

RESERAPPORT

THE NINTH MEETING OF THE INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS (ICG-9)

Prag, Tjeckien, november 2014
Mikael Lilje, Geodesienheten, Lantmäteriet

BAKGRUND

Det nionde mötet av "*International Committee on Global Navigation Satellite Systems (ICG)*" hölls i Prag mellan 9 och 14 november 2014. För ca 10 år sedan bildades *UN Committee on the Peaceful Use of Outer Space (COPUOS)* en gruppering med namnet *Action Team on Global Navigation Satellite Systems (GNSS)*. Resultatet blev att ICG bildades och att UNOOSA (*UN Office for Outer Space Affairs*) skulle ansvara för ICG. Tanken är att stärka utvecklingen av GNSS genom att ha ett forum där leverantörer och användare träffas för att diskutera gemensamma utvecklingsfrågor.

Den internationella lantmätarföreningen FIG är medlem av UNOOSA och jag är FIGs representant. Det var av den egenskapen som jag deltog vid detta möte. Det finns dessutom starka kopplingar till geodesienhetens arbete i det som diskuterades på mötet varför det är naturligt att Lantmäteriet är med vid dessa möten. Däremot är Sverige inte medlem i ICG.

ICG har vuxit i betydelse under de senaste åren. I år kom närmare 250 deltagare där Ryssland och Kina kom med stora delegationer. Detta var det största evenemanget hittills och intresset gjorde att veckan före mötet skulle ske var arrangören tvungen att hitta en större lokal i Prag. Noterbart är att alla leverantörer av satellitpositioneringssystem som GPS (USA), Galileo (Europa), GLONASS (Ryssland) och Beidou (Kina) deltar aktivt i ICG och på dessa möten. I samband med mötena så redovisar de öppet om planerna för respektive system och bland de deltagarna som har varit med under flera ICG-möten så har klimatet mellan de olika leverantörerna blivit mycket mer öppet. Idag ser alla systemleverantörerna fördelarna med att de samverkar för användarnas skull men också för deras egen skull. Som användare av GNSS, som är ett samlingsnamn för de olika satellitpositioneringssystemen, vill vi ha en mottagare (idag t.ex. GPS) som klarar av att ta emot signaler från alla systemen samtidigt. Den stora fördelen blir att vi kan dra nytta av att det finns oerhört många satelliter tillgängliga vid mätning vilket säkerställer framförallt tillgängligheten och möjligheten att göra mätning.

Lantmäteriet har en nationell samordningsroll kring Geodesi och den informationen som vi får vid möten som detta sprider vi via olika forum till användare i Sverige.

JOINT STATEMENT FROM ICG-9

Som en sammanfattning av mötet kommer alla deltagarna överens om en "Joint Statement" innan mötet avslutas. Dessutom tas det fram ett antal rekommendationer från ICG. Sammanfattningen finns i bilaga A.

Föredragen som presenteras ger en bra bild på läget i utvecklingen av GNSS samt på användningen av GNSS. ICG mötet är inte som en konferens där deltagarna skickar in förslag på föredrag och att ICG sedan byggs upp med föredragningar från morgon till kväll. Detta möte har planerats vid ett par andra planeringsmöten under det senaste året. ICG kan ses som det tillfälle där GNSS leverantörerna träffas för att gemensamt redovisa läget och planer samt att planera vad som behöver göras under det kommande året. Det är också ett tillfälle då ett större antal användarorganisationer är med för att lyssna och bidra. ICG startar med gemensamma sessioner då alla är samlade men ganska snabbt bryts det ner till arbete i de fyra olika arbetsgrupperna som är

- Working Group A; Compatibility and Interoperability
- Working Group B; Enhancement Performance of Global Navigation Satellite Systems Services.
- Working Group C; Information Dissemination and Capacity Building
- Working Group D; Reference Frames, Timing and Applications

Från arbetsgrupperna tas det fram förslag på rekommendationer som sedan diskuteras i plenum. Alla föredrag tillgängliggörs på UNOOSAs hemsida (www.oosa.unvienna.org/oosa/en/SAP/gnss/icg/meetings.html).

