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Possible Russian Contribution to the ERNP

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The Government of the Russian Federation has made available, subject to certain conditions, the GLONASS satellite radionavigation system for civil use. Use of the system is free and there is no intention to introduce coding or to cause any deterioration to the accuracy of the signals. Discussions are currently taking place between the European Commission and the Russian Federation on cooperation concerning the implementation of a navigation satellite system for civil purposes. Discussions are also taking place between interested European Governments and the Russian Federation into the possibility of developing joint Chayka/Loran-C chains wherever this is feasible, and in particular, to cover the Barents Sea, the Baltic Sea and the Black Sea. The development of a concept on integration of radionavigation systems would probably be a significant contribution to the European Radionavigation Plan.

1. INTRODUCTION. Presently the Russian Federation has established and operates a navigation support infrastructure based on long-range terrestrial radionavigation systems, space navigation systems and various special short-range radionavigation systems. The basic trends in developing radionavigation aids are stated in the Russian Radionavigation Plan and the Intergovernmental Radionavigation Programme of the member States of the Commonwealth of Independent States. However, it is most probable that only the satellite navigation system GLONASS and the long-range terrestrial system Chayka will contribute to, or complement, the European Radionavigation Plan. Recognising

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that in the longer term satellite navigation systems can be expected to attract the majority of users, the GLONASS system will be addressed first.

2. SATELLITE NAVIGATION SYSTEMS.

2.1. *Policy of the Russian Federation on GLONASS.* In March 1995, the Government of the Russian Federation resolved to submit all necessary documents to ICAO and IMO to prepare agreements on the application of the GLONASS system. Subsequently the appropriate Russian authorities have, subject to the protection of the national security interests and the foreign policy of the Russian Federation, committed the GLONASS system for use by aviation and marine communities worldwide. The policy of the Russian Federation on supporting, improving and using GLONASS is that the system will be controlled, operated and developed in compliance with the following main principles:

(i) subject to the allocation of the necessary funds, the Russian Federation will support and improve the GLONASS system to ensure that it provides its basic specified characteristics for at least 15 years.

(ii) The standard precision signal will be committed free of charge for civil, commercial and scientific applications on a constant global basis. No special coding or standard accuracy deterioration techniques are foreseen.

(iii) The precise signal will be available for military applications and for other authorised organisations of the Russian Federation in accordance with regulations in force.

(iv) The GLONASS system, as well as aids which increase its efficient application in the Russian Federation, will be state property and governed by competent state bodies.

(v) The Russian Federation will continue its cooperation with other states and international institutions in the cause of civil applications of GLONASS.

(vi) The Russian Federation will follow the course of acceptance of the GLONASS system and its augmentations, directed toward improving its characteristics as elements of the global navigation satellite system GNSS-1.

(vii) The Russian Federation will promote GLONASS integration into all areas of activity as soon as possible and support the development and manufacturing of necessary facilities. It will not make arrangements directed toward the reduction of commercial activities in the field of GLONASS applications if they do not interfere with the national security and economic interests of the country.

(viii) The Russian Federation will render assistance and preferences to domestic manufacturers of user equipment and promote all kinds of mutually beneficial cooperation with foreign states in satellite navigation technologies.

2.2. *Cooperation with the European Union.* The policy outlined above could contribute considerably to any decisions concerning the European Radionavigation Plan. Indeed, meetings have already been held between delegations of

