

PROBLEM OF COORDINATION THE USE OF NATIONAL GNSS SYSTEMS

Anatoly Kapustin, Gennady Zhukov,

THE RUSSIAN PEOPLE'S FRIENDSHIP UNIVERSITY

kapustin@mail.rudn.rssi.ru; g-zhukov@mtu-net.ru

ABSTRACT

This paper put for discussion the idea of creation one consortium in charge to coordinate the use of national GNSS systems for the civil aviation, maritime and land traffic management. One should found the idea of creation the international commercial consortium on financial and economic facts. The common efforts may enable national GNSS systems to penetrate more actively the market for satellite navigation service. The coordination of national GNSS activities by one body would facilitate the interoperability and continuity of the satellite navigation system. This also may help to resolve the problem of liability for this kind of activity.

INTRODUCTION

In the paper the attempt is made to investigate prospects of development of international cooperation in commercial use of navigation satellites systems. Two operational systems: GPS (USA) and GLONASS (RUSSIA) are of double purpose. The paper is interested only by a civil part of these systems. GALILEO system will be in commercial operation phase from 2008. GALILEO system is Europe's global navigation satellite system, providing highly accurate global positioning service under civilian control. GPS, GLONAS and future GALILEO are interoperable. Users will receive GPS, GLONAS and GALILEO signals on the same receiver.

Copyright © 2005 by the authors.
Published by the American Institute
of Aeronautics and Astronautics, Inc.,
with permission. Released to AIAA
in all forms

GNSS will have to address the needs of all transportation means, whether on land, railway, sea or air, as well as the needs of space systems. It is most likely to include enhanced broadcast capabilities and to be associated with complementary communication functions which will be needed for instance for telematics applications (road traffic reporting and forecasting, fleet management systems) and Automatics Dependent Surveillance (ADS) for air traffic management. The GNSS was introduced as a supplementary means of navigation in 2005-2010 and should be as a sole means for all flight phases in near future.

THE FIRST STEP ON THE WAY TO INTERNATIONAL COORDINATION

The huge possibilities of using national navigational satellite systems were estimated by international organizations. Each of these organizations not only has appreciated the use of GNSS services possibilities at its true value, but also has tried to formulate their position in this question. The ICAO was the first to define its position from the point of view of an advanced stage of air navigation development.

In 1998 the ICAO Assembly adopted a Charter on Rights and Obligations of States Relating to GNSS Services.¹ The Charter is based on the Chicago Convention. Article 44, which states ICAO's objective "to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport". In the Charter the ICAO Assembly agreed that the following principles should apply to international GNSS services:

1. States recognize that the safety of international civil aviation shall be the paramount principle in the provision and use of GNSS,

2. States and aircraft shall have access, on a non-discriminatory basis under uniform conditions, to the use of GNSS services,

3. (a) States preserve the sovereignty of their own airspace and the right to control aircraft operation in their sovereign airspace; (b) GNSS providers shall not restrict States control over their sovereign air space.

4. GNSS providers "shall ensure the continuity, availability, integrity, accuracy and reliability of such services, including effective arrangements to minimize the operational impact of system malfunctions or failure, and to achieve expeditious service recovery. Such State shall ensure that the services are in-accordance with ICAO Standards".

5. States shall co-operate to secure the highest practicable degree of uniformity of GNSS services.

6. GNSS charges shall comply with the Chicago Convention, Art 15.

7. States shall be guided by the principle of cooperation and mutual assistance in planning and providing GNSS

8. In providing GNSS States shall give due regard to interests of other States,

9. States may provide GNSS Services jointly with other States.

Legally, the Charter on Rights and Obligations, as an ICAO Resolution, does not bind ICAO member states like a treaty.

THE SECOND STEP ON THE WAY TO INTERNATIONAL COORDINATION

Other international organizations and joint ventures also have demonstrated their interest to the GNSS Services. Among these IMO, WMO, WTO and many other.

The involvement of IMO is, and will continue to be, positive and interactive and consideration is being given to the establishment of a forum whereby meaningful discussions can take place with air and land users, to resolve difficult mutual institutional matters and consider a joint way forward. The policy recognizes that maritime users are expected to be only a small part of the very large group of users of a future GNSS and that maritime users may not have the highest operational requirements.