SUMMERING KRING UTVECKLINGEN AV GNSS

GNSS leverantörerna har en stark roll inom ICG. Att få dem att träffas på detta vis ett par gånger per år är viktigt vilket gör att deras frågeställningar kommer i fokus. Det som inte lyfts fram så mycket är då användningen men det finns andra forum där detta lyfts fram än mer som t.ex. FIG-konferenser. Dock så är detta ett viktigt forum för dem där de träffas för att diskutera gemensamma frågor. Första sessionen på ICG, efter välkomstanföranden, är beskrivning av läget hos respektive leverantör. Vad som särskilt kunde noteras denna gång är:

- Som värd startade EU presentationerna med att uppdatera oss kring Egnos och Galileo:
 - EU rapporterade om en stabil kommande sjuårsperiod kring Galileo med budget m.m.
 - Det finns 26 satelliter beställda och dessutom kontrakt för uppskjutning av dessa.
 - De två Galileosatelliter som sköts upp i augusti hamnade tyvärr i felaktiga banor pga oväntade problem. Oklart hur dessa kommer att kunna användas i framtiden. Satelliter som sådana verkar dock fungera bra.
 - Tjänsterna som kommer att tillhandahållas blir *Open Service, Public Regulated Service, Search* och *Rescue Service, Commercial Service*. De tre första kommer att finnas tillgängliga från 2014.
 - Hemsida: ec.europa.eu/galileo
- USA presenterade status för GPS
 - USAs policy är att förse världen med kontinuerlig och global tillgänglighet till fredlig användning, gratis för direkt användning samt verka för och uppmuntra till kompatibilitet och interoperabilitet
 - Bara under 2014 har fyra GPS satelliter skjutits upp. Detta har inte hänt sedan 1993. För tillfället betyder det 30 stycken satelliter som fungerar.
 - Hemsida: <http://www.gps.gov/>

- Ryska GLONASS meddelade att:
 - GLONASS tryckte på att deras civila tjänster är fritt tillgängliga globalt
 - Den ryska regeringen beslutade den 3 mars 2012 om en rymdsatsning som täcker perioden 2012-2020 inkluderande en budget kopplad till den. GLONASS är prioriterat i Ryssland.
 - Av de 28 satelliter som finns i systemet just nu är 24 i bruk. Under 2014 har två satelliter skjutits upp.
 - Hemsida: www.glonass-center.ru

- Kina presenterade statusen för Beidou:
 - För närvarande finns 14 satelliter uppskjutna kring Beidou varav fem är geostationära, 5 geosynkron bana med inklination samt fem med något lägre höjd.
 - Kineserna gav uttalanden om att Beidou kommer att förse världen med kontinuerliga, stabila och globala tjänster och att Beidou tillhör både Kina och världen.
 - Hemsida: <http://en.beidou.gov.cn/>

- Indien presenterade statusen av GAGAN and IRNSS
 - GAGAN står för *GPS Aided GEO Augmentation Navigation System*.
 - GAGANs huvudfokus är civilt flyg för att säkerställa säkrare utnyttjande av indiskt luftrum samt lägre bränsleförbrukning.
 - GAGAN inkluderar 3 GEO satelliter, 3 markstationer samt 2 driftscentraler. Två av satelliterna har skickats upp och GSAT-15 kommer att skickas upp inom 2-3 år.
 - IRNSS är ett oberoende regionalt navigationssystem som kommer att inkludera sju satelliter. Full konstellation förväntas i slutet av 2015.

- Japan presenterade statusen kring deras system som heter *Quasi Zenith Satellite System (QZSS)*.
 - Den första QZSS-satelliten (Michibiki) kommer att följas av ytterligare tre till med start av tjänster senast 2018.
 - Japan har beslutat att öka takten i utvecklingen så skyndsamt som möjligt.
 - Målsättningen är att ha sju satelliter i omlopp vilket inkluderar tre GEO satelliter.