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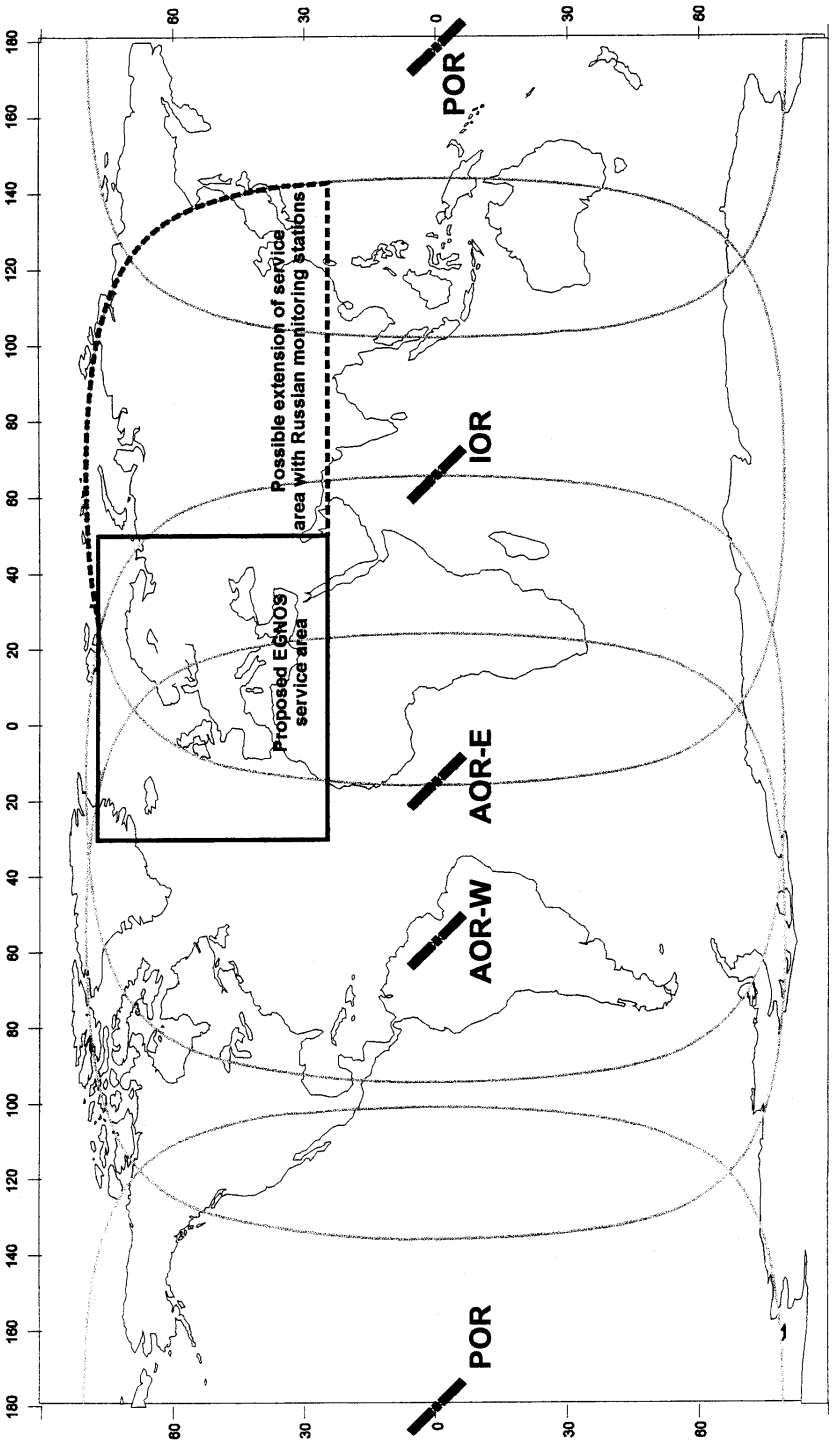


Fig. 1. EGNOS service area

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the European Union and the Russian Federation on the implementation of a navigation satellite system for civil purposes. At a recent meeting between the two parties, it was recognised that there is a mutual interest, based on the principle of equal treatment of all participants, in developing the use of advanced satellite navigation technology and the following priority issues were identified for further consideration and cooperation:

(i) Cooperation in the field of joint research, development, production and application of navigation and positioning satellite technology, including combined GLONASS/GPS/GNSS receivers for the future global navigation system, taking into account relevant security considerations and the civil/military designation of the system.
(ii) The development, construction and implementation of wide area and local augmentation systems for GLONASS and GPS in Europe, taking into account EGNOS and networks for the exchange of navigation information, including a common ground network of control and monitoring stations on the territories of Western Europe, the Russian Federation and the CIS republics. Figure 1 indicates how the service area of EGNOS might be extended by additional monitoring stations.
(iii) Determination of the need of users and development of the future of satellite navigation systems for civil use (GNSS-2).
(iv) Cooperation on questions of international standardisation and certification, in particular for safety-related applications, including land transport. This cooperation should include discussion of coordination of positions with respect to international organisations.
(v) Coordination in the development and realisation of European and Russian radionavigation plans, including those of the CIS republics.

