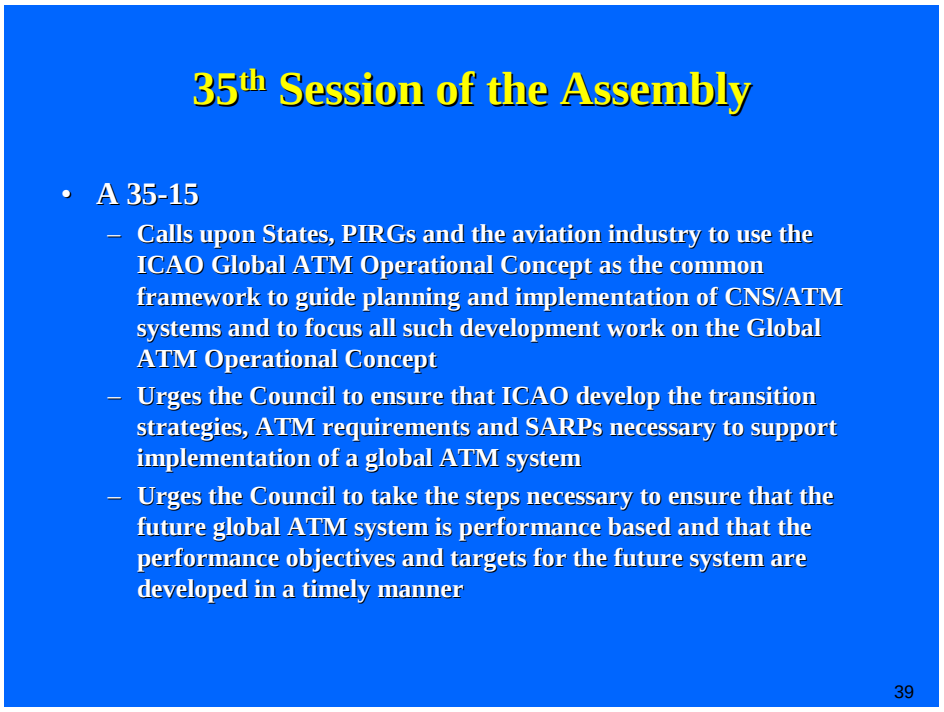

The Eleventh Air Navigation Conference in 2003 brought together 1100 people from 122 Contracting States and 20 international organizations. The operational concept was endorsed by the Conference and several important recommendations were made that continue to guide the work toward implementation of a 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.

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

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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

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