The Global Positioning System makes a huge contribution to the meteorological and climate aspect of environmental monitoring and has a tremendous potential to make much more. In the field of operational meteorology, it has already become the prime system for determining position information for balloon soundings

and hence for measuring balloon height and obtaining wind speed information. Ground-based GPS receivers can provide an estimate of the total precipitable water in the column above the receiver and hence the total latent heat available, which is a major input for Numerical Weather Prediction models. Satellite-based receivers can measure vertical profiles of temperature from 5-7 km to 40 km and above using the so-called radio-occultation approach, where the refraction of the GPS signal through the atmospheric limb is determined twice per receiver orbit from every GPS satellite. This can provide as many as 500 profiles per day, uniformly distributed around the earth, and thus offers the exciting prospect of complete global coverage in space and time from a constellation of receivers used in conjunction with a subset of the current costly radiosonde system. This space-based application of the GPS system has been named GPS/MET, and continuing research will extend its capabilities beyond the current highly-promising results.

GPS/MET will also make a major contribution in the area of climate monitoring in that it can provide long-term, accurate, consistent measurements of mean temperatures on a regional and global scale which are very difficult or impossible to make from earth-based sensors. Measurements of stratospheric temperatures will contribute to understanding the ozone problem, particularly in respect to predicting the formation of polar stratospheric clouds in conditions of extreme cold. These clouds play a key role in the ozone depletion cycle, while stratospheric cooling itself may exacerbate ozone losses.

GNSS will have to address the needs of all transportation means, whether on land, railway, sea or air, as well as the needs of space systems. It is most likely to include enhanced broadcast capabilities and to be associated with complementary communication functions which will be needed for instance for telematics applications (road traffic reporting and forecasting, fleet management systems) and Automatic Dependent Surveillance (ADS) for air traffic management. The GNSS should be transformed from a supplementary means of navigation in 2005-2010 to a sole means for all flight phases in 2010-2015.

Since satellites have only a limited lifetime, space segments must be continuously maintained and updated. Ground segments must be extended to provide greater geographical cover-

age and improved services. Applications share will be 92% for terrestrial (mainly car navigation and consumer/cellular applications), 4.5% for aeronautical, 2% for maritime, and only 1..5% for military applications.

THE THIRD AND LAST STEP ON THE WAY TO INTERNATIONAL COORDINATION

The future GNSS should be developed in parallel to the present GNSS, or could evolve, in part or in whole, from the present GNSS.

In advance of full system implementation, a regional system that is fully operational and which has the potential to be a component of a global system, may be recognized as a component of a future GNSS.

The future GNSS should have institutional structures and arrangements for control by an international civil organization in particular representing the contributing Governments and users.

The international civil organization should have institutional structures and arrangements to enable it to provide, operate, monitor and control the system to the predetermined requirements at minimum cost.

These requirements can be achieved either by the use of an existing organization or by the establishment of a new organization. The organization can provide and operate the system by itself or monitor and control the service provider.

IMO itself is not, for instance, in a position to provide and operate a GNSS. However, IMO has to be in the position to maintain control over the following aspects of a GNSS:

- the continued provision of the service to the maritime users;
- the operation of the GNSS in respect of its ability to meet the maritime user requirements;
- the application of internationally established cost-sharing and cost-recovery principles; and
- the application of internationally established principles on liability issues.

At a certain stage of GNSS development the international organizations interested in use of national navigational systems, should precisely determine their interest in this sphere and formulate a position similarly to ICAO. After that the coordination of positions is required on the part of international organizations. When the interested Parties will come to an agreement at a political level in business should enter the lawyers-experts, that to transfer political arrangement into legal principles. The optimum solution is the inclusion of a question in the COPUOS and its legal subcommittee agenda. The COPUOS task will consist in elaborating Legal Principles of GNSS Use. Obviously on it the lot of time is required. After COPUOS will fulfil his task, and the General Assembly of the United Nations will approve "Legal Principles of the GNSS Use for Peaceful Purposes" there will be a need for the real GNSS institution coordination. These circumstances will generate an urgent need to create of an International Consortium invoked to coordinate the GNSS activities. Probably in the future on this kind of Consortium the provider's duties to supply service to users will be assigned.

It seems to us that in this way the legal and organizational prospects of GNSS development will be in future.

Note

¹ ICAO Assembly Resolution A32-19 (1998)