For further cooperation, it was agreed to develop mechanisms and equitable economic principles for joint action and to determine a structure and organisation for the meetings.

3. LONG RANGE TERRESTRIAL RADIONAVIGATION SYSTEMS. The Chayka and Loran-C radionavigation systems satisfy marine, air and land user requirements for regional radionavigation services. The high performance of these systems and the relatively low costs to provide and operate them indicate that they will continue to be available to users during the near future and possibly until a civil satellite system is in operation.

At present, the Chayka and Loran-C systems operate as independent chains or as joint Chayka/Loran-C chains. As an example of independent operation, the European Chayka chain is currently completely independent of any of the Loran-C chains of the North West European Loran-C Service. An example of a joint Chayka/Loran-C chain is the Russian/American chain which has been established using Chayka stations at Alexandrovsk and Petropavlovsk and a Loran-C station located at Attu.

The Russian Federation believes that, if joint Chayka/Loran-C chains were to be established in Europe particularly covering the Black Sea, Baltic Sea and Barents Sea, the system would cover virtually all of Europe and the surrounding

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seas from about 15° West to 50° East. This would contribute substantially to both the European and the Russian radionavigation plans. It should, perhaps, be mentioned that Russia is in discussions with appropriate Governments concerning the Barents Sea, and the Baltic Sea and with the European Commission regarding the Black Sea.

4. FULL INTEGRATION OF SATELLITE AND TERRESTRIAL SYSTEMS. Integration of systems, primarily by use of specially designed receivers, would improve significantly the overall efficiency of radionavigation. While combining Chayka with Loran-C and GLONASS with GPS would improve the effectiveness of terrestrial and satellite radionavigation respectively, full integration of Chayka, Loran-C, GLONASS and GPS would greatly improve the availability, reliability and integrity of radionavigation information. The integration of these terrestrial and satellite radionavigation systems would facilitate the establishment of the concept of a united radionavigation field based on a common time base and a common geodetic datum.

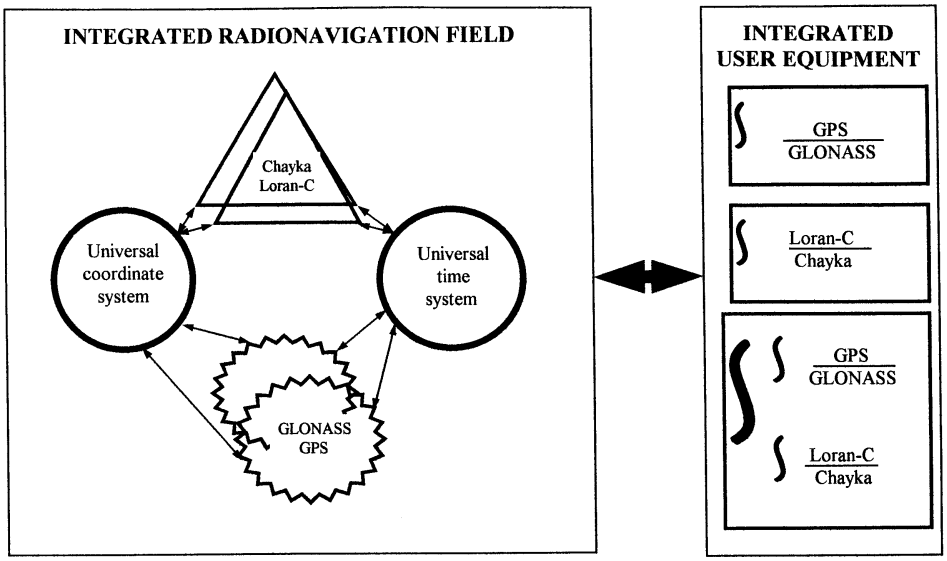


Fig. 2. Concept of integration of radionavigation systems

Figure 2 illustrates the concept of integration of radionavigation systems, and Fig 3 indicates how the concept could be realised from the present four stand-alone systems firstly by combining the systems effectively to develop one terrestrial system and one satellite system, and finally by integrating all of the systems to provide the optimum navigation service available from the present generation of systems.

