Real Time Pilot Project

Minutes of Teleconference

Analysis Centre Coordination

9 October 2008

1 Meeting Summary

This teleconference was held on 9 October 2008 and was hosted by NRCan.
Participants were:

ESOC:	Loukis Agrotis, Pedro Alfaro
NRCan:	Mark Caissy, Ken MacLeod, Paul Collins, Francois Lehais
BKG/TU Prague:	Leos Mervart (part time)
TU Catalonia:	Manuel Hernanez-Pajares
GMV:	Álvaro Mozo García, Guillermo Tobías González, Daniel Rodríguez Porcheron
Geo++:	Gerhard Wuebbena , Martin Schmitz

The following expressed regrets that they could not participate on the day of the teleconference. Separate discussions will be organised.

BKG:	Georg Weber
Chalmers	Jan Johansson
IGG	Robert Webber
DLR	André Hauschild
CDDIS	Carey Noll

The meeting agenda items are listed below:
1. Review of individual AC status and plans, and outline of processes used by each AC
2. Data Formats and Protocols, including a briefing on the RTCM discussions held at ION. In addition:
    a) Formats and protocols for RT product dissemination between ACs
    b) Formats and protocols for RT product dissemination of the combination
3. RT product accuracy and latency targets
4. Ideas on methodologies for the combination product
5. Ionosphere product
6. AOB

2 PP/AC Status

Mark said a few words about the status of the PP. He noted the IGS workshop recommendations, some with significant action. They include the beginning of comparisons, as well as requirements for common formats for products and data. Ken attended the last ION meeting and participated in the RTCM format discussions. More things need to be done and in particular the visibility of the project is not where it should be. This is not such a concern as the project is now on a sound footing. Visibility will be increased by updating the PP web site and including links to the AC comparisons.

Another key area is the status of the network, which needs to be augmented with more stations. Mark will contact GFZ to see if they can start contributing. They were early contributors to the PP but they had to pull out because of other commitments. At the workshop they made some interesting contributions and it is understood that they have a desire to join the PP.

In addition, Ken is working on including some stations from NTRIP and including them on the RTIGS stream.

Loukis presented the status of the analysis centre contributions. There are five ACs currently submitting: NRCan, BKG, DLR, GMV (in the last 2 days) and ESOC. Chalmers, Geo++ and TU Vienna confirmed their intention to participate in the near future. The results of the clock comparisons are very promising and are consistently at or better that 0.4 ns RMS (compared to IGR) for NRCan, DLR and ESOC. The DLR solution is exceptional when it's good, at around 0.2 ns sigma and 0.3 rms. The NRCan solution is also approaching these levels now. ESOC RMS is slightly higher, but there is a known issue of not applying P1C1 biases, affecting data from MAW1. This will be corrected soon. The sample availability is at near-100% levels. It was pleasing to see that in the short time since the comparisons became available, the improvements in the individual solutions are very apparent. This is a justification for making the effort to participate in the PP and shows that there are benefits for all.

The comparisons do not do justice to the BKG solutions, which are optimised for correcting the double difference observable and are only available over Europe. This issue needs to be discussed further with Leos and Georg, to see how their clock solutions can be compared properly and on techniques to include them in the combination.

Loukis, Paul, Alvaro, Gerhard and Manuel gave brief descriptions of the methodologies and software they are using. The DLR process is described in a paper that was presented at this year's ION conference.

ESOC produced a Real Time infrastructure (RETINA) that includes core utilities for processing Real Time streams. The estimation process is based on a Kalman Filter, using fixed orbits and estimating clocks, ZTD and phase biases. The orbits are estimated using a batch process running every 2 hours.

NRCan use a sequential filter that utilises fixed orbits updated hourly to minimise the orbit prediction error. The clock solution is already disseminated in a similar format similar to WAAS (RTCA 159). NRCan are looking at ambiguity resolution methods to allow for ambiguity fixing in order to improve the PPP solutions.

GMV have started uploading their products, which are not yet produced by RT data. Instead, they are using RINEX data from the IGS LEO network to simulate the real time streams, while they are waiting to resolve internal security issues related to access to UDP data. Their process runs hourly and there are issues with the latency of the data and also with the small network size. Alvaro stated that GMV expect to move to Real Time processing by the end of the year.

Geo++ use a Kalman Filter for estimating orbits, clocks, signal biases, ambiguities, and tropospheric delays. They are planning to use techniques for fixing ambiguities. Gerhard said that Geo++ will be in a position to start RTCM dissemination of their products in 3 weeks. They are planning to prepare a converted from RTCM to clock RINEX and SP3 for their submissions to the PP.

Manuel confirmed the TU Catalonia commitment for generating a Real Time ionospheric product. He will be ready with a first version by end of summer 2009, processing data from BKG and testing the process for a global product with a sparse network. The problem is ambiguity fixing, which is possible over Europe, is difficult with a sparse global network.

3   Data Formats and Protocols

Ken debriefed everyone on the RTCM discussions during the ION meeting in Savannah. He indicated that there was acceptance of the need to carry data at a precision level that allows generation of RINEX files without loss of accuracy. He is not happy with what is currently in RTCM 3.1 and 3.2 because of the precision issue.

