

**United Nations/United States of America International Workshop on
The Use and Applications of Global Navigation Satellite Systems
8-12 December 2003, Vienna, Austria**

**Report by Matt Higgins
Chair, FIG Commission 5**

1 Introduction

The United Nations/USA International Workshop on the Use and Applications of Global Navigation Satellite Systems (GNSS) was held from 8 to 12 December 2003 at the United Nations Office at Vienna, Austria. This report draws heavily on the Summary Report produced by staff of the UN Office for Outer Space Affairs (UN OOSA).

The event was convened as a Joint Meeting of the UN Action Team on GNSS and GNSS experts who attended UN/USA Regional Workshops and the International Meeting held in 2001 and 2002. I attended representing the International Federation of Surveyors (FIG) as a member of the UN Action Team.

The Workshop was attended by 75 participants from the following 29 countries and 9 international organizations: Austria, Brazil, Bulgaria, Colombia, Czech Republic, Egypt, Hungary, India, Italy, Japan, Kenya, Malaysia, Maldives, Morocco, Namibia, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, Russian Federation, Slovakia, Syrian Arab Republic, Ukraine, United States of America, Zambia, International Telecommunication Union (ITU), European Commission, European Space Agency (ESA), Bureau International des Poids et Mesures (BIPM), International Association of Geodesy (IAG), International Cartographic Association (ICA), International Federation of Surveyors (FIG), International GPS Service (IGS) and the United Nations Office for Outer Space Affairs.

2 Presentations

The Workshop was briefed on the latest developments with Global Positioning System (GPS USA), Glonass (Russia), Galileo (European Union), and the major GNSS augmentation systems such as EGNOS, GAGAN and Japanese GNSS augmentations, as well as the GPS-Galileo negotiations.

The Workshop heard presentations on regional geodetic reference frame initiatives such as AFREF (Africa), SIRGAS (South America) and EUPOS (the proposed RTK/DGPS service in Eastern Europe).

There was a series of presentations on initiatives at national level to coordinate GNSS activities that might provide models for other countries to consider. Countries presented included; Slovakia, Colombia; Hungary; Italy, Romania, Poland and work by Nigeria to develop its own satellite navigation payload for SBAS for the benefit of Africa. I made a presentation on behalf of the Australian GNSS Coordination Committee (AGCC). The Workshop stressed the importance of supporting the efforts, particularly in developing countries, to establish national coordination mechanisms to promote and support the use and applications of GNSS.

The Workshop considered results from the series of UN/USA Regional Workshop and International Meeting held in 2001-2002; grouped in the following 5 areas:

- i) Surveying, mapping and Earth sciences;
- ii) Agriculture and management of natural resources,
- iii) Management of environment and natural disasters;
- iv) Transportation;
- v) Education, training and implementation.

The Workshop established working groups to address those five thematic areas and undertake the following tasks:

- identify any initiatives or follow-up actions undertaken to date
- identify any outstanding recommendations and suggest the way forward
- identify recommendations requiring assistance from the Office for Outer Space Affairs in 2004-2005 and prioritize those recommendations.

The working groups met (intermingled with sessions with relevant presentations) from 9 to 11 December.

3 Results of the Working Group on Surveying, Mapping and Earth Sciences

For this report I will concentrate on this Working Group. The full summary report from OOSA has details of the other working groups and can be obtained from me if required.

István Fejes (Hungary) chaired the working group with William Martínez-Díaz (Colombia), Chee Hua Teng (Malaysia), Reynold Moyo (Zambia) and Ruth Neilan (International GPS Service) as vice-chairs. Experts from 15 countries and 4 international organizations (including myself representing FIG) participated in the working group.

The working group made 12 recommendations, which were grouped into 3 categories, i.e. projects, standards and general policy.

The working group noted that GPS-based ground geodetic networks (infrastructures) were among the backbones and basic preconditions of most GNSS applications, not only in the area of surveying, mapping, earth sciences, but also in the areas of transport, environmental protection, agriculture and others. The working group, therefore, strongly recommended initiatives to develop such infrastructures. In this context, the working group recommended that the AFREF project in Africa, the EUPOS project in Central and Eastern Europe, the SIRGAS project in South America and the APRGP project in the Asia-Pacific region should be supported.