ANDRA INTRESSANTA NOTERINGAR

Bland de många intressanta föredragen kan följande noteras:

- Både FIG Technical Seminar och FIG Technical Seminar Manual presenterades och noterades vid ett flertal tillfällen. Jag har varit aktiv i att genomföra och tagit fram både dessa.
- Den föreslagna FN resolutionen presenterades och noterades. UNOOSA/ICG stödjer dessutom denna resolution.
- Nästa globala referenssystem (ITRF2014) kommer att presenteras under nästa år.
- Att den internationella GNSS-tjänsten IGS i år fyller 20 år noterades. Sverige var ett av de första länderna att bidra med data till denna tjänst. IGS är mycket viktig för GNSS-industrin och framförallt för oss användare.
- Att synkronisera de respektive GNSS-tiderna med UTC har nu diskuterats under några år och skillnaderna blir mindre och mindre. Sedan förra året rapporterades om stora framsteg från GLONASS och Beidou.
- Användarperspektivet noteras och diskuteras även om det inte är helt klart vilka användare som vi pratar om.

ARBETSGRUPPSMÖTE, WORKING GROUP D AND ITS TASK FORCES ON GEODETIC AND TIMING REFERENCES

ICG består av fyra arbetsgrupper;

- Working Group A: Compatibility and Operability
- Working Group B: Enhancement of Performance of Global Navigation Satellite System
- Working Group C: Information Dissemination and Capacity Building
- Working Group D: Reference Frames, Timing and Application

FIG leder arbetsgrupp D tillsammans med representanter från Internationella Geodesiassociationen (IAG) och IGS. Arbetsgruppen genomförde två möten samt en kortare avstämning kring rekommendationstext. Mötena lockade något färre personer denna gång. Minnesanteckningar (på engelska) kan hittas i appendix B. Alla minnesanteckningar från denna arbetsgrupp, liksom för de övriga, finns publicerade på ICGs websida.

Vi noterade under mötet att framför allt GLONASS men även Beidou har förbättrad tidsynkroniseringen mot UTC. Vi pratar nu om skillnader på 150ns. Vi noterade också att WGS84 är uppdaterad.

Dessutom la arbetsgruppen fram två rekommendationer till ICG. Dessa finns presenterade i minnesanteckningarna i appendix B;

- o WG-D Recommendation #22 – ICG support to the UN General Assembly Resolution on the *Global Geodetic Reference Frame for Sustainable Development*
- o WG-D Recommendation #23 – Improving the accuracy of multi-GNSS orbit determination by the IGS, via detailed satellite information

NÄSTA MÖTE AV ICG

USA kommer att arrangera ICG-10 i Boulder, USA mellan 1-6 november nästa år. Ryssland meddelade intresse för ICG-11 och Japan för ICG-12.

Appendix A

Ninth Meeting of the International Committee on Global Navigation Satellite Systems (ICG), 10 – 14 November 2014, Prague, Czech Republic

Joint Statement

The Ninth Meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Prague, Czech Republic from 10 to 14 November 2014 to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members, and observers to address recent developments in their organizations and associations with regard to GNSS services and applications. The Deputy Minister of Transport of the Czech Republic, the Head of Unit Galileo International Relations of the European Commission and the Executive Director of the European GNSS Agency (GSA) delivered opening speeches on behalf of the European Union. The Director of the Office for Outer Space Affairs of the United Nations Secretariat also addressed the Meeting.

The European Commission and GSA on behalf of the European Union organized the Meeting. The Meeting was attended by representatives of China, India, Italy, Japan, Malaysia, the Russian Federation, the United Arab Emirates, the United States of America and the European Union, as well as the following intergovernmental and non-governmental organizations: Arab Institute of Navigation (AIN), Civil Global Positioning System Service Interface Committee (CGSIC), European Space Agency (ESA), European Space Policy Institute (ESPI), European Position Determination System (EUPOS), Interagency Operations Advisory Group (IOAG), International Aeronautical Federation (FAI), International Association of Geodesy (IAG) and IAG Reference Frame Sub-Commission for Europe (EUREF), International Association of Institutes of Navigation (IAIN), International Bureau of Weights and Measures (BIPM), International Earth Rotation and Reference Systems Service (IERS), International Federation of Surveyors (FIG) and International GNSS Service (IGS). Representatives of the Office for Outer Space Affairs of the United Nations Secretariat and the International Telecommunication Union (ITU) also participated. Canada was invited to attend as an observer. The representative of Space Generation Advisory Council (SGAC) also attended. The representatives of the Asia-Pacific Space Cooperation Organization (APSCO) also attended. APSCO was recognized by ICG as a new observer.

