RESERAPPORT
THE SEVENTH MEETING OF THE INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS (ICG-7)

Beijing, Kina, november 2012
Mikael Lilje, Geodesienheten

BAKGRUND

Det sjunde motet av "*International Committee on Global Navigation Satellite Systems (ICG)"*hölls I Beijing, Kina mellan 5 och 9 november 2012. För ca 10 år sedan bildade *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 undertecknad är FIGs representant. Det var av den egenskapen som jag for till Beijing. 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.

ICG har vuxit under de senaste åren och i år kom mer än 220 deltagare. Noterbart är också att alla leverantörer av satellit positioneringssystem 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 samordningsroll kring Geodesi och den informationen som vi får vi möten som detta sprider vi via olika forum till användare i Sverige.

JOINT STATEMENT FROM ICG-7

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. ICG startar med gemensamma sessioner men ganska snabbt bryts det ner till arbetsgrupperna. 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 får en allt starkare roll inom ICG. I år diskuterades förhållandet GNSS leverantörer och användare mer än någonsin. 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:

- Kina, som värdland startade presentationerna med att presentera och lyfta fram utvecklingen av Beidou:
    - Sedan ICG-6, har sex stycken satelliter skjutits upp nu uppe i 15 stycken varav 5 stycken är GEOs. Täckningen i sydost Asien significant.
    - *Initial Operational Capability* (IOC) för den regional komponenten av Beidou annonserades den 27 december, 2011 samtidigt som dokument för *Interface Control Document* (ICD) av BeiDou systemet (test versionen) och *Development of BeiDou Navigation Satellite System (v 2.0)* publicerades. En uppdaterad version av ICD förväntas publiceras snart för att stötta mottagarindustrin att utveckla mottagare.
    - Fas 2 av BeiDou, den regionala komponenten förväntas nå *Full Operational Capability* (FOC) under 2013.
    - Efter det förväntas fas 3 utvecklas från regional till global täckning under andra hälften av decenniet.
    - Hemsida: beidou.gov.cn

- 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 oh uppmuntra till kompatibilitet och interoperabilitet
    - 30 satelliter fungerar för närvarande. USA har kunnat erbjuda fullt utvecklad GPS sedan december 1993.
    - Hemsida: pnt.gov and gps.gov

- Ryska GLONASS meddelade att:
    - 24 satelliter är förnärvarande operatinella och ytterligare en är uppskjuten och i testfas. Ytterligare satelliter skjuts upp under 2012.
    - Under 2014 kommer den moderniserade glonass-K2 att börja skjutas upp.
    - Ett nytt Glonassprogram beslutades 3 mars i år och den täcker 2012-2020. Glonass är prioriterat.
    - Hemsida: www.glonass-center.ru

- EU presenterade statusen för Egnos och Galileo:
    - Galileo har nu fyra satelliter uppskjutna.
    - IOV förväntas bli nått under 2013. Målet är att nå FOC under 2020 med 30 satelliter.
    - GIOVE testsatelliterna, som skjöts upp 2005 och 2008 är inte aktiva längre.
    - 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

- 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, med tre GEO satellite, är att ha sju satellite i omlopp.

- Indien var tyvärr inte på plats.

ANDRA INTRESSANTA NOTERINGAR

Bland de många intressanta föredragen kan följande noteras:

- IGS Multi-GNSS Experiment (IGS M-GEX) rullar på bra och Sverige deltar aktivt med stationer.
- Navipedia (www.navipedia.org) är ett ESA initiativ för att skapa en referenssida för GNSS. Det är möjligt för vem som helst att bidra med information, som går genom någon form av granskning för att säkerställa en viss kvalitet, till sidan (likt WIkipedia).
- BIPM utvecklar en snabbare beräkningsprocedur kring UTC, kallat UTCr. Beräkningsproceduren förväntas vara i drift under 2013.
- Kanadas GNSS Vision trycker på ett starkare gemensamt engagemang från de största och viktigaste användarna av GNSS. Det är likt den roll som Lantmäteriet vill ha men I Kanada har de valt linjen att frikoppla det från någon myndighet.