The working group stressed the importance of the application of global standards in the area of Spatial Data Infrastructure. The working group recommended that all regional and national geodetic datums should be tied to the International Terrestrial Reference Frame (ITRF). The working group urged measures to protect GNSS frequency bands from harmful interference. The working group also considered it important to provide support for developments of precise geoid models in order to assist unification of leveling networks by GNSS.

The working group also considered some cross-cutting issues, including the need to support establishment of national or regional institutional frameworks for coordination, planning and applications of GNSS. The working group recommended that governments should support the development of GNSS ground-based infrastructures at national level. The working group also

suggested eight actions that could be implemented by the Office for Outer Space Affairs in the next two years.

4 Follow-up to the recommendations of the working groups: next steps

To facilitate follow-up actions and exchange of information, it was agreed that OOSA would establish a web site for the Workshop. That web site would include:

- a) all presentations;
- b) reports of the working groups, including all proposals and recommendations;
- c) list of potential funding sources to be identified;
- d) major international and regional policies that indicate priorities of the international community or region.

Participants of the Workshop will work more on outlines of the proposed projects and activities with a view to presenting them to potential funding sources.

Between December 2003 and February 2004, OOSA will review and evaluate the proposals submitted by the working groups and develop a work plan for initiatives that it could support in 2004 and 2005. OOSA aims to circulate the work plan by the beginning of March 2004.

It was proposed that OOSA should also invite developing countries to establish an entity at national or regional level to coordinate GNSS activities in order to promote GNSS applications through inter-institutional arrangements, building upon the efforts and investment made by various sectors of economy of the countries.

5 Meeting of the UN Action Team on GNSS

Parallel and intermingled with the above was work by the UN Action Team. It held two informal meetings, on 9 and 10 December, to discuss draft terms of reference of the International Committee on GNSS. I am a member of the Action Team, representing FIG.

The Action Team held its eighth plenary meeting on 11 December; presided over by the co-chairs, K. Hodgkins (United States) and M. Caporale (Italy). The meeting considered the following documents:

- a) Revised full report;
- b) Summary version of the report;
- c) Inputs for the report of the Committee on Peaceful of Outer Space (COPUOS) to go to the UN General Assembly for its UNISPACE III+5 review in 2004;
- d) Draft terms of reference of the International Committee on GNSS.

The Action Team agreed to include the following countries and organizations in its membership: Egypt, Nigeria, Romania, Zambia, International Association of Geodesy (IAG) and International Cartographic Association (ICA).

The Action Team agreed on the following action items:

Full report

- The full report will be revised and circulated to the members of the Action Team by early February.

- I made a submission to the final report on behalf of FIG (Attached as Appendix A). I also made a presentation based on that submission.

Short version of the report and template

- The co-chairs will revise the short version of the report on the basis of comments received during the meeting and submit it to the Scientific and Technical Subcommittee in time for its 41st session (16-27 February 2004).

Draft terms of reference of the International Committee on GNSS

- The co-chairs will prepare a clean copy of the draft terms of reference as amended by the Action Team and circulate it to all members.
- The first meeting of the International Committee on GNSS could be held on the margins of the next UN/USA International Workshop on GNSS, currently planned in December 2004 at Vienna.

Schedule of work

- The Action Team will meet on the margin of the 41st session of the Scientific and Technical Subcommittee.
- The agenda of the meeting would include:
 - Finalisation of the full report;
 - Ways and means to disseminate the full report;
 - Planning for a first meeting of ICG.

6 Additional Comments from the Workshop

In addition to the above report on the Workshop, the following are specific comments from my perspective as FIG representative.