The ICG recalled that the United Nations General Assembly, in its resolution 68/75 of 16 December 2013, had noted with satisfaction the continuous progress made by the ICG towards achieving compatibility and interoperability among global and regional space-based positioning, navigation and timing systems and in the promotion of the use of GNSS and their integration into national infrastructure, particularly in developing countries, and noted with appreciation that the ICG held its eighth meeting in Dubai, United Arab Emirates, from 10 to 14 November 2013. The ICG addressed GNSS application market opportunities, and applications in the area of aviation, spatial aerial plants (i.e. cable cars), train control and management systems, and high precision agriculture. Representatives from industry, academia and Governments shared views on challenges and opportunities for GNSS services. The ICG noted that the working groups focused on the following issues: compatibility and interoperability; enhancement of the performance of GNSS services; information dissemination and capacity building; and reference frames, timing and applications. Beginning at its inter-sessional meeting held in Geneva, Switzerland, hosted by the ITU, and continuing during the ninth meeting of the ICG, the Working Group on Compatibility and Interoperability (WGA) addressed all four areas of its current work plan. The compatibility and performance standard subgroup reported on the status of on-going work in these areas and updated

its recommendation on compatibility between international mobile telecommunications (IMT) and radio determination satellite service (RDSS)/radio navigation satellite services (RNSS) spectrum. In addition to the inter-sessional meeting, the newly formed Interference Detection Task Force organized and completed the third ICG Interference Detection and Mitigation (IDM) Workshop at the ITU. This event and subsequent deliberations led to three recommendations on IDM capabilities and the conduct of United Nations workshops on spectrum protection and IDM to be organized by the Office for Outer Space Affairs on a regional basis.

The International GNSS Monitoring and Assessment (IGMA) Task Force also brought forward two recommendations to the Working Group based on three meetings held in 2014, including a proposal to hold an IGMA workshop in Xi'an, China immediately preceding the 2015 China Satellite Navigation Conference. Finally, the Interoperability Task Force reported on three workshops held in Russia, China, and Japan, where inputs from industry and users on the subject of multi-GNSS interoperability continued to be collected and analyzed. The Task Force will continue its work in 2015, to include an interoperability workshop in Europe, and leading to potential recommendations for working group and committee consideration at the Tenth Meeting of the ICG.

The Working Group B on the Enhancement of GNSS Service Performance (WGB) made progress in establishing an interoperable GNSS Space Service Volume (SSV). SSV relevant characteristics were presented by Global Positioning System (GPS), Global Navigation Satellite System (GLONASS), BeiDou Navigation Satellite System (BDS) and Quazi-Zenith Satellite System (QZSS). Galileo aims to release its SSV related characteristics in the Spring of 2015. Members of WGB will develop a booklet on "Interoperable GNSS SSV". WGB will continue to work towards an interoperable GNSS SSV. WGB members acknowledged the benefits of signal broadcast from satellites in non-nominal orbit or from satellites not part of the operational constellation for a wide range of users, including SSV users. Apart from SSV the group continued to work according to its workplan. Good quality ionospheric error compensation models were identified in order to provide single frequency users with better accuracy. Results obtained from one of these, the Nequick Galileo model, demonstrating good performance, were discussed. Following the recommendation of ICG-8 the discussion continued on the Time To First Fix (TTFF) estimation methodology leading to the identification of additional Figures of Merit.; Interference mitigation techniques at the antenna level and at the Digital Signal Processing level were discussed and the importance of investigating interference mitigation techniques at the user level was confirmed. The Application Subgroup of WGB held dedicated meetings and continued monitoring application needs. The findings will be summarized in a report. The way forward to ICG-10 for WGB and its Application Subgroup were defined.