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 Dessemination and Capacity Building
- Working Group D: Reference Frames, Timing and Application

FIG leder arbetsgrupp D tillsammans med representanter från Internationella Geodesiassociationen m.fl. De två genomförda mötena lockade 30-40 personer. Minnesanteckningar (på engelska) kan hittas i appendix B. Alla minnesanteckningar från denna arbetsgrupp, liksom för de övriga, finns publicerade på ICGs websida.

Vi noterade att alla leverantörer utom Indien, som inte var närvarande, och Ryssland, som väntar på ett godkännande, har levererat beskrivningen av deras *Geodetic and Timing References*. Dessa finns nu publicerade på ICGs hemsida

Vi noterade också utvecklingen hos ISO om att utveckla ITRS till en mer formell standard.

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

- WG-D Recommendation #14 – Interrelationship of the GNSS geodetic references through the International Terrestrial Reference System (ITRS)
- WG-D Recommendation #15 – Improving the GNSS contribution to the ITRF defining parameters
- WG-D Recommendation #16 – Information on the works related to the proposed redefinition of UTC
- WG-D Recommendation #16 – Declaration on the computation of Rapid UTCr.

MÖTEN MELLAN MEDLEMMAR, ASSOCIERADE MEDLEMAR OCH OBSERVATÖRER

Arbetsgruppsordförandena för arbetsgrupp D tog ett initiativ för ett möte mellan medlemmar, associerade medlemmar och observatörer till ICG. De huvudsakliga diskussionsämnena var:

- Kring en rapport som leverantörerna håller på att arbeta fram kring hur de ser på utvecklingen av ICG. Diskusisonen på mötet berörde fundering kring om rekommendationer skall vara bindande eller inte, behov av tydligare budskap från medlemmarna kring deras behov av ICG samt antalet arbetsgrupper inom ICG.

- ICG inkluderar ett leverantörsforum och diskussion pågår inom ICG om behovet av ett användarforum och att ge det en mer formell status inom ICG. Leverantörforumet får en mer och mer tyngd inom ICG medan användarsidan av GNSS tonas ner. Det var tydligt under detta möte att leverantörerna har svårt att se behovet av att få in användarperspektivet mer inom ICG.

NÄSTA MÖTE AV ICG

Förenade Arabemiraten kommer att arrangera ICG-8 i Dubai mellan 10-14 november nästa år. EU har redan meddelat intresse av att arrangera ICG-9 i Europa under 2014.

Appendix A

Joint Statement - Seventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG), 4 – 9 November 2012, Beijing, China

The Seventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Beijing, China from 4 to 9 November 2012, 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 opening ceremony moderated by Chairman of China Satellite Navigation Committee, Li Andong. State Counselor, Liu Yandong delivered an opening speech on behalf of host government. Director of the United Nations Office for Outer Space Affairs, Dr. Mazlan Othman addressed the meeting. The Ministers from Ministry of Foreign Affairs, Ministry of Science and Technology, China National Space Administration and other departments also attended the opening ceremony.

ICG addressed GNSS professional, mass-market and scientific applications. Representatives from industry, academia and governments shared views on GNSS services.

The Meeting was hosted by the Government of the People's Republic of China. Attendees included China, 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 nongovernmental organizations: Civil Global Positioning System Service Interface Committee (CGSIC), European Space Agency (ESA), Federation Aeronautique Internationale (FAI), International Federation of Surveyors (FIG), International Association of Institutes of Navigation (IAIN), International Association of Geodesy (IAG) and IAG Reference Frame Sub-Commission for Europe (EUREF), International Bureau of Weights and Measures (BIPM), International Earth Rotation and Reference Systems Service (IERS), International GNSS Service (IGS) and Interagency Operations Advisory Group (IOAG). Representatives of the Office for Outer Space Affairs and International Telecommunication Union (ITU) also participated. Australia and Canada were invited to attend as observers. The representatives of Pakistan, Saudi Arabia, Republic of Korea and Thailand, as well as the Asia-Pacific Space Cooperation Organization (APSCO), the African Regional Centre for Space Science and Technology Education - in French Language (CRASTE-LF), the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) and Space Generation Advisory Council (SGAC) also participated. ICG recalled that the General Assembly, in its resolution 66/71 of 9 December 2011 welcomed the continuous progress made by 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 global navigation satellite systems and their integration into national infrastructure, particularly in developing countries, and noted with satisfaction that the International Committee held its sixth meeting in Tokyo from 5 to 9 September 2011.

