Real-Time GNSS Data Processing at the Technical University Vienna
Current Status and Upcoming Developments

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1. Introduction

To meet the increasing demand of upcoming real-time (RT) applications the IGS (International GNSS Service) has initiated a real-time working group (RTIGS) to investigate the feasibility of real-time GNSS data distribution and the generation of derived products. Nowadays the utilized real-time station network consists of approximately 80 stations. Scientific organizations and companies operating reference stations can participate in the working group either by delivering their data-streams via a central service or by providing real-time GNSS products such as precise clock and orbits corrections.
This presentation deals with the contributions of the Institute of Geodesy and Geophysics (IGG), Technical University of Vienna to the IGS Real-Time Working Group. IGG provided on a regular basis GPS-clock corrections. Currently the processing scheme is subject to change to account for phase float solutions which will increase the accuracy of the satellite clock corrections by a factor of 2-3 compared to the previous deliverables. In parallel a project was started recently at IGG which deals with the estimation of Uncalibrated Phase Delays (UPD) from global and regional network data, which shall be forwarded to user receivers to allow for zero-difference integer phase bias fixing.

2. The software RTIGU-Control

From 2008 onwards the software RTIGU-Control was developed at IGG mainly to monitor the quality of the IGU products. RTIGU-Control is able to calculate orbit and clock corrections for the whole GPS satellite constellation in “near” real-time (delay of approximately 15 – 20 seconds). The three main features of RTIGU-Control can be summarized as follows:

- Monitoring of the predicted IGU products, especially the satellite clock corrections
- Calculation of individual daily RTIGU-Control clock products
- Assisting real-time positioning applications by providing real-time satellite clock correction data

The current software requires some fundamental changes. For that reason the IGG closed the service at the end of 2011. In the following two paragraphs significant upcoming changes are summerized.

1. RTIGS Multicast Receive

RTIGU-Control is obviously the last software of all IGS RT-Analysis Centers which processes data streams provided in the outdated RTIGS-format. In future the software BNC will be used for receiving observations of the RTIGS Station-network. A new interface between RTIGU-Control and BNC 2.7 (see Figure 1) was already developed. This also allows the use GLONASS observation data in the future.

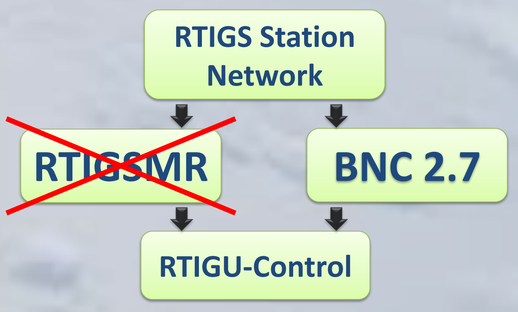

Fig. 1: Change of Interface

2. Processing scheme

Currently the estimation of the clock and orbit corrections is based on carrier smoothed code observations. Figure 2 illustrates the drawback of this procedure. The blue line indicates the raw code measurements, the green one the carrier-smoothed measurements. The limiting factor of the phase-smoothed code measurements is the initial code bias **b** which varies for each receiver-satellite pair. This bias affects the accuracy of the estimated satellite clock corrections.
It is planned to change the processing scheme to account for phase float solutions. Therefore the estimated state vector has to be extended by additional initial phase bias terms**.** We expect to increase the accuracy of the satellite clock corrections by a factor of 2-3 compared to the past deliverables.

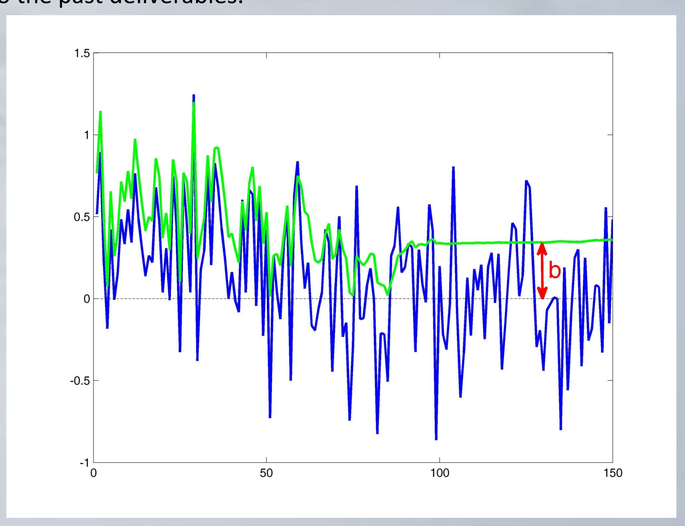

Fig. 2: Smoothing algorithm

3. The software PPP-Serve

The recently started project PPP-Serve (Network based GNSS Phase Biases to enhance PPP Applications – A new Service Level of GNSS Reference Station Provider) aims at the development and realization of adequate algorithms for the estimation of Uncalibrated Phase Delays.
The project workflow consists of a design and evaluation phase which covers the processing of real GNSS observation data in order to identify the adequate method for bias determination. Subsequently, by means of simulated observation phase bias data, we investigate the potential of the chosen approach to re-establish UPDs and access the quality and accuracy of the re-established parameters. Further on, we use observation data of at least one month to establish UPD time-series and check their temporal stability. Introducing the UPDs to rover observation data for PPP point positioning completes the design and evaluation phase. Based on the attained knowledge we plan to set up a real-time service which estimates wide-lane and narrow-lane UPDs from the reference sites observation data at the EPOSA central computing facility and forwards these parameters to users by means of a proprietary format.