Recognizing the present status of GNSS and the prospects for continued development of a wide variety of applications critical to science, commerce and infrastructure, the Working Group C on Information Dissemination and Capacity-Building (WGC) recommended that more workshops and training courses should continue to be held on specific areas of interest to end users. The WGC encouraged knowledge transfer via e-learning systems using existing web-based distance learning programmes, as well as communication and outreach to the wider community through the UN affiliated regional centres for science and technology acting as information centres for the ICG. To improve cooperation between existing or developing user information centres of the providers, WGC recommended that all the provider and GNSS user information centres consider development and adoption of a process for referring inquiries to each other where appropriate.

The Working Group D on Reference Frames, Timing and Applications (WGD) apprised the ICG of developments within the United Nations Economic and Social Council (UN ECOSOC) in New York, to establish a Committee of Experts for UN Global Geospatial Information Management (UN-GGIM), and a working group on the Global Geodetic Reference Frame (GGRF). UN-GGIM notes that the services derived from GNSS technology provide a framework for all geospatial activity, as a key

enabler of spatial data interoperability, disaster mitigation and sustainable development. The Co-Chairs of WGD are engaged in the GGRF working group, and suggested that the ICG and UN GGIM explore close cooperation. WGD noted significant continued progress on the geodetic and timing references for the GNSS currently represented in the ICG. Specific progress was noted in (1) the refinement of the alignments of GNSS associated reference frames to the latest realization of the International Terrestrial Reference (ITRF) System in the form of ITRF2008, and (2) on timing references in relation to rapid Coordinated Universal Time (UTCr), BIPM publication and GNSS time offsets. WGD has contributed and will continue to contribute to the IGMA initiative. The Working Group also made two recommendations: one in relation to the UN-GGIM initiative regarding a United Nations General Assembly resolution on GGRF, and one on the possible provision by GNSS Providers of satellite data that would improve orbit modeling and accuracy.

The ICG adopted a Vision Statement contained in the Annex to this statement. The ICG accepted the invitation of the United States to host its Tenth Meeting of the ICG in Boulder, Colorado from 2 to 6 November 2015. The Office for Outer Space Affairs, in its capacity as the Executive Secretariat of ICG and its Providers' Forum, will assist in the preparations for the meeting and for interim planning meetings and Working Groups activities to be held in 2015. The ICG noted the expression of interest by the Russian Federation to host the Eleventh Meeting of the ICG in 2016, and by Japan to host the Twelfth Meeting of the ICG in 2017. All the presentations made during the ICG-9 are available at the ICG information portal (www.unoosa.org).

Vision Statement of the International Committee on Global Navigation Satellite Systems

The International Committee on Global Navigation Satellite Systems (ICG) strives to encourage and facilitate compatibility, interoperability and transparency between all the satellite navigation systems, to promote and protect the use of their open service applications and thereby benefit the global community. Our vision is to ensure the best satellite based positioning, navigation and timing for peaceful uses for everybody, anywhere, any time.

**ICG WORKING GROUP D
REFERENCE FRAMES, TIMING AND APPLICATIONS**

**ICG WORKING GROUP D
REFERENCE FRAMES, TIMING AND APPLICATIONS**

Ninth Meeting of the International Committee on GNSS (ICG), Prague, Czech Republic

**WG D MEETING NOTES
Tuesday 11 November 2014
Wednesday 12 November 2014**

Co-Chairs: Zuheir Altamimi, Mikael Lilje, Ruth Neilan, Chris Rizos

1. INTRODUCTION

The Co-Chairs welcomed all to the meeting. Unfortunately Matt Higgins could not attend ICG-9 and Mikael acted on behalf of FIG. Zuheir acted as chair of the meeting and Ruth and Mikael as secretaries. The participants can be found in appendix A. The meeting was split into two days where discussion devoted to Geodetic References were held on Tuesday, Nov 11 and Timing References on Wednesday Nov 12.