- a) For me, the major outcome from the week was the proposal for the establishment of the International Committee on GNSS (ICG) under the auspices of the UN (through OOSA). It should be noted that there will now be discussions back in the jurisdictions of the major players (USA, Russia and EU) about issues associated with forming the ICG. It is likely that there will be some politics to follow but hopefully the concept of the ICG will be seen as valuable and it will come to fruition. For the first time in the more than 40 years history of GNSS, the ICG will allow organised, global input by civilians. The involvement of IGS, FIG, IAG and ICA, is a significant recognition of the importance of GNSS users in the Surveying, Mapping and Earth Sciences community. As a community, we need to take advantage of this opportunity.
- b) The report of the Action Team is very broad ranging and documents many GNSS applications, issues and coordination mechanisms across many countries. It also documents the current situation with the 3 GNSS systems and several augmentation systems. As such, the report will be a useful document for everyone interested in GNSS. The related presentations are also useful.
- c) It was gratifying to see the recognition by all Working Groups that geodetic reference frame is a significant infrastructure issue for all GNSS users.
- d) The UN deliberately involved people from developing countries in this process (including from many Surveying and Mapping organisations). This proved very beneficial in ensuring the recommendations really did address the needs of developing countries. Also, in working sessions, people from developing countries worked directly with office bearers in relevant international organisations, which was of benefit to both parties.

- e) Civilian input to GPS development can occur through the Civil GPS Interface Committee and that has an established mechanism for input by the Surveying and Mapping community. Since the Workshop in Vienna I have had email conversations with the Glonass and Galileo representatives about equivalent mechanisms for their systems. I think any coordination of input to the IGC from our community should also recognise these uni-lateral mechanisms.

7 Additional FIG Activities

As well as the GNSS Workshop itself, I was able to carry out several other FIG activities during the trip, including:

- a) A meeting at Heathrow with 2 of my FIG Working Group Chairs (Mikael Lilje (Sweden) and Dan Schnurr (UK)) to discuss the FIG Event in Morocco (during the week before) and plans for future Commission 5 activities.
- b) In Vienna, I was able to discuss FIG issues with the delegates from Brazil, Bulgaria, Colombia, Malaysia, Maldives, Philippines, Slovakia, Syrian Arab Republic and Zambia.
- c) Through Gerhard Muggenhubber (Chair of FIG Commission 3), I was able to arrange a visit to the Austrian Surveying and Mapping organisation (BEV) for delegates from Brazil and Colombia.
- d) The contact with OOSA in general was also beneficial. For example, I have commenced discussions with the Director of OOSA to give a keynote at the FIG Working Week in Athens in May 2004. As well as GNSS coordination, OOSA is also involved in work on (for example) Space Technology for Disaster Management and in the UN Regional Centres for Space Technology Education.

Matt Higgins
Chair, FIG Commission 5
January 23, 2004

Appendix A

Submission by the International Federation of Surveyors (FIG) To the Report of the United Nations Action Team on GNSS (Contact is Matt Higgins, Chair of Commission 5)

What is FIG?

The International Federation of Surveyors (FIG – French acronym) is a federation of national professional surveying associations and is the only international body that represents all surveying disciplines. FIG was founded in 1878 in Paris. It recognised as a non-government organisation by the UN. Over 110 countries are represented in FIG and there are 230,000 Surveyors around the world in the Member Associations.

The Technical Work of FIG

The following 10 Commissions carry out the technical work of FIG:

1. Professional Standards and Practice
2. Professional Education
3. Spatial Information Management
4. Hydrography
5. Positioning and Measurement
6. Engineering Surveys
7. Cadastre and Land Management
8. Spatial Planning and Development
9. Valuation and Real Estate Management
10. Construction Economics and Management

GNSS is being applied in many of the topics covered by the above commissions and that application occurs at various levels of accuracy.

As an example of close involvement in GNSS topics, Commission 5 has several relevant Working Groups:

- 5.1 Standards, Quality Assurance and Calibration (for equipment and techniques)
- 5.2 Reference Frame in Practice
- 5.3 Integrated Positioning, Navigation and Mapping System
- 5.4 Low Cost Surveying Technology and Techniques for Developing Countries (Joint with Commissions 3 and 7).

FIG Commission 5 also administers the MoU between FIG and the International Association of Geodesy (IAG). FIG also has a Standards Network that acts across all the Commissions to coordinate any work on Standards and to have a single point of contact between FIG and relevant bodies such as the ISO.

