Base on PBN’s General Aviation Airspace Planning Research

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Abstract: At present, all kinds of general aviation in China developing fast. The market of general aviation facing the never seen before appeared challenges. Improve the utilization of airspace resources and expand operational capability of general aviation have become very urgent task. Nowadays PBN Navigation can be used for the operation of general aviation. Improving the utilization of airspace resources, promoting the quality of the flight operation and ensuring flight safety under the same condition. This paper put forward the basic procedure method and operational recommendations for PBN based airspace planning by studying the PBN based airspace planning method.

1. Introduction
With the continuous development of China’s low altitude opening policy, China’s general aviation is developing rapidly. At present, the total number of general aviation aircraft operated by our country has exceed 2000. General aviation has been widely used in pilot training, emergency rescue, line pipe patrol, forest-fire prevention, marine aviation commute, tourism and sightseeing, aerial photography, entertainment aviation and many other service field. General aviation has become an important part of improving China’s civil aviation service level and promoting economic development as same as transport aviation.

The slow advance and slow development of China’s low altitude opening policy of air traffic have much to do with the unclear usage method, characteristics of China’s air traffic in the area of air traffic and the imperfect way of supervision over air traffic. This resulted in extensive development of general aviation airspace, inadequate use of supervision, and ineffective protection of flight safety. These objective factors are also the important reasons why the low altitude opening of China’s general aviation has not yet achieved a major breakthrough and the general aviation can not improve the quality of service. At present, China’s general aviation development policy signal is strong, industrial capital and investment funds are highly concerned. China’s general aviation will usher in a new round of development boom, the general airport serving general aviation flight will also usher in a new construction climax. With the support of the policy, our country should apply the new PBN technology to general aviation to realize the healthy and rapid development of general aviation in China.

The superiority of PBN enables it to better integrate with general aviation. Higher requirements for track control, safety and flexibility are put forward by the greater differences between general airports and operating areas. The complexity of fleet composition and the flexibility of business content urgently need a unified national and even global operation mode. The implementation of PBN in
general airport can no longer rely entirely on ground navigation facilities as traditional flight procedures, such as VOR, DME, NDB, ILS and so on. Thus reducing the construction and maintenance of ground equipment and significantly reducing airport construction. The PBN program is implemented for general aircraft. The optimal flight path can be implemented horizontally and the sustainable descent can be implemented on the vertical section, which can reduce flight time, increase traffic flow and airspace capacity, reduce fuel consumption and greenhouse gas emission. Not only reduce operating costs, but also green environmental protection.

2. Research Status and Development Trend at China and Abroad
Currently, navigation based on PBN has been widely used in transport aviation, and can also be applied to general aviation. With the wide application of PBN airborne equipment and the reduction of cost, it is possible to install various types of PBN airborne equipment in general aviation aircraft. At the same time, transport the airport PBN flight programming capabilities can also be easily transferred to general aviation airports on the basis of VFR and IFR flight procedures. By applying the latest PBN technology to general aviation, it can improve the flight safety of general aviation, use airspace more efficiently and conduct flight supervision more conveniently. Therefore, it can effectively solve the problems of high difficulty of general aviation airspace delimitation, high efficiency in airspace use, flight safety and low altitude supervision. Break through the technical bottleneck of general aviation in the use of airspace, and promote the rapid development of general aviation services.

China has signed a letter of intent with the International Civil Aviation Organization (ICAO) for the Asia Pacific Regional PBN flight procedure office, which is in line with the international practice in terms of technology application, program design concepts and personnel training. China's civil aviation PBN implementation will be divided into three stages, the recent implementation of PBN key applications, the medium-term implementation of PBN comprehensive applications, and long-term implementation of PBN and CNS/ATM system integrations. At present, Lhasa, Linzhi, Lijiang, Xiamen and other airports PBN program has completed the design and flight test validation, accumulated a certain amount of PBN operation experience.