2. REVIEW OF MINUTES FROM ICG-8 MEETING

The minutes from the working group meeting at ICG-8 in Dubai were reviewed. Round-table discussion of the representatives of Providers on the minutes concerning the templates and comments can be found in the meeting notes.

3. TASK FORCE ON GEODETIC REFERENCES

Discussion on progress with WG-D Recommendations:

Recommendation 13 – International GNSS Service Multi-GNSS Global Experiment – IGS M-GEX

- ESA - has upgraded their IGS stations to multi-GNSS and support M-GEX.
- BKG - also upgrading HW & SW to manage multi-GNSS analysis
- China – Wuhan, computing orbits for Beidou since 1.5 years
- Russia – no update
- USA/GPS – NGA not involved in M-GEX
- India – no representative at this part of the meeting

Recommendation 15 – Improving the GNSS contribution to the ITRF defining parameters.

Calibrating each satellite antenna before launch

Clarification, the measurements of the phase center of the antenna to center of mass of the satellite. And compare to the estimated values from post-launch orbits.

- Galileo – was requested and is under review.
- GPS – Future GPS will have SLR retro reflectors due to efforts of NGA and NASA and other US agencies.
- GLONASS – Calibrate antennas during factory tests. WG-D requests that the information be made available
- China – Antennas are measured and will continue.
- Japan – no update
- India – no representative

Adding retro-reflectors to GNSS satellites

- GPS – will be on GPS III on SV 9, can also estimate on orbit
- Galileo – will be on all Galileo satellites
- GLONASS – already installed.
- China – every satellite carries retro, 14 on orbit each installed.
- India – no representative

Studying the possibility and utility of adding an accelerometer to new satellites

GPS – not clear why is needed, as contributions from VLBI, SLR are valued (Malys). Accelerometer would help to determine geo-center motions (ZA)

Presentations on Recent Developments in Geodetic References;

The following presentations were made. They are all available on the ICG-9 webpage.

- Transformation to Classical Horizontal Mapping Datums, by S Malys (US)
- System of Geodetic Parameters "Parametry Zemli 1990" (PZ-90.11), by A. Zueva, E. Novikov, D. Pleshakov, I. Gusev (RU)
- Update on Galileo Geodetic Reference Frame, by W Enderle(ESA)
- Study on updating the BDS Terrestrial Reference Frame using BDS observations, by Q Zhao (China)
- Positioning by MultiGNSS: the user point of view based on processing of real data, by A Caporali, (Italy)
- India- quick update by A Banik (India),

During his presentations, Malys proposed a possible recommendation for WG-D to develop and maintain a multi-national authoritative list of horizontal mapping and charting datums that is still in use and that may be encountered by a GNSS user. The decision at the meeting was that ICG WG D is not the correct place for such a list but it should be of interest for others as e.g. ISO, UN GGIM/GGRF.

Discussion of the need for more comprehensive information about new GNSS satellites to improve orbit modeling (Altamimi for M. Ziebart);

Notes need for improved information needed for satellite orbit dynamics modeling. This will comprise a new recommendation from WG-D. The meta data should cover;

- Surface geometry and dimensions
- Surface optical properties
- Nominal attitude model
- Transmitted power in all signals
- Solar panel constructions information
- Position and power of output radiators
- Thermal properties of multi-layered insulations....

The group agreed to formulate a recommendation on these aspects.

Relevant Developments in International Standards Organization (ISO);

L Hothem reported that ISO TC 211 on Geographic Information are the standards that are relevant for ICG WG-D. The members of the TC 211 are representatives from 36 countries. All the provider nations, and also other organizations as IAG, FIG are members. The ISO Geodetic Registry would become a common source for 'meta-data'. The TS 19127 Geodetic Codes and parameters is currently under review, and in compliance with TS 9111. Technical report due in 2015. Control Body had a number of permanent members, Australia just named John Dawson to the Body and it is chaired by Hothem (USA) and Craymer (Canada).