4. Workflow and Design

Figure 3 shows a timeline including the most significant tasks for both projects. The tasks for RTIGU-Control are shown in green the one for PPP-Serve in blue. The timeline starts on the first of June 2012 and has a duration of 1.5 years.

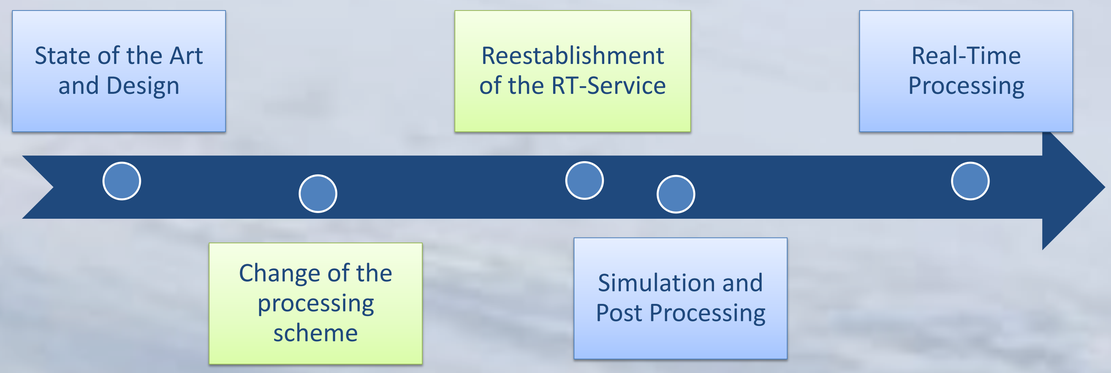

Fig. 3: Timeline

Figure 4 shows a chart flow for the calculation scheme for both projects. The already existing parts “Collection and Correction of Observations” and “Archiving and Streaming” of RTIGU-Control can also be used for PPP-Serve.

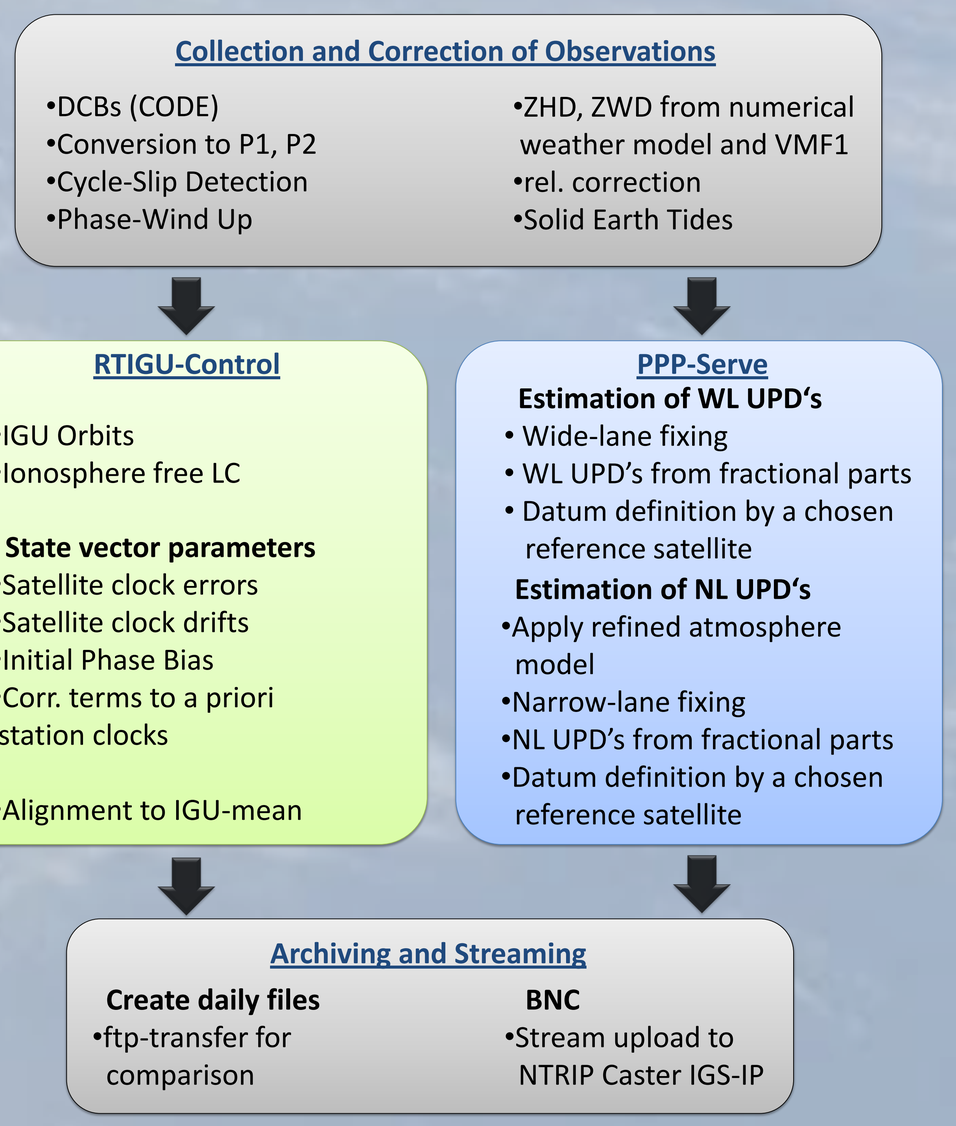

Fig. 4: Design of RTIGU-Control and PPP-Serve

5. Conclusions

Within the next six months the IGG will re-establish the real-time service based on an improved processing scheme which will increase the accuracy of the products. Based on the already existing software RTIGU-Control an additional software for the estimation of UDP’s will be developed within the next 1.5 years.