3. General Aviation Airspace Planning Method Based on PBN
According to the characteristics of general aviation development in China and the experience of applying PB technology to general aviation development in Europe and America, the general aviation airspace planning based on PBN mainly includes the following aspects:

3.1. Application Scope and Capability of PBN Navigation in General Aviation Airspace
Currently, China's general aviation low altitude airspace is classified by controlled airspace, surveillance airspace, reporting airspace and visual flight routes. Instrumented flights are allowed in controlled airspace and visual flights are allowed in surveillance, reporting airspace and visual flight routes. PBN navigation can be used not only for instrument flight but also for visual flight guidance. By studying the characteristics of general aviation for various types of flights, the range and capability requirements of PBN navigation are determined. For example, the feasibility of applying PBN technology in flight transit training, oil pipeline patrol, highway rescue, City patrol and other specific flights, the requirements for airborne equipment, the use of navigation equipment, and the determination of possible navigation specifications.

3.2. Characteristics and Requirements of General Aviation in Various Airspace Uses
The general aviation flight area can be divided into airport area, flight area and operation area. But general aviation has many kinds of flight, wide range and low altitude. The requirements of different general aviation flights to airspace have their own characteristics and require more complicated. This project will further refine the characteristics of the airspace requirements for different types of general
aviation flights, more clearly define their spatial scales and the relationship with other airspace, and provide a technical basis for the effective designation and efficient use of airspace.

Figure 1. Characteristics of airspace usage based on PBN

3.3. Define the PBN Planning and Design Methods and Recommendations for General Aviation Airspace

According to the characteristics of different types of general aviation, refine the navigation performance and accuracy requirements of general aviation in different flight types, flight stages and different airspace environments. To determine the space scale and related performance requirements of the PBN program, and set a alarm threshold in the PBN airspace to ensure the flight in the designated area. And then formulate specifications and standards for all kinds of general aviation mm airspace planning and design. Define programming requirements and navigation equipment requirements.

Figure 2. Design of general aviation PBN instrument and visual program

4. The Next Stage Needs to Be Completed

Research on the characteristics of various types of general aviation flight, define the feasibility of applying PBN technology in various specific flights, the scope and capability requirements of PBN navigation, and determine the navigation modes that can be used in various general aviation flights. According to the area and type of general aviation flight and from the relationship between the space scale and the width of the protection area of all kinds of generally aviation flight with the flight safety guarantee such as take-off, climb, cruise, operation and descent of aircraft. Determine the relevant technical parameters required for general aviation airspace planning based on PBN to provides technical support for effective delimit and efficient utilization of airspace. Define the width of protective areas for all kinds of general aviation flight, the connection of protective areas and turning areas in different flight phases. And propose the general aviation airspace planning method and recommended standard specification base on PBN.
5. Concluding Remarks
The application of PBN in general aviation planning can provide the corresponding technical reference for general aviation airspace planning, improve the efficiency and rationality of general aviation airspace planning. Fully tap the airspace resources of our country and expand the airspace of general aviation flight. Effectively solve the difficulties of general aviation airspace delimitation, airspace efficient use, flight safety and low altitude supervision. To break through the technical bottleneck of low altitude airspace development and promote the rapid development of general aviation services. At present, general aviation has begun to widely use airborne GAMIN navigation and display equipment such as GPS. Through this project, the airspace of general aviation flight planning can be integrated into navigation system, which can be widely used in general aviation, improve the flight safety of general aviation, and can use airspace more effectively. Using PBN program for airspace planning can ensure the guidance of general aviation in the flight route and area, enhance the flight safety under visual conditions. It can ensure the interval between general aviation aircraft and other airspace aircraft and enhance the ability of general aviation aircraft to use airspace dynamically. Through the combination of geographical information system to enhance the situational awareness of general aviation aircraft, improve the safety interval between aircraft and aircraft, between aircraft and terrain, improve the planning and management of airspace based on PBN, and promote the rapid development of general aviation.

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