4. TASK FORCE ON TIMING REFERENCES

Discussion on progress with WG-D Recommendations:

Recommendation 11 on “Finalization and Publication of Templates on Geodetic and Timing References”;

- GPS: on the web. No update
- Galileo: on the web. No update
- IGS: on the web
- Glonass: The template will be sent to ICG-secretariat in due time for publication
- Beidou: Not ready for publication yet
- QZSS: Not ready yet but will be sent to ICG-secretariat in due time for publication
- India: No representative at the meeting

The following presentations were made. They are all available on the ICG-9 webpage.

- Storage effects on space borne Rubidium Atomic Clocks, by A Binak (India)
- Absolute calibration of GNSS time transfer equipment at CNES, by J Delporte, (EU)
- GLONASS time and UTC, actions for decreasing their offset observed with GNSS receivers, by F Arias, G Petit; (BIPM)
- Progress on works related to the proposed redefinition of UTC, by F Arias , G Petit (BIPM)
- New level of development for the National time scale of Russia, V Palchikov; (RU)
- Improvement of GLONASS Time Synchronization with other GNSS Time, by A. Druzhin, A. Pokhaznikov, A. Tiuliakov; (RU)
- GLONASS Time. A. Druzhin, A. Pokhaznikov, A. Tiuliakov, (RU)
- Progress of BDT and its relationship with UTC/UTCr – H Chunhao, (China)

The Russian delegation noticed that the values published from October and forward are the correct ones concerning the UTC-Glonass Time offset. They presented the correct values later on during the meeting and propose a mechanism to make sure that correct values are presented at the meetings.

5. NEXT STEPS FOR WORKING GROUP D

Agreement on Recommendations to Plenary of ICG-9.

There will be two recommendations from the Working Group D regarding reference frame (see appendix B);

- ICG support to the UN General Assembly Resolution on the Global Geodetic Reference Frame
- Improving the accuracy of multi-GNSS orbit determination by the IGS, via detailed satellite information

The Working group discussed several opportunities for meetings during 2015 as for example during or in conjunction with.

- ICG planning meetings, February and June, Vienna
- COPOUS, Vienna, UN OOSA, Feb 2-13
- Munich Satellite Navigation Summit, March 24-26
- IGMA Task Force meeting, Xian, May 11-12 (In conjunction with China Satellite Summit Conference)
- ICG-10, Boulder, US

APPENDIX 1: ATTENDANCE LIST

Tuesday meeting

Mr Qile Zhao	China
Mr Alak Banik	India
Mr Alessandro Avanzi	Italy
Mr Alessandro Caporali	Italy
Mr Antonio Paolozzi	Italy
Mr Ryuichi Ichikawa	Japan
Mr Ryoichi Kojiroi	Japan
Ms Anna Dorofeeva	Russia
Mr Igor Gusev	Russia
Mr Vitaly Palchikov	Russia
Mr Larry Hothem	US
Mr Stephan Malys	US
Ms Linda Rowan	US
Mr Werner Enderle	ESA
Mr Artur Oruba	EUPOS
Mr Jaroslav Simek	EUPOS
Mr Johannes Ihde	EUREF
Mr Mikael Lilje	FIG
Mr Zuheir Altamimi	IERS
Ms Ruth Neilan	IGS
Mr Chris Rizos	IAG

Wednesday meeting

Mr Chunhai Han	China
Mr Wenjun Zhao	China
Mr Alak Banik	India
Mr Alessandro Caporali	Italy
Mr Ryuichi Ichikawa	Japan
Mr Ryoichi Kojiroi	Japan
Ms Anna Dorofeeva	Russia
Mr Andrei Druzhin	Russia
Mr Alexander Grechkoseev	Russia
Ms. Natalia Basha	Russia
Mr Igor Gusev	Russia
Mr Vitaly Palchikov	Russia
Mr Arkadii Tiuliakov	Russia
Mr Larry Hothem	US
Mr Stephen Mitchell	US
Mr Stephan Malys	US
Ms Linda Rowan	US
Mr Alberto Madrazo	GSA
Mr Werner Enderle	ESA
Mr Artur Oruba	EUPOS
Mr Jaroslav Simek	EUPOS
Mr Johannes Ihde	EUREF
Mr Mikael Lilje	FIG
Mr Zuheir Altamimi	IERS
Mr Chris Rizos	IAG
Mr Gerard Petit	BIPM