The common time base of the systems would be the Coordinated Universal Time (UTC). At present, the GPS system uses UTC(USNO) as maintained by the US Naval Observatory which is within about 20 nanoseconds of the international UTC standard. The GLONASS system uses UTC(SU) as maintained by the National Time

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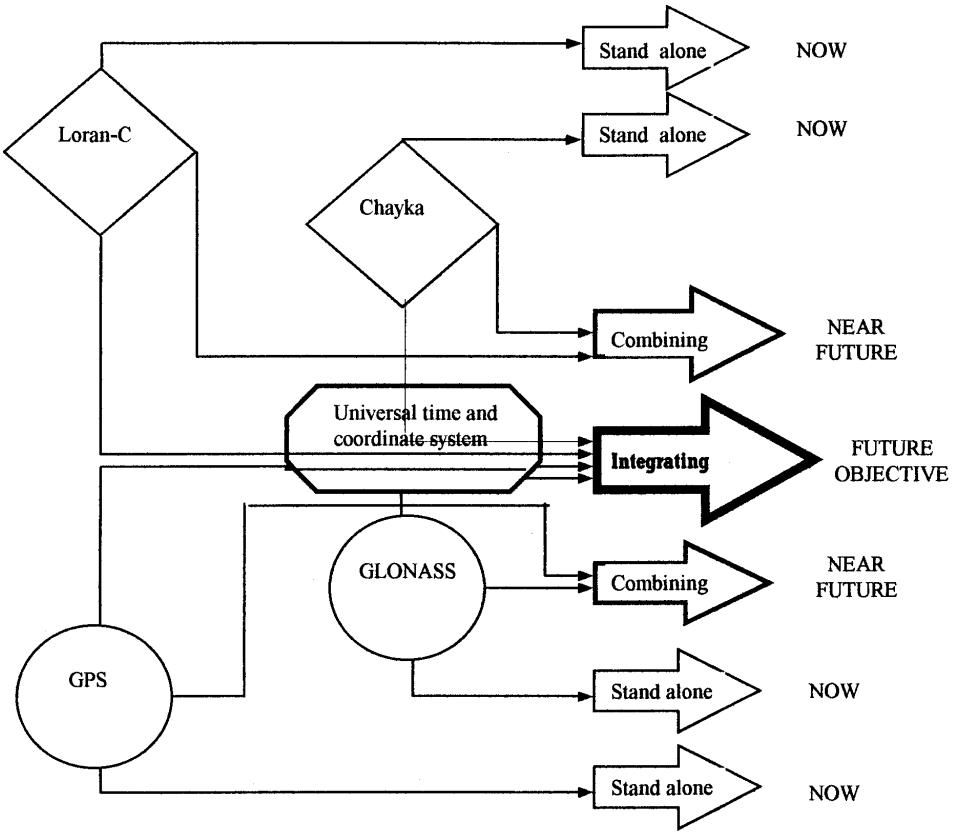


Fig. 3. Possible application of combined and integrated receiver technology

and Frequency Service of the Russian Federation which was several microseconds ahead of the international UTC standard. Some steps have already been taken by Russia to reduce the difference between UTC(SU) and the international UTC standard and the objective is to bring the system's time very close to UTC.

The geodetic datum used by GLONASS is Parameters of the Earth 1990 (PE-90). This datum is a terrestrial reference system with its coordinate frame defined in the same way as that of the International Terrestrial Reference Frame (ITRF). However, the PE-90 frame has some offsets in origin and orientation as well as a difference in scale with respect to both ITRF and the World Geodetic System 1984 (WGS 84) which is used by GPS. Studies by geodetic institutes in several countries, including Russia, are being carried out into transformation parameters between PE-90, WGS 84 and ITRF-94 to ensure that the effect on position accuracy of integrating systems using different geodetic datums is reduced to a minimum and, if practicable, becomes insignificant.

5. SUMMARY. The Russian Federation has already contributed to the European Radionavigation Plan by making available the GLONASS satellite navigation system to civil users throughout Europe. Further contributions can be foreseen by making more use of the Chayka terrestrial radionavigation system and developing joint Loran-C/Chayka chains wherever this is feasible. However,

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perhaps the greatest contribution would be the development jointly by Western Europe and the Commonwealth of Independent States of an integrated radionavigation concept making maximum use of currently available systems and providing to all users a radionavigation service which would have a very high level of reliability, availability and integrity.

KEY WORDS

1. Navaids. 2. Radio. 3. GNSS.

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