Global Issues and the Surveyor

FIG is actively working with relevant United Nations Organizations to address global issues such as reducing urban poverty and progressing sustainable development. Relevant organizations include:

- UN Habitat (an MoU exists with FIG)

- UN Food and Agriculture Organization (FAO) (an MoU exists with FIG)
- The various UN mandated regional Committees on Spatial Data Information Infrastructure, especially those in regions with developing countries.
- The UN GNSS Action Team

By way of example, FIG is helping to address Habitat's overriding goal, which is urban poverty reduction. Habitat is advancing that through two global campaigns:

- Secure Tenure
- Urban Governance

Both of these campaigns require accurate spatial information. With “Secure Tenure” for example, it is now widely accepted that geodesy, surveying and mapping are vital for granting secure title to land. For developing countries, once secure title is established a property market can begin to develop. That in turn allows people to use equity in their ownership of land to access capital, which in turn enables steps toward a mature economy. Given this, geodesy and surveying are important disciplines at the foundation of economic development.

FIG is also participating in the relevant standards being developed within the frameworks of the International Standards Organization (ISO). Two examples are:

- ISO Technical Committee 211 on Geographic Information and Geomatics
- ISO Technical Committee 172, which addresses Surveying Instruments

The Role of GNSS and Spatial Information

- Several studies have shown that over 80% of Government decisions involve a Spatial component – “Where?”
- Accurate and Timely Spatial Information is required to deal with the priorities of Habitat, FAO etc
- GNSS is a key technology for capturing accurate spatial information.

The Nature of the GNSS Surveying Market

It is important to recognise that GNSS Surveyors are intelligent users at the “top end” of the market. The history of the take up of GNSS in the mass-market shows that users start off happy with the accuracy being achieved. However, many mass-market users quickly identify a need for improved accuracy for certain applications. In that context, Surveyors have always been 5 to 10 years ahead of the mass market in their requirements for accuracy, reliability and for real-time results. Therefore, at any given time, the surveying market can be thought of as a snapshot of the mass-market in the future.

It is also important to recognise that while the GNSS surveying market is small compared to the mass-market applications, the dollar values of the equipment, software and of the application projects are high.

Future Issues in GNSS Surveying

The latest GNSS surveying techniques squeeze millimetres from the least possible amount of data, in real time, using all satellites in view and with multiple frequencies. The majority of work is using GPS and is already very efficient. The advantages for surveyors from future

developments in GNSS will be even greater efficiency but more importantly increased reliability:

- As L2 C/A GPS receivers come online, equipment and data processing will become less complicated. Theoretically this should enable less expensive survey grade GPS receivers. It will be interesting to see if that will be realised.
- The additional L5 frequency on GPS will give even better redundancy, accuracy, efficiency and reliability.
- The availability of GLONASS has demonstrated the advantage of extra satellites, especially for those applications where satellite masking occurs; such as in urban canyons, under tree canopies or in open cut mines.
- Galileo will add all of this again and more.

One concern for surveyors is that existing GNSS surveying receivers are the most complex and therefore the most expensive on the market. This requires that equipment must be useful for several years so that return on investment can be realised. This is especially true for private surveying companies and in developing countries. Therefore, the cost to upgrade equipment to take advantage of new developments is a significant issue for surveyors and will affect how quickly we will take-up and apply new GNSS capabilities. This could be magnified by the fact that many current surveying users are already getting good performance from the capabilities offered by GPS as it is now.

The Role of FIG in GNSS Development.

FIG can play several roles in progressing the goals of the UN Action Team on GNSS. FIG is well placed to help for the following reasons:

- FIG is already committed to assisting with developing country issues and has several MoU with key UN Organisation.
- National Delegates to many FIG Commissions are working in GNSS applications every day and at various levels of accuracy. FIG's National Delegate network could be very useful for new users to contact existing educated users in their country or region.
- FIG Commissions can assist with implementing and publicising reports and road maps through its existing network of contacts and through its existing outreach activities such as Regional Conferences in regions with developing countries.
- In relation to GNSS Education, FIG has a Surveying Education Database with over 240 institutes offering 425 courses in 64 countries. Given the prominence of GNSS as a tool for surveyors many of these courses will include GNSS content. Importantly, that content will be tailored to deal with local issues such as dealing with the current geodetic reference frame in a given country or region.
- FIG is also working closely with IAG on issues such as Reference Frame matters and is well placed to help GNSS users understand the issues.

Final Comment

As a final comment, FIG supports the need for an International Committee on GNSS under the auspices of the UN.