NRCan are also working on converting from RTCM (carried on NTRIP) to RTIGS and have targeted a set of stations to transmit. These are:
1. RCMN, Kenya
2. HOFN, Iceland
3. REYK, Iceland
4. NTUS, Singapore
5. SUWN, Korea
6. OHI2, Antarctica
7. CTWN, South Africa
8. NICO, Cyprus
9. NRMD, New Caledonia
10. PDEL, Portugal
11. WGTN, New Zealand
12. SUTH, South Africa
13. ONRJ, Brazil
14. CEEU, Brazil
15. ADIS, Addis Ababa

Martin said that for the Next Generation RTCM3, Geo++ are proposing a very compressed data format using variable length messages. The proposal will be made at the next RTCM meeting in February. The precision issue will be resolved, as any resolution can be transmitted. All observables tha are not yet in RTCM can be carried. RTCM has recognised the need for this kind of evolution, which will probably take one year to adopt. Transmission of raw data is also being discussed, using new compression methods. L2P and L2C a problem now but will be resolved soon. Several messages are being defined for clock, orbit and bias dissemination. The pre-final message definition will be ready in January.

A short discussion followed on the data formats and protocols for Real Time product exchange between the Analysis Centres and for distribution of the combination product. There are two proposals on the table, from BKG and NRCan. Since Georg could not attend the teleconference, it was decided to hold a separate discussion in the next two weeks (see AI M2-2). One issue is the need to carry the receiver clocks in the solution streams. It was agreed that the discussion should also involve Carey to prepare the way for the possibility of eventually hosting the combination product on CDDIS and the other IGS Data Centres.

On the issue of data availability, Loukis stated that RTIGS and NTRIP should provide two independent sources for supply of data. ESOC are only using RTIGS for now but they are planning to use both in the future and select stations individually in order to provide redundancy. The ESOC stations are only available through RTIGS at the moment, for Pilot Project participants. DLR and Geo++ had expressed a desire to receive the ESOC data. NRCan (Ken) will provide assistance for this and configure the streams to supply them with the data (see AI-M2-3).

4   RT product accuracy and latency targets

The parties in the teleconference agreed on the following targets for the RTPP products:

Satellite Clock Accuracy:	0.3 ns
Station Clock Accuracy:	0.3 ns
Orbit Accuracy:	At the level of the IGS Ultra predictions
Latency (of the combined product):	10 s

It was agreed that the standard deviation of the clocks should be reported in the comparisons, but there will be no specific target for this as the limit is constrained by the RMS target. It was also agreed that it is desirable for each clock to have a near-zero mean in the comparisons.

Loukis also outlined the product availability targets. ESOC was a month late in making the comparisons available, from the targets stated in the IGS Workshop. The next target, of making a batch combination product, is also going to be somewhat late and there is a need to discuss the methodology (see below). However, it is intended to maintain the target date of end of January for the availability of RT product streams from the ACs, and end of March for the Real Time combination product.

5   Ideas on methodologies for the combination product

Loukis outlined his ideas for computing the combination product. The proposed approach is similar to the methodology for making the comparisons, by removal of a common offset per epoch between pairs of solution sets, after removal of the effect of the radial orbit error. Majority voting techniques will be adopted for the selection of samples and the elimination of outliers. A concern was expressed that the combination product should be compatible with Ken Senior's requirements for publishing an absolute time scale. It was agreed that Ken should be approached by Loukis and Gerhard to agree on the requirements (see AI-M2-4).

6   Ionosphere

Manuel gave some more details on his plans for the ionospheric product. His intention is to provide a preliminary product by end of the summer 2009. This will consist of vertical TEC maps on the illuminated points of the RTIGS network, using the IONEX format. Subsequently, he is aiming to provide multi-layer content using the IONEX format and focus on providing direct slant TEC values.

Geo++ indicated that they would also be interested in providing TEC solutions in the future, while NRCan could make a regional product available. ESOC may also participate if resources allow it.

7 AOB

The next teleconference will be held late November, prior to the IGS Governing Board meeting in December.

Loukis expressed his gratitude to NRCan for hosting the teleconference.

8 Action Item List[1]

Action Item	Status	Submit Date	Due/Close Date	Title	Description	Actionee	Response
M1-1	Closed	18/04/08	9/10/08	Archive of RT Products	Request the IGS Data Centres to host repositories for the Real Time products and Analysis Centre comparisons and investigate the possibility for storing the 15 minute high rate data files.	Mark Caissy	Discussions took place with Carey who welcomes this. IGN and KASI also expressed an interest. Refer to AI M2-2.
M2-1	Open	9/10/08	31/10/08		Mark to contact GFZ and discuss GFZ participation to the PP	Mark Caissy	
M2-2	Open	9/10/08	31/10/08	Products and Formats	Organise teleconference in the next two weeks between NRCan, BKG, ESOC and CDDIS on product formats and protocols. The discussion will also include the issue of hosting the RTPP products on the IGS data centres	Loukis Agrotis	
M2-3	Open	9/10/08	31/10/08	ESOC data on RTIGS	Ken and Martin to exchange information on access to the ESOC data using the RTIGS streams	Martin Schmitz, Ken MacLeod	
M2-4	Open	9/10/08	31/10/08	Requirements for clock combination solution	Contact Ken Senior to establish requirements for the combination product and agree methodology.	Loukis Agrotis, Gerhard Wübbena	

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[1] Greyed-out entries have been confirmed as closed