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. The Working Group on Compatibility and Interoperability (WG-A) addressed all four areas of its current work plan through an intersessional meeting held in July, 2012 in conjunction with the 2012 IGS Workshop, Olsztyn, Poland, and additional presentations and discussions conducted during ICG-7. The Compatibility and International GNSS Monitoring and Assessment (IGMA) subgroups of WG-A

also provided reports at the intersessional meeting that formed the basis for recommendations on spectrum protection and open service performance monitoring. WG-A organized and completed the first ICG Interference Detection and Mitigation Workshop, held in Vienna, June 2012, and reported the conclusions to the ICG-7, including a recommendation to conduct additional workshops. The next workshop will take place in April 2013 immediately preceding the ION Pacific PNT Meeting, where an interoperability workshop involving users and manufacturers will also be held.

The Working Group B on the enhancement of GNSS service performance followed up its workplan and its recommendations of ICG-6. The group discussed the benefits of an interoperable GNSS Space Service Volume. All WG-B participants believe that a fully interoperable GNSS Space Service Volume will result in significant benefits for future space users as it will allow for performance no single system can provide on its own. WG-B will continue to work towards an interoperable GNSS SSV. Concepts allowing for maritime integrity by exploiting the arising multiplicity of new satellite navigation signals were discussed and the significance of multipath resistant navigation signals for good ranging performance was confirmed. The value of multi-GNSS application demonstrations was identified.

The Working Group C on information dissemination and capacity-building addressed education and training programmes related to GNSS for purposes of building capacity in developing countries through the Regional Centres for Space Science and Technology Education affiliated to the United Nations and centers of excellence, such as an International Centre for GNSS Science Technology and Education at the Beihang University of China. It was noted that these centers, acting as the information centers for ICG, might grow into a network of centers and provide a major springboard for the transfer and enhancement of skills and knowledge in GNSS research and applications. A new item on information dissemination, including web-presence materials, was introduced in the Working Group's workplan.

The Working Group D on Reference Frames, Timing and Applications noted significant continued progress on the geodetic and timing references for the GNSS currently represented in the ICG. Specific progress was noted in the alignment of CGS2012 for BeiDou, JGS2010 for QZSS, PZ90 for GLONASS and WGS84 for GPS to the latest realisation of the International Terrestrial Reference System in the form of ITRF2008. The Working Group also made recommendations in relation to developments in the recognition of the International Terrestrial Reference System (ITRS) and Universal Time Coordinated (UTC). A notable development was the progress with a pilot service by the BIPM and associated timing laboratories to produce "Rapid UTC".

The 9th meeting of the Providers' Forum was held in conjunction with the 7th meeting of ICG. The providers agreed upon a statement highlighting key achievements of the ICG and the Providers' Forum contained in Annex.

ICG accepted the invitation of the United Arab Emirates to host its Eighth Meeting in Dubai, from 10 to 14 November 2013. 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. ICG noted the expression of interest by the European Union to host the Ninth Meeting of ICG in 2014.

Appendix B

ICG WORKING GROUP D
REFERENCE FRAMES, TIMING AND APPLICATIONS

Seventh Meeting of the International Committee on GNSS (ICG), Beijing, China

WG D MEETING NOTES
Wednesday 7 November 2012
Thursday 8 November 2012

1. INTRODUCTIONS

The Co-Chairs welcomed all to the meeting. Almost 50 persons were present at the beginning of the meeting on Wednesday. About 30 persons attended the Thursday meeting. A list of participants can be found in Appendix A

2. REVIEW OF MINUTES FROM TOKYO MEETING

The minutes are available on the ICG website. No comments were made at the meeting on the minutes.

3. REPORT ON AD-HOC MEETING IN POLAND

The IGS 2012 workshop was held in Poland in July. The workshop was successful with many delegates and reports on important developments within IGS. Special focus was given to the Multi-GNSS experiment (MGEX) and the IGS real-time service. The presentations from the workshop are available on the IGS website (http://igs.org).