Recommendation for Committee Decision (WG-D # 22)

Prepared by: ICG WG-D

Date of Submission: November 13, 2014

Issue Title: ICG support to the UN General Assembly Resolution on the Global Geodetic Reference Frame

Background/Brief Description of the Issue:

Considering

- The importance of geodesy and the global geodetic reference frame for scientific and societal applications;
- The important contribution of GNSS to location-based services in general and to the International Terrestrial Reference Frame in particular;
- The ICG mission and vision;

Discussion/Analyses:

The Committee of Experts of the United Nation Global Geospatial Information Management (UN-GGIM) has established a Working Group on the Global Geodetic Reference Frame (GGRF), tasked to draft (1) a text of a UN General Assembly Resolution, (2) an associated Concept Note, (3) Terms of Reference of the WG, and (4) establish a geodetic roadmap. At its 4th session held in New York in August 2014, the UN-GGIM Committee of Experts has adopted the draft text of the resolution prepared by the WG on GGRF and submitted it to ECOSOC for further referral to the General Assembly of the United Nation for adoption.

Recommendation of Committee Action:

The ICG WG-D recommends that the ICG Providers' Forum consider supporting the approval by the UN-GGIM Committee of Experts of the draft resolution on Global Geodetic Reference Frame for Sustainable Development and its submission to the UN General Assembly.

Members Consensus Reached _____; **No Consensus Reached** _____

Chairperson Signature: _____ **Date:** _____

Recommendation for Committee Decision (WG-D # 23)

Prepared by: ICG WG-D

Date of Submission: November 13, 2014

Issue Title: Improving the accuracy of multi-GNSS orbits determination by the IGS

Background/Brief Description of the Issue:

Considering

- several global navigation satellite systems (GNSS) exist and that each is continuously expanding and improving,
- the importance of improving the ITRF defining parameters for earth science and positioning applications
- the importance of the GNSS contribution to the ITRF from the IGS,
- the importance of the accuracy of the GNSS orbits determined by the IGS and their impact on the IGS products, and subsequently on the ITRF;
- the necessity of improving the orbit dynamics modelling of GNSS satellites by the IGS

Discussion/Analyses:

The knowledge of GNSS satellite structure, geometry, dimensions, among other satellite data is fundamental to improving orbit modeling and accuracy.

Recommendation of Committee Action:

The ICG WG-D recommends that the GNSS Providers consider the possibility of making available the following list (or a sub-set) of satellite data for better orbit dynamics modeling:

Primary list:

- Surface geometry and dimensions
- Surface optical properties (or material types)
- Nominal attitude model
- Transmitted power in all signals (and direction if relevant)
- Solar panel construction information (thickness, conductivity, power draw)
- Position and power output of radiators
- Thermal properties of multi-layered insulation

More detailed list:

- Structural data/drawings of the satellite, with dimensions (surface only – we don't need the internals)
- Optical properties (reflectivity, specularity) of the surface materials
- Identification of what is covered in multi-layered insulation (MLI) or 'thermal blankets'
- Attitude model of the satellite

- Power of all transmitted signals (note we don't need to know anything about function of the signals, only which way they are pointed, and how much power is transmitted)
- Construction data of the solar panel (material types, thickness, conductivity, surface properties – reflectivity, specularity, emissivity, power draw from the panel)

Other necessary information:

- Centre of mass location
- Change of centre of mass over time (manoeuvres)
- Location of antenna reference point
- Phase centre offset for all frequencies w.r.t. antenna reference point
- Phase centre variation as function of azimuth and elevation
- Knowledge about the epoch of change of the attitude mode (e.g. for QZSS and BeiDou that switch from Yaw-steering to normal-mode)
- Attitude of the satellite as measured/computed on board (i.e. those values used by the attitude control system)
- Differential group delays between the different signals (on board of the satellite): can be measured pre-launch

Members Consensus Reached _____; **No Consensus Reached** _____

Chairperson Signature: _____ **Date:** _____

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