At the workshop, both ICG Working Group A and Working Group D met as well as the ICG Working Group A subgroup GNSS Monitoring and Assessment. This was the first meeting for the subgroup. Working Group D noticed at this meeting that some of the geodetic and the timing templates are missing but progress was being made to finalize and receive the missing ones. Follow up on this is done at ICG-7.

4. REPRESENTATIVES AT THIS MEETING FROM THE PROVIDERS REGARDING GEODETIC REFERENCE SYSTEM AND TIMING

The appointed representatives from the different providers at this meeting regarding Geodetic Reference System and Timing can be found in the table below. Unfortunately, India was not present at this meeting.

	Beidou	**Galileo**	**Glonass**	**GPS**	**QZSS**
Geodetic	Yang Yuanxi	Altamimi	Vdovin	Wiley	Kishimoto
Timing	Han Chunhao	Delporte	Tyulyakov	Wiley/Hothem	Ichikawan

Note: Ed Powers, the official representative for GPS on Timing References, was not present but was represented by Wiley and Hothem from USA.

Note also that all presentations from this Working Group D Meeting are already available on the meeting website (www.icg2012.cn - click on "Download File"). They will also be made available on the ICG web site from UN OOSA in due course**.**

5. TASK FORCE ON GEODETIC REFERENCES

This agenda item was led by Zuheir Altamimi.

Discussion on progress with WG-D Recommendations:
All the providers were asked to give a summary on the status regarding the following recommendations.

- ICG Recommendation 4 and ICG Recommendation 10 on "*Retroreflectors for Laser Ranging to GNSS satellites"*
  QZSS reported that retro-reflectors are on their satellites.

- ICG Recommendation 11 on *"Finalization and Publication of Templates on Geodetic and Timing References";*
  - Galileo template on Geodetic Reference is available for ICG.
  - GPS template on Geodetic Reference is available for ICG. However, there is ongoing work on updating WGS84 and aligning it to ITRF2008. This will be accomplished soon and the template will be updated accordingly.
  - Glonass template on Geodetic Reference is not available yet. Russia informed that the work on the template is progressing and they are waiting for approval to release it. It can be expected before ICG-8. Russia also informed on the update regarding the reference frame for Glonass, see below.
  - Beidou template on Geodetic Reference was provided to ICG at the IGS workshop in Poland in July 2012. The Beidou reference system will be updated and this was also presented at this meeting, see below.
  - QZSS template on Geodetic Reference had been provided earlier.

  ACTION: The available templates will be published as soon as possible on the ICG website.

- ICG Recommendation 12 on *"Interoperability of geodetic references among the different GNSS systems";*
  Zuheir also informed all the delegates that input GNSS data for ITRF2013 will be adjusted by IGS during 2013 and urged all to have data ready by January 2013. China and USA will be supplying data for inclusion in next computation of ITRF in accordance with Recommendation 12. Japan informed that they could make data available once RINEX format covering QZSS data is officially approved.

- ICG Recommendation 13 on *"International GNSS Service Multi-GNSS Global Experiment - IGS M-GEX".*

Presentations made at the meeting concerning Geodetic References;
The following presentations were made. They are all available on the ICG-7 webpage.

- Compass Geodetic System (CGS) by Wei Ziqing, China
- Global Geocentric Coordinate System of the Russian Federation by V. Vdovin, Russia

Relevant Developments in International Standards Organization (ISO);
The presentation was prepared by Claude Boucher but presented by Zuheir.
A proposal to investigate standardization needs related to geodetic references has been submitted by France to the International Standardization Organization (ISO) early in 2012. This proposal was

specifically sent to the ISO Technical Committee 211 on Geographical information/Geomatics. This proposal was approved in June by ISO TC 211 under the title of Project 19161.

Larry Hothem reported on the progress for the Geodetic Registry Network, another ISO standard initiative.

6. TASK FORCE ON TIMING REFERENCES

This agenda item was led by Wlodzimierz Lewandowski in place of Felicitas Arias, who was unavailable for this meeting.

Discussion on progress with WG-D Recommendations:

- Recommendation 11 *on "Finalization and Publication of Templates on Geodetic and Timing References";*
    - Russian Federation has drafted the Timing template on GLONASS and is awaiting approval to release it.
    - The Working Group has still no response from India.
    - The templates from all other GNSS are now submitted.
    - No responses as yet from any SBAS but EU reported that Timing Template for EGNOS has been drafted and is awaiting approval for release.

Presentations made at the meeting concerning Timing References:

- Performance Evaluation of Satellite Clocks of Beidou System by Lin Yuting, China;
- Generation of the National time scale UTC(SU), its transfer to Glonass and harmonization with UTC, Russia – I. Silvestrov
- System time scale Generation and Coordination to UTC(SU) – A. Tyulyakov, Russia

Report on developments with *"Rapid UTC"*

Wlodzimierz went through parts of the presentation that he gave at the plenary sessions. The need to publish UTC more rapidly motivated the project Rapid UTC (UTCr). A pilot project of UTCr has started at the beginning of 2012. The methodology is still under development (a few ns is the goal between UTC and UTCr). UTC is kept unchanged. UTC will benefit from UTCr due to better anticipation and easier detection of problems (clocks and links). Lack of calibration of Glonass clocks leads to differences of about 150 ns between Glonass and UTC. Difference between GPS and UTC is typically some ns. Last CCTF in September 2012 has endorsed the UTCr and a regular service should start in 2013.

Report on Leap Second deliberations at the ITU

The discussion on redefinition of UTC as a continuous time scale started in 2000 at the ITU-R, SG7 Science Services WP7A Time Signals and Frequency Standard Emissions. The SG7 sent the Draft Recommendation to the Radiocommunication Assembly 2012 (January) for « final decision ». However, WRC 2012 put back the recommendation to SG7-WP7A for a final decision at WRC 2015.

7. NEXT STEPS FOR WORKING GROUP D

The following Draft Recommendations to Plenary of ICG-7 were discussed.

- Interrelationship of the GNSS geodetic references through the International Terrestrial Reference System (ITRS).

- Provision of Physical Information on GNSS Satellites for Improving Orbit Dynamic Modelling and Orbit Determination. **After discussion it was decided that this recommendation will not be put forward this time**. **ACTION**; To next ICG-8

Working group D to develop the MGEX template on satellite information and at ICG-8 make a recommendation on asking the various providers to fill in the template.

- Improving the GNSS contribution to the ITRF defining parameters. ACTION: Share any existing papers studying calibration of antennas. **ACTION**: Share any existing papers studying the usefulness of accelerometers on satellite. **ACTION**: Study other additional information on satellite "equipment" (?) that will improve the GNSS contribution to ITRF defining parameters.

- Recommendation on the on-going redefinition of UTC – to raise awareness about the issue.

- Declaration on the computation of Rapid (UTC).

The recommendations put forward to the Plenary can be found as attachments to these minutes.

8. NEXT MEETING

- The next full meeting of Working Group D will be at ICG-8. Communication and meetings between co-chairs and other participants will occur between meetings on an opportunity basis.

APPENDIX 1: ATTENDANCE LIST

Wednesday meeting

Mr Chunhao Han	China
Mr Xiaolin Jia	China
Mr Wenhai Jiao	China
Mr Shuanggen Jin	China
Mr Donghang Li	China
Mr Tianke Xu	China
Mr Xianbing Wu	China
Mr Ziqing Wei	China
Mr Yuanxi Yang	China
Mr Werner Enderle	ESA
Mr Jérôme Delporte	EU
Mr Satoshi Horiuchi	Japan
Mr Ryuichi Ichikawa	Japan
Mr Motohisa Kishimoto	Japan
Mr Yoshimi Ohshimi	Japan
Mr Dmitry Aronov	Russia
Ms Anna Dorofeeva	Russia
Mr Roman Fatkulin	Russia
Mr Alexander Grechkoseev	Russia
Mr Alexey Ivanov	Russia
Ms Ekatarina Kapustina	Russia
Mr Andrey Kupriyanov	Russia
Ms Tatiana Migorodskaya	Russia
Mr Alexey Pokhaznikov	Russia
Mr Sergey Revnivykh	Russia
Mr Sergey Rybkin	Russia
Mr Igor Silvestrov	Russia
Mr Grigoriy G. Stupak	Russia
Mr Arkady Tyulyakov	Russia
Mr Vladimir Vdovin	Russia
Mr Larry Hothem	US
Mr Perry Nosker	US
Ms. Barbara Wiley	US
Mr Johannes Ihde	EUREF
Mr Matt Higgins	FIG
Mr Mikael Lilje	FIG
Mr Chris Rizos	IAG
Mr Zuheir Altamimi	IERS
Ms Ruth Neilan	IGS
Mr Wlodzimierz Lewandowski	BIPM
Mr Bernald Smith	FAI
Ms Elisabeth Fischer	IAIN
Ms Jina Maceachern	Canada
Mr Khalid Ishaq	Pakistan

Thursday meeting

Mr Chunhao Han	China
Mr Xiaolin Jia	China
Mr Donghang Li	China
Mr Tianke Xu	China
Mr Xianbing Wu	China
Mr Ziqing Wei	China
Mr Yuanxi Yang	China
Mr Werner Enderle	ESA
Mr Jérôme Delporte	EU
Mr Satoshi Horiuchi	Japan
Mr Ryuichi Ichikawa	Japan
Mr Motohisa Kishimoto	Japan
Mr Yoshimi Ohshimi	Japan
Ms Anna Dorofeeva	Russia
Mr Roman Fatkulin	Russia
Mr Alexander Grechkoseev	Russia
Mr Arkady Tyulyakov	Russia
Mr Vladimir Vdovin	Russia
Mr Larry Hothem	US
Ms. Barbara Wiley	US
Mr Johannes Ihde	EUREF
Mr Matt Higgins	FIG
Mr Mikael Lilje	FIG
Mr Chris Rizos	IAG
Mr Zuheir Altamimi	IERS
Ms Ruth Neilan	IGS
Mr Wlodzimierz Lewandowski	BIPM
Mr Khalid Ishaq	Pakistan

ICG/REC/2012

Recommendation for Committee Decision **(WG-D # 14)**

Prepared by: ICG WG-D

Date of Submission: November 8, 2012

Issue Title: Interrelationship of the GNSS geodetic references through the International Terrestrial Reference System (ITRS)

Background/Brief Description of the Issue:

Considering

- that several global navigation satellite systems (GNSS) exist and that each is continuously expanding and improving,
- these navigation systems have unique timing and geodetic references for operational necessity. Interoperability of the GNSS requires interrelationship of the timing and geodetic references to reduce ambiguities for users with regard to the interpretation of navigation and timing solutions.
- the existence of the International Terrestrial Reference System (ITRS),
- the adoption of the ITRS by the International Union of Geodesy and Geophysics (IUGG) and by the General Conference on Weights and Measures (CGPM) for geosciences and metrological applications,
- that the adoption of a theoretical reference system would lead to benefits for users regarding interrelationship of navigation and timing solutions and systems interoperability.

It is essential for multi-GNSS positioning users to be able to position precisely their locations in a unique terrestrial reference frame. Given the fact that each GNSS system has its own reference frame, e.g. WGS84 for GPS, PZ-90 for GLONASS, CGCS2000 for COMPASS, GTRF for Galileo, etc., it is desirable, from the user point of view, to relate or align these different frames to the International Terrestrial Reference Frame (ITRF), as a realization of the ITRS

Discussion/Analyses:
The individual GNSS reference frames are materialized through the provision/computation of the coordinates using data collected at the ground control stations.
All the current individual GNSS reference frames are aligned to the ITRF.

Recommendation of Committee Action:

The ICG WG-D recommends that the ITRS, as defined by the International Union of Geodesy and Geophysics (IUGG), adopted by the General Conference on Weights and Measures (CGPM) and realized by the International Earth Rotation and Reference Systems Service (IERS), be adopted by the ICG as the theoretical reference system for the alignment of GNSS terrestrial reference frames to the ITRF.

Members Consensus Reached_____; **No Consensus Reached**_____
Chairperson Signature: _____ **Date:** _____

Recommendation for Committee Decision **(WG-D # 15)**

Prepared by: ICG WG-D

Date of Submission: November 8, 2012

Issue Title: Improving the GNSS contribution to the ITRF defining parameters

Background/Brief Description of the Issue:

Considering

- several global navigation satellite systems (GNSS) exist and that each is continuously expanding and improving,
- the existence of thousands of continuously observing GNSS stations,
- 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 nearly unique role of GNSS in accessing and densifying the ITRF,

But considering also

- that weaknesses affect the GNSS reference frame in origin and scale

Discussion/Analyses:
The GNSS reference frame exhibits weaknesses in origin and scale determination because of high correlations between (1) the reference frame Z-axis and satellite solar radiation pressure parameters and (2) the scale of the reference frame and the satellite antenna phase center offset.

Recommendation of Committee Action:

The ICG WG-D recommends that the GNSS Providers consider (1) calibrating satellite antenna phase center and variations before launch, (2) adding retro-reflectors to GNSS satellites and (3) studying the possibility and utility of adding an accelerometer to new satellites.

Members Consensus Reached_____; **No Consensus Reached_____**

Chairperson Signature: _____ **Date:** _____

Recommendation for Committee Decision **(WG-D # 16)**

Prepared by: ICG WG-D

Date of Submission: November 8, 2012

Issue Title: Information on the works related to the proposed redefinition of UTC

Background/Brief Description of the Issue:

Considering that:

- the navigation systems have unique timing and geodetic references for operational necessity. Interoperability of the GNSS requires interrelationship of the timing and geodetic references to reduce ambiguities for users with regard to the interpretation of navigation and timing solutions.
- discussion on redefinition of UTC started in 2000 at the ITU-R, SG7 Science Services WP7A Time Signals and Frequency Standard Emissions,
- during 2000-2010 WP7A studied the issue, considered different options, organized an open meeting (Torino, 2003), and worked on a proposal for an amended ITU recommendation,
- in 2010 the Draft Recommendation ITU-R TF.460-6 (new proposed version) was submitted by WP7A to SG7; discussion came to a « dead-end » with a 10-year opposition from one administration, plus two more administrations joining this position,
- the SG7 sent the Draft Recommendation to the Radiocommunication Assembly 2012 (January) for « final decision »,
- WRC 2012 put back the recommendation to SG7-WP7A for a final decision at WRC 2015;
- WRC 2012 Resolution 653 on the feasibility of a continuous UTC involves the BIPM, CCTF, CGPM, IAU, IUGG, URSI, ICAO, IMO, WMO, ISO, and invites to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of UTC or some other method, and take appropriate action, taking into account ITU-R studies,

WG D recommends to the ICG

to inform the Providers and all ICG participants that the redefinition of UTC was not resolved at the WRC-2012 and the decision is deferred until WRC-2015. It is recommended that the ICG monitors the ongoing development of this issue.

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

Chairperson Signature: _____ **Date:** _____

Recommendation for Committee Decision **(WG-D # 17)**

Prepared by: ICG WG-D

Date of Submission: November 8, 2012

Issue Title: Declaration on the computation of Rapid UTCr

Background/Brief Description of the Issue:

Considering:

- that 10 to 40 days delay as publication of UTC in *BIPM Circular T* is not adequate for some applications,
- that short term assessment of UTC(k) steering to UTC, is impacting contributing laboratories, and in particular GNSS times steering to UTC(k),
- better determination of GNSS times offsets is essential for interoperability of navigation systems,
- discussions at the ICG in 2010 and 2011,
- discussions with experts in commissions for developing strategies for GNSS times,
- need of a « rapid » product, to give access on a shorter delay to an approximation to UTC, before final validation by *Circular T*, similar to IERS, IGS rapid products ,
- that UTC contributing laboratories have been invited to participate on a voluntary basis to a pilot experiment (daily submission of daily data),
- positive responses of national time laboratories with adequate equipment,
- pilot experiment started on January 2012 computing every Wednesday rapid UTC and publishing it on BIPM website,
- report to the Consultative Committee for Time and Frequency in September 2012,
- pilot experiment will continue until final validation (few months)
- routine production of UTCr should start in 2013,
- UTC as calculated and published today will not be affected, however, it will benefit from UTCr,

WG D recommends to the ICG

to recognize UTCr as an important service benefiting interoperability of navigation systems, and to thank the BIPM and contributing time laboratories for their efforts and commitment. It further recommends that GNSS providers consider studying the possibility of using UTCr as a common time reference for interrelationship between GNSSs.

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

Chairperson Signature: _____